CAMELOT LANDFILL
CITY OF LEWISVILLE, DENTON COUNTY
TCEQ PERMIT NO. MSW-1312B

MAJOR PERMIT AMENDMENT APPLICATION

VOLUME 3 OF 6

Prepared for

City of Farmers Branch

March 2012

STATE OF TEXAS
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LICENSED
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3-23-12

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WBC Project No. 1339-351-11-02-6B

This document is intended for permitting purposes only.

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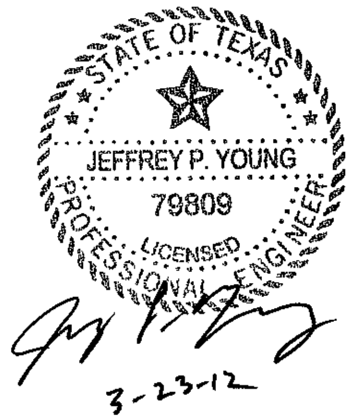

CAMELOT LANDFILL
CITY OF LEWISVILLE, DENTON COUNTY
TCEQ PERMIT NO. MSW-1312B

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIF
SURFACE WATER DRAINAGE PLAN

Prepared for

City of Farmers Branch

February 2012

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NEVZAT TURAN
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1 INTRODUCTION

This section addresses §330.63(c)

The Surface Water Drainage Plan is prepared as part of a permit amendment application for the Camelot Landfill consistent with Title 30 Texas Administrative Code (TAC) Chapter 330. This plan addresses surface water drainage design and erosion control. Permit level plans and details are presented for the proposed drainage system in this appendix. This appendix also includes a demonstration consistent with Title 30 TAC §330.305(a) that the proposed landfill development will not adversely alter permitted drainage patterns. Parts I/II, Section 11.1 and Appendix I/IIC include a demonstration showing that the site is in compliance with the floodplain location restriction. The 100-year floodplain as defined by the Federal Emergency Management Agency (FEMA) and the United States Army Corps of Engineer (USACE) is shown in Appendix IIIO. Appendix IIIO contains excerpts from the Conditional Letter of Map Revision (CLOMR) request and the Trinity River Corridor Development Certificate (CDC) application developed for the continued development of the Camelot Landfill.

This appendix includes the design of the final cover erosion layer and drainage structures (i.e., chutes and swales), perimeter drainage channels, detention ponds, as well as hydrologic calculations. Consistent with Title 30 TAC §330.63(c) and §330.305(b) and (c), these facilities are designed to convey run-off produced from the 25-year storm event. In addition, an Erosion Control Plan for all phases of landfill development is included in Appendix IIIF-F. All drainage facilities will be constructed and maintained in accordance with this plan.

This appendix also includes (Section 4) a demonstration that shows that the proposed landfill development will not adversely alter the existing permitted drainage patterns. As noted in Section 4, the proposed condition represents the proposed configuration of the site after the landfill has been completely developed. Consistent with Title 30 TAC §330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a), the proposed completion condition is compared to the existing permitted condition to demonstrate that the continued development of the Camelot Landfill will not adversely alter the existing permitted drainage patterns.

To provide a complete comparison between the proposed condition and the existing permitted condition, the existing permitted condition was updated to include the expanded permit boundary and to incorporate analysis methods consistently accepted by the TCEQ. These updates are discussed in Section 4.

2 STORMWATER MANAGEMENT

2.1 Drainage System Layout

Stormwater runoff collected in swales located on the top dome and sideslopes of the landfill will be conveyed to drainage letdown structures (chutes) down the slopes to the perimeter channels. The perimeter channels collect runoff from drainage letdowns and conveys the runoff to stormwater detention ponds. The perimeter channels, will be constructed before fill is placed above existing grade in each adjacent landfill sector. The perimeter drainage system will be constructed in the general sequence shown on Parts I/II Drawings I/IIA-4 through I/IIA-7. As shown on Drawing IIIF.1 – Drainage Structure Plan, runoff generated from the majority of the developed areas will be discharged into one of three detention ponds to be attenuated before being discharged into the Elm Fork of the Trinity River (Elm Fork) or Midway Branch.

Pond P1 receives runoff from the northern portion of the developed landfill and discharges into a natural channel which conveys offsite flow from off-site Area O1 (refer to Figure 4.3 for off-site drainage areas) through an existing culvert under the landfill access road. This flow then merges with runoff from offsite Areas O1A, O2, and O3, and onsite Drainage Area S6 (refer to Figure IIIF.2 for onsite drainage areas), and exits the permit boundary at location DCP1 (refer to Figure 4.4). Off-site Drainage Area O4 merges with runoff from discharge point DCP1 in Midway Branch and re-enters the permit boundary from the east. Runoff from two drainage areas within the permit boundary (A6 and S8) merges with the flow in Midway Branch and exits the permit boundary again at discharge point DCP2.

Runoff from the remainder of the landfill development is collected in Ponds P2 and P3. Discharge from these ponds merges and exists the permit boundary to the south through an existing outfall channel directly into the Elm Fork at discharge point DCP3. Consistent with the existing permitted drainage layout, two post-development drainage areas, S9 and S10 (refer to Drawing IIIF.2), flow directly off the permit boundary into the Elm Fork at locations DCP5 and DCP4, respectively. Similarly, discharges at locations DCP6, DCP7, and DCP8 do not collect any runoff from the proposed landfill development and flow directly off the west side of the permit boundary, into offsite Drainage Area O5, and ultimately into the Elm Fork.

The facility has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act, respectively. Camelot Landfill has a current Texas Pollution Discharge

Elimination System (TPDES) multi-sector general permit (MSGP) for industrial activity as stipulated under Section 402 of the Clean Water Act and under Chapter 26 of the Texas Water Code, the TPDES program. A copy of the multi-sector permit is included in Parts I/II, Appendix I/IIG. Any stormwater that has become contaminated by contact with the working face or with leachate will be handled in accordance with Appendix IIIC – Leachate and Contaminated Water Management Plan. The facility maintains a current Stormwater Pollution Prevention Plan prepared consistent with the provisions of TPDES MSGP TXR050000.

2.2 Erosion and Sedimentation Control Plan

The Camelot Landfill will use various interim and permanent erosion and sedimentation controls during all phases of site development to provide effective erosion stability for the external sideslopes and top dome surfaces. The interim controls will be used around active areas and external embankment sideslopes and top dome surfaces. These controls will include temporary letdown structures, soil berms, and seeding of intermediate cover areas to minimize the erosion potential. These interim controls will be used during all phases of landfill development to provide effective erosion stability for the external sideslopes and top dome surfaces until final cover is installed. Refer to Appendix IIIF-F – Erosion Control Plan for All Phases of Landfill Operation for more information.

Permanent controls include swales and chutes that will be constructed upon completion of the final cover installation. As part of the final cover construction, an erosion layer capable of sustaining vegetation will be constructed. Areas that receive final cover will be vegetated in accordance with Appendix IIIJ – Closure Plan upon completion of final cover placement. Final cover vegetation will protect the erosion layer soil against erosive runoff velocities. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIF-D. The erosion layer will include a vegetation layer that provides for a 90 percent ground coverage, to keep soil loss below the required design values. If there are areas that do not maintain at least 90 percent vegetative coverage, vegetation in these areas will be reestablished to maintain at least 90 percent vegetative cover.

Erosion will be controlled by vegetation in drainage structures with flow velocities less than or equal to 5 feet per second (fps). For drainage structures with flow velocities greater than 5 fps, rock riprap, gabions, or other surface reinforcing materials as designed will be used for surface reinforcement.

During site development, non-structured and structural best management practices (BMPs) will be employed to control erosion and sedimentation ponds will be installed to prevent sediment discharge from the site. BMPs may include the use of temporary rock riprap, silt fences, straw bales, check dams, interceptor swales and berms, temporary and permanent seeding and sodding, surface roughening, matting and mulching, sediment traps, and surface wetting for dust control (refer to Appendix IIIF-F for more information).

Runoff volume (25-year, 24-hour storm event) from the active fill area (i.e., working face of the landfill operation) will be contained by the containment berm (refer to Part III, Appendix IIIC – Leachate and Contaminated Water Management Plan for details) to prevent potential discharge of contaminated runoff from the site.

2.3 Stormwater System Maintenance Plan

In accordance with Title 30 TAC §330.305(e)(1), the constructed stormwater systems such as channels, drainage swales, and chutes will be repaired and restored in the event of wash-out or failure from extreme storm events. Stormwater BMPs installed during all phases of landfill development will also be replaced or repaired in the event of failure. Excessive sediment will be removed, as needed, so that the drainage structures, such as the perimeter channels and detention ponds, function as designed. Site inspections by landfill personnel will be performed weekly or within 24 hours after any significant rainfall event of 0.5 inches or more, or as soon as the areas are accessible. Documentation of the inspection will be included in the Site Operating Record.

The following items will be evaluated during the inspections as further discussed in Appendix IIIF-F and Part IV – SOP:

- Erosion of daily and intermediate cover areas, final cover areas, perimeter ditches, chutes, swales, detention ponds, berms, and other drainage features.
- Settlement of intermediate cover areas, final cover areas, perimeter ditches, chutes, swales, and other drainage features.
- Silt and sediment build-up in perimeter ditches, chutes, swales, and detention ponds. Removed silt and sediment used as daily cover or to replenish intermediate cover soils.
- Obstructions in drainage features.
- Presence of erosion or sediment discharge at offsite stormwater discharge locations.
- Presence of sediment discharges along the site boundary in areas which have been disturbed by site activities.

Maintenance activities will be performed to correct damaged or deficient items noted during the site inspections. These activities will be performed as soon as possible after the inspection. The time frame for correction of damaged or deficient items will vary based on weather, ground conditions, and other site-specific conditions.

Maintenance activities will consist of the following, as needed:

- Vegetation reestablishment.

- Placement, grading, and stabilization of additional soils in eroded areas or in areas which have settled.
- Replacement or repair of riprap or other surface lining materials.
- Placement of additional riprap in eroded areas.
- Removal of obstructions from drainage features.
- Removal of silt and sediment build-up from drainage features.
- Repairs to erosion and sedimentation controls.
- Installation of additional erosion and sedimentation controls.

3 DRAINAGE SYSTEM DESIGN

3.1 Methodology

Drainage calculations for the final cover system erosion control structures and perimeter drainage system are based on the peak flow rates resulting from the 25-year frequency rainfall event for the area. The United States Army Corps of Engineers (USACE) HEC-1 computer program was used to compute peak flow rates produced from the design storm. The hydraulic methods employed in this study are consistent with those presented in the TCEQ *Guidelines for Preparing a Surface Water Drainage Report for Municipal Solid Waste Facility (RG-417, August 2006)* and TxDOT *Bridge Division Hydraulic Manual*, December 1985.

Water surface profiles were determined for the perimeter channels using the Channel Analysis Program (HYDROCALC HYDRAULICS Version 1.2a for Windows, Dodson & Associates, 1996) that is based on Manning's formula for uniform flow. The perimeter channels are designed to collect and route runoff from the 25-year frequency storm event to the detention ponds.

3.2 Hydrologic Analysis

3.2.1 Description of Computer Program

HEC-1 was developed by the USACE Hydrologic Engineering Center to simulate the surface runoff response of a watershed. The HEC-1 model represents a watershed as a network of hydrologic and hydraulic components. The modeling process results in the computation of stream-flow hydrographs at desired locations in the watershed. The hydrologic analysis for the post-development condition is presented in Appendix IIIF-A. The hydrologic analysis for the permitted landfill completion condition is included in Appendix IIIF-E.

3.2.2 Watershed Subareas and Schematization

The landfill areas that contribute flow to each detention pond were delineated into subareas to derive peak flow rates for the design of the perimeter channel and final cover drainage letdowns. Hydrographs are developed for each subarea and appropriately combined and routed through the swales and perimeter channels. The subareas are shown on Drawing IIIF.2 – Post-Development Drainage Area Plan as well as in Appendix IIIF-E for the permitted completion condition.

Offsite areas (areas outside the permit boundary) incorporated into the hydrologic analyses as appropriate have been delineated using topography obtained from the North Central Texas Council of Governments (NCTOG) compiled from aerial photography flown from January to March 2007. The offsite drainage area delineation is shown on Figure 4.3 for the post-development discharge analysis. The offsite areas are also included in the hydrologic analysis for the permitted landfill completion condition, as shown in Appendix IIIF-E.

3.2.3 Time Step

The time step, or the program computation interval, is the time interval at which the flow rates for the hydrographs are generated by the program. Time step used for a design storm event hydrograph generation is 5 minutes.

3.2.4 Hypothetical Precipitation

The hypothetical precipitation for the hydrologic analysis is consistent with the currently permitted hypothetical precipitation data. The hypothetical storm data was obtained from the National Weather Service (NWS) Technical Paper 40 (TP-40) (NWS, 1961) and NOAA Technical Memorandum NW3 Hydro-35 for the project area. For the design storm event analysis, a return period (frequency) of 25 years and a duration of 24 hours is used. The precipitation is assumed to be evenly distributed over the entire area modeled for each time interval.

3.2.5 Precipitation Losses

Precipitation losses (the precipitation that does not contribute to the runoff) are calculated using the Soil Conservation Service (SCS) Curve Number (CN) method. CN is a function of soil cover, land use, and antecedent moisture conditions. A CN of 86 was selected to represent the final cover sideslopes, and a CN of 84 was selected for final cover top dome surfaces. A CN of 100 was used for the detention pond areas. Further discussion on selection of CN values is provided in Appendices IIIF-A and IIIF-E for post-development and permitted landfill completion conditions, respectively.

3.2.6 Hydrograph Information

Two different types of hydrograph generation methods have been used in the drainage analyses: distributed runoff methods and the Snyder unit hydrograph method using the Espey "10-Minute" method for parameter estimation. Muskingum-Cunge and pond storage discharge methods were used for hydrograph routings. Example hydrograph development information for both distributed runoff and Snyder unit hydrograph methods is provided in Appendix IIIF-A.

Distributed Runoff Methods

The distributed runoff method (e.g., kinematic wave method) is applicable to small-water catchments with uniformly sloped overland flow plains that drain into channels. Landfill final cover areas consist of relatively short (typically 120 feet on 4H:IV sideslopes) overland flow lengths that drain into landfill final cover swales. Distributed runoff estimation methods are applicable to landfill final cover areas because of the following:

- These methods were developed for uniform slopes that drain to collection channels. For a landfill final cover area, this translates to an overland flow segment of final cover that drains to a swale.
- These methods were developed for a network of relatively small drainage areas. Typically, to design the various perimeter channels, landfill drainage areas need to be subdivided to determine a peak flow at several points.
- These methods are also inherently conservative because it is based on watershed dimensions as opposed to other methods that use empirical information. Also, this method is conservative because flow attenuation is not accounted for.
- This method is also more conservative than the rational method because watershed lag time is computed as a function of real flow time without any limitations such as using a minimum time of concentration (i.e., 10 minutes), which is common practice for the rational method.

The kinematic wave method has been used for estimating peak runoff rates from the landfill final cover areas. A hydrograph from each drainage area with channelized flow (e.g., landfill final cover areas to swales) was developed using the kinematic wave method to simulate both overland and channelized flow. This method utilizes a simplified form of the energy equation and is based on the characteristics of the drainage area, swale, or channel. This method uses physical (measurable) characteristics (e.g., flow lengths, slopes, surface roughness coefficients, channel cross sections) of a watershed to estimate peak discharges.

Snyder Unit Hydrograph Method

The Snyder unit hydrograph method has been used mainly for non-landfill drainage areas (e.g., offsite drainage areas). The method is applicable to drainage areas with a wide range of characteristics. Several different methods have been developed to estimate Snyder unit hydrograph parameters (watershed lag and peaking coefficient). Espey "10-Minute" method was used in this project to estimate Snyder unit hydrograph parameters. The Espey "10-Minute" method was developed using flow records from 41 different watersheds in Texas and other states. The main advantage of the Espey "10-Minute" method is that it is one of the best methods for small-size drainage areas.

Hydrograph Routing

The Muskingum-Cunge Method (RD record in HEC-1) was used for routing of the flood wave through the drainage channels. This method is capable of accounting for hydrograph attenuation based on physical channel properties such as length, bottom slope, channel shape, and channel roughness.

Hydrographs at pond outlets were generated by routing the combined incoming flow hydrographs through the ponds. Pond routings (RS – Storage Routing record in HEC-1) were performed by using storage/elevation relationships for each pond by defining pond surface area versus depth. Additionally, discharge structure (low level outlet and spillway) characteristics of each pond are used for pond routing.

3.3 Hydraulic Analysis

3.3.1 Swale and Channel Analysis

Drainage structure details are illustrated on Drawings IIIF.9 through IIIF.12. The swales and channels are designed to convey the peak flow rate generated by the design storm event. These swales and channels will also reduce maintenance at the site after closure by minimizing erosion.

Hydraulic analyses of the swales and channels are conducted using Manning's uniform flow formula. The uniform flow assumption is applicable to long prismatic channels of uniform slope, as proposed at the site.

The general form of Manning's equation is

$$V = \frac{1.49\, R^{0.667}\, S^{0.5}}{n}$$

in which

V = *Velocity of flow, fps (feet per second)*
n = *Manning's "n" (unitless)*
R = $\frac{A}{P}$ = *Hydraulic radius, ft (feet)*
S = *Friction slope for nonuniform flow or channel slope for uniform flow, ft/ft*
A = *Area of water perpendicular to direction of flow, sf (square feet)*
P = *Wetted perimeter, ft.*

Using the relationship

$$Q = VA$$

Manning's equation can be written as

$$Q = \frac{1.49\, A\, R^{0.667} S^{0.5}}{n}$$

The uniform flow assumption equates the channel slope to the friction slope; therefore, the slope of the channel can be used for "S" in Manning's formula for computation of uniform flow.

Typical values for Manning's "*n*" are presented in the 2009 TXDOT *Bridge Division Hydraulic Manual* ("Suggested Manning's Roughness Coefficients" Table, Chapter 6, Section 1). A value of 0.030 is used for "*n*" for swales, a value of 0.040 is used for gabion-lined chutes, and a value of 0.030 is used for perimeter channels. These values represent typical roughness coefficients to the proposed drainage structures, after vegetation has become established.

3.3.2 Drainage Letdown Structure (or Chute) Analysis

A typical chute detail is illustrated on Drawing IIIF.9. The final cover drainage letdown structures are designed to convey the flow rate generated by the design storm event. Hydraulic analysis of the letdown structures is conducted under the principles of tumbling flow. Tumbling flow is a function of channel slope, discharge, spacing and sizing of energy dissipating elements. The tumbling flow regime consists of a series of hydraulic jumps and overfalls that maintain critical velocity down the chute. The spacing and sizing of the energy dissipaters controls the velocity and flow of the water in the chutes, thereby reducing erosive conditions at slope transitions with the perimeter road low water crossings and chute/perimeter channel confluences.

Appendix IIIF-C presents calculations for the energy dissipaters.

3.3.3 Hydraulic Analysis of The Elm Fork Trinity River

A hydraulic analysis has been developed for the Elm Fork Trinity River as a part of the Conditional Letter of Map Revision (CLOMR) request and Corridor Development Certificate (CDC) application. As shown on Figure 4.6 and 4.7 Elm Fork forms the south side of the permit boundary.

The USACE Hydraulic Engineering Center's River Analysis System (HEC-RAS) v.4.1.0 computer program was used for the hydraulic analysis of the Elm Fork (refer to Appendix IIIO for additional information). The analysis was developed for the 1-, 2-, 5-, 10-, 25-, 50- 100-, 500-year and standard project flood (SPF) frequency storm events. The 25-year and 100-year frequency storm flow rates used in the hydraulic analysis were obtained from FEMA and the USACE. Refer to Appendix IIIO for more information on the analyses performed on the Elm Fork.

4 DRAINAGE PATTERNS

Consistent with Title 30 TAC §330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a), this section provides a demonstration showing that the proposed landfill development will not adversely alter the existing permitted landfill completion condition drainage patterns. The appendices containing the two drainage conditions analyzed are listed below.

- Appendix IIIF-A (Post-Development Condition Hydrologic Calculations) – This appendix contains analysis and supporting calculations for the proposed configuration of the site after development of the expanded landfill is complete.
- Appendix IIIF-E (Permitted Condition Hydrologic Calculations) – This appendix contains analysis and supporting calculations for the updated permitted configuration of the site and excerpts from the currently permitted drainage analysis. Section 4.3.1 includes a discussion of how the existing permitted drainage analysis has been updated to provide an equivalent comparison with the post-development condition.

The following three sections discuss: (1) regional drainage associated with the site; (2) site drainage patterns; (3) effect of the proposed development on peak flows, volumes, and velocities discharged from the site.

4.1 Regional Drainage Information

As shown on Figure 4.1, the 469.6-acre Camelot Landfill permit boundary is located approximately 2 miles south of Lake Lewisville. The Elm Fork Trinity River forms the southern boundary of the site. Midway Branch, a tributary of the Elm Fork, flows along the east side of the permit boundary.

Lake Lewisville is one of the largest man made surface water impoundments in Texas with a 46.24 square mile (25,592 acres) surface area at the crest elevation of the Lake Lewisville Dam. As shown on Figure 4.2, the Lake Lewisville watershed encompasses approximately 1,660 square miles. The total drainage area of the Elm Fork (which includes Prairie Creek and Stewart Creek) between Lake Lewisville Dam and the downstream end of the permit boundary is approximately 17 square miles. The permit boundary drainage area, which is comprised of the permit boundary and offsite areas discharging onto or directly receiving flow from the permit boundary, is 2.82 square miles (0.17 percent of the Elm Fork's drainage area upstream of the site).

The main influence on regional drainage patterns is the Lake Lewisville Dam. For example, the USACE operates the dam outlet structures, and their standard operating procedure is to close the outlet structures, during the 50-year and higher frequency storm events. As discussed in Section 4.3.5 and Appendix IIIO, the peak flow rates in the Elm Fork have been determined by the USACE for the Trinity River hydrologic model as a part of the development of the CDC permit application for the year 2050 (refer to Appendix IIIO for more information). A discussion of the effect of the continued development of the landfill on the 100-year floodplain is provided in the Section 4.3.5.

Figure 4.3 – Offsite Drainage Area Map shows the watershed associated with flows entering and leaving the permit boundary. The majority of the area within the permit boundary discharges south or west into the Elm Fork. A smaller portion of the area within the permit boundary drains east into Midway Branch and ultimately discharges into the Elm Fork approximately 200 feet southeast of the permit boundary.

4.2 Site Drainage Patterns

The permitted and proposed site drainage patterns are shown on Figure 4.4 – Site Drainage Patterns. As shown on Figure 4.4, the proposed drainage patterns are consistent with the currently permitted and updated permitted drainage patterns. The entire permit boundary drains directly into Elm Fork or through the Midway Branch into the Elm Fork of the Trinity River. The drainage patterns that include the individual outfalls at the permit boundary and individual runon locations (locations where upstream offsite areas flow onto the permit boundary) for both the permitted and proposed conditions are the same. Run-on and runoff locations have been added or removed due to the expansion of the permit boundary relative to the existing permitted condition (i.e., removal of DCPN2O and addition of run-on Point DCPO1). Runoff and run-on locations of the expanded permit boundary are the same for the updated permitted condition and the post-development condition. Also, the onsite drainage areas draining to Midway Branch and the Elm Fork under the proposed landfill completion conditions are consistent with the permitted conditions.

As shown on Figure 4.4, the total drainage area of the permit boundary is increased by 114.92 acres from the permitted condition to the updated permitted condition. This increase in the permit boundary allows for a direct comparison to be made between the two conditions. As shown in the onsite drainage area information on Figure 4-4, the updated permitted and proposed onsite drainage delineations are consistent.

Areas drain directly to the Elm Fork from discharge locations DCP3, DCP4, and DCP5 as shown on 4.4 for the permitted and proposed conditions. Discharge from DCP6, DCP7, and DCP8 traverses offsite Drainage Area O5 before discharging into the Elm Fork. The total drainage area to these six outfalls is comparable for the updated permitted (230.79 acres) and post-developed conditions (245.35 acres). Slight changes among the areas draining to these six outfall locations are shown on Figure 4.4. The difference in total drainage areas is due to changes in landfill final cover drainage areas (i.e., Areas 1, 2, and

3). In the proposed condition approximately 14 acres that were draining into Midway Branch have been diverted to drain into the Elm Fork.

As shown on Figure 4.4, discharge locations DCP1 and DCP2 discharge directly into Midway Branch. The Midway Branch converges with the Elm Fork approximately 200 feet south of discharge location DCP2. The total drainage area to the Midway Branch is 1,445.76 acres and 1,460.32 acres for the post-development and updated permitted conditions, respectively. The difference of 14.55 acres is the same difference in the total area flowing into the Elm Fork for the updated permitted and post-development conditions. In total, runoff from the same area, 1,691.11 acres, is discharged from the permit boundary for the updated permitted and post-development conditions. Note that Area O5 does not drain onto the permit boundary and is not included in the 1,691.11 acres discharging from the permit boundary. As mentioned above, changes to the design of the landfill final cover areas (i.e., Areas 1, 2, and 3) result in 14 acres of Midway Branch Drainage Area being diverted to drain to the Elm Fork.

4.3 Effect of Site Development on Drainage from the Site

The purpose of this section is to evaluate the peak flow rates, runoff volumes, and peak flow velocities of the existing permitted, updated permitted, and post-development hydrologic conditions. A summary of peak flow rates, runoff volumes, and peak flow velocities entering and exiting the permit boundary is provided in Table 4.1 and Figure 4.5 – Site Drainage Patterns, Runon/Runoff. Section 4.3.1 discusses the updates made to the currently permitted landfill completion condition drainage analysis to facilitate a complete and relevant comparison to be made between permitted and post-development landfill completion conditions.

Sections 4.3.2 through 4.3.5 discuss the impact of the proposed landfill conditions on peak flow rates, runoff volumes, and peak flow velocities entering and exiting the permit boundary.

4.3.1 Comparison of Existing Permitted and Updated Permitted Conditions

4.3.1.1 Purpose of the Updated Permitted Condition

As shown in Drawing 4.4, the drainage analysis included in TCEQ Permit No. 1312A (for the purpose of this appendix, this case will be designated the "existing permitted condition") developed by Reed Engineering Group, Inc. in November 2000 utilizes a different landfill permit boundary and offsite drainage areas than those used in the post-development condition. An update to the existing permitted condition was necessary to allow an accurate comparison to be made with the results from the post-development condition. As noted in Section 1.2, to comply with Title 30 TAC §330.63(c)(1)(C), the proposed landfill completion condition is compared to the existing permitted condition of the landfill to demonstrate that the continued development of the landfill will not adversely alter the existing permitted drainage patterns. This comparison is only meaningful if both the post-development and existing permitted conditions are based on consistent drainage information, including the same permit boundary. A discussion of the model parameters used in the existing permitted condition and the "updated permitted condition" is included in Section 4.3.1.2.

4.3.1.2 Model Parameter Comparison

Updates to the existing permitted condition are listed below.

- The landfill permit boundary was updated to the currently permitted landfill permit boundary. Changing the permit boundary requires that the offsite drainage areas must also be re-delineated to determine flow rates, volumes, and velocities entering and leaving the new permit boundary.
- Offsite Areas O1 through O5 were delineated for the updated permit boundary. As noted in Section 3.2.2, these offsite areas were delineated using the 2007 topography provided by NCTCOG.
- To be consistent with methods utilized in recently approved TCEQ applications, precipitation loss, hydrograph development, channel routing, and pond storage routing methods were updated as follows:
  - Curve numbers for all drainage methods were updated to 84 for most non-landfill drainage areas, 84 for landfill top dome surfaces, 86 for landfill side slope surfaces, and 100 for ponds based on tabulated curve numbers for the land uses of these areas (see Appendix IIIF-E). Curve numbers in the existing permitted condition are 80 for all non-landfill drainage areas, and 84 for landfill drainage areas.
  - Hydrographs are developed in the updated permitted landfill completion condition using distributed runoff methods or Snyder's unit hydrograph, as discussed in Section 3.2.6. The existing permitted condition utilizes the SCS unit dimensionless hydrograph for all drainage areas.
  - The channel routing mechanism was updated to the Muskingum-Cunge Method for all channels, and routing through the Elm Fork or Midway Branch was removed from the HEC-1 Model.
  - Pond routing is accomplished using the storage routing method, with storage/elevation data, and spillway and low-water outlet information input into HEC-1. The existing permitted condition utilized unverified (storage/elevation supporting information was not cited) rating curves for pond routing.
- The drainage area delineation for the currently permitted final cover drainage letdowns has been updated to model top dome surfaces and sideslope areas separately to better represent the final cover drainage areas. This update provides more accurate flow rates for the top dome area drainage letdown structures.

4.3.1.3 Comparison of Peak Flows at the Permit Boundary

As shown in Figure 4.4, discharges to the east of the permit boundary at locations DCP1 and DCP2 for the existing and updated permitted conditions are different due to the addition of over 1.5 square miles of offsite drainage areas. Offsite flows from DCPO3 are approximately equal for the existing and updated permitted condition. The discharge at location DCP3 is higher in the updated permitted condition by 41 cfs, and is attributable to the change in Pond Routing Methodology. Flow rates at locations DCP4, DCP5, DCP6, and DCP7 are lower for the updated permitted condition.

4.3.2 Peak Flow Rates

As shown on Figure 4.5 and in Table 4-1, the peak flow rates entering the permit boundary from DCPO1, DCPO2, and DCPO3 are identical for the updated permitted and post-development conditions. The peak flow rate for DCPO3 is higher for the existing permitted condition. After leaving the permit boundary at DCP1, stormwater re-enters the permit boundary at location DCPO4. Peak flow rates are not comparable at this location between the existing permitted and the updated permitted or post development conditions due to the addition of over 1,200 acres in the latter two conditions. The peak flow rate for the post-development condition at location DCPO4 is 6 cfs (0.2%) lower than the updated permitted condition. This difference is due in part to the slightly lower total drainage area and the larger detention area (Pond P1) in the post-development condition.

As noted above, stormwater that enters the site from an off-site area and stormwater that is generated from within the permit boundary discharges at eight separate locations along the permit boundary (DCP1, DCP2, DCP3, DCP4, DCP5, DCP6, DCP7, and DCP8 as shown on Figure 4.4). At these discharge points, the peak flow rates from the 25-year frequency storm event that are discharged from the site for the post-development condition are all less than the updated permitted conditions. This reduction in the peak flow rates is due to the additional detention provided by the addition of Pond P3 and the slightly different delineation of drainage areas (due to the slight difference between permitted and in-place drainage channels and Pond P2).

The 25-year peak flow rate in the Elm Fork at the upstream and downstream limits of the site shown on Figure 4.5 and Table 4-1 is 8,900 cfs. This flow rate is provided in the CDC hydraulic model for Elm Fork Trinity River (refer to Appendix IIIO for peak flow rate, velocity, and other information). The peak flow rates in the CDC model were developed based on a year 2050 expected region-wide watershed development scenario.

4.3.3 Volumes

As shown in Table 4-1, the volumes entering the permit boundary are consistent for the updated permitted and post-development landfill conditions (the volume increase for the site is 10 ac-ft or 1.26%). The increase in the runoff volume for the entire site is a result of the final cover improvements and additional detention pond area for which a CN of 100 is used. This volume increase is insignificant, because the reduced peak flow rate results in a better regulated release of the increased storm volume. Runoff volume calculations are provided in Appendices IIIF-A and IIIF-E.

4.3.4 Velocities

A summary of the 25-year frequency storm peak flow velocities that enter and exit the site are shown on Table 4-1. As shown, the velocities at each discharge point are equal or lower for the post-development condition compared to the permitted conditions. This is due to the lower flow rates, given that the cross-sectional area at each drainage outfall remains unchanged. Velocity calculations are provided in Appendices IIIF-A and IIIF-E for the post-development and permitted conditions, respectively.

4.3.5 Floodplain

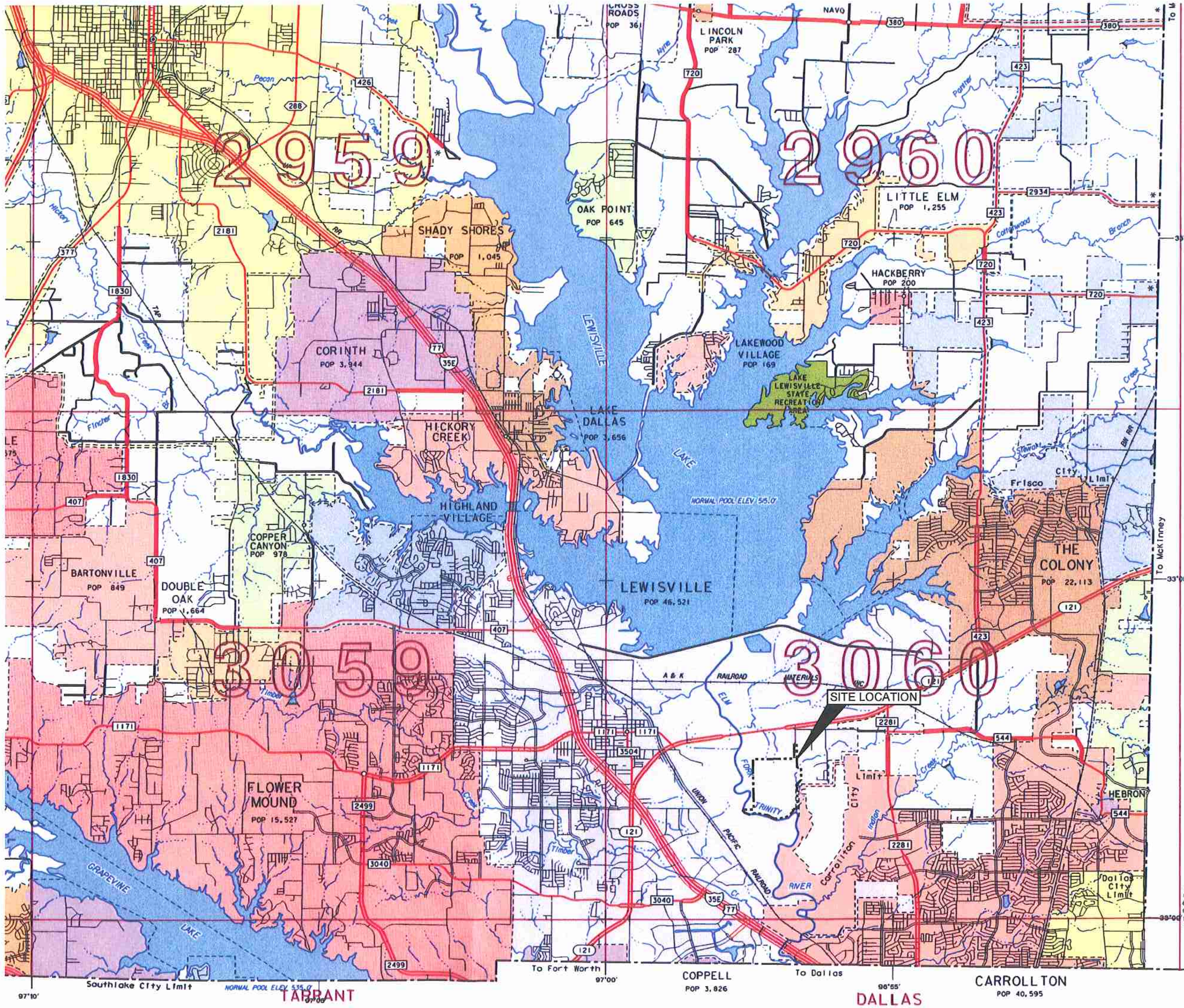
Because of the nature of the Trinity River as a major drainage conduit in heavily developed areas, development within the Trinity River corridor is regulated by the ACOE and FEMA. As a part of this application, a CDC permit and CLOMR request were developed and submitted to the ACOE and FEMA, respectively. The effective models for the region around the permit boundary are maintained independently by FEMA and ACOE, however there are only very small differences in the effective models.

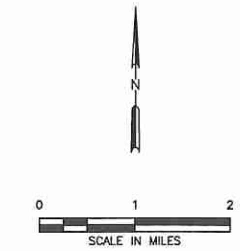
A comparison of the floodplain elevations for both the currently permitted landfill configuration and the proposed landfill expansion configuration using both the CDC and CLOMR models are presented in Table 4-2. As shown in Table 4-2, the floodplain elevations for the Elm Fork during the 100-year storm are generally unaffected due to the proposed landfill expansion. Creation of additional floodplain valley storage in the area between the landfill and the Elm Fork results in a very slight decrease in flood plain elevations in some of the cross sections. To meet the CDC requirements, the amount of floodplain valley storage created has to be more than the amount of existing valley storage consumed. In this case, the valley storage is increased by over 106 acre-feet for the 100-year storm event because of the development of the landfill.

From this analysis, it is concluded that the proposed landfill development will not adversely alter the floodplain of the Elm Fork. This conclusion is supported by the City of Lewisville, the USACE, and FEMA's approval of the proposed project and resulting 100-year floodplain delineation. Approval letters are included in Appendix IIIO.

4.4 Summary

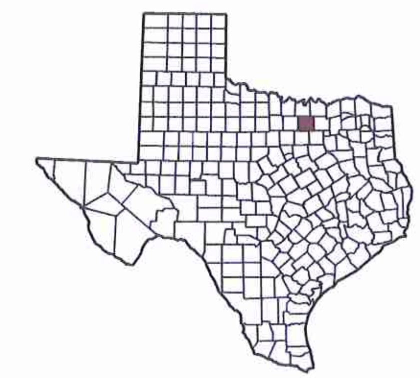
From the hydrologic evaluations of the updated permitted and proposed conditions, the existing drainage conditions at the permit boundary will not be adversely altered by the proposed development. Given that: (1) drainage patterns are not adversely altered, (2) total design stormwater peak discharge rate at the permit boundary is less than the permitted total stormwater peak discharge rate (and the post-development peak flows entering the site are less than or equal to the updated permitted peak flows entering the site), (3) the hydrograph time to peak at the permit boundary is not significantly altered for the proposed landfill expansion, (4) total volume of stormwater entering and leaving the permit boundary is not significantly altered, (5) there is no increase in velocity at the permit boundary, (6) the stormwater discharge outfall locations are consistent with the permitted configuration, and (7) the permitted floodplain is not increased at the permit boundary and the limits of waste is at a minimum of 3 feet above the corresponding floodplain elevation, it is concluded that the proposed landfill development will not adversely alter permitted drainage patterns consistent with Title 30 TAC 330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a).





LEGEND

PERMIT BOUNDARY



KEY TO COUNTIES

GENERAL HIGHWAY MAP
DENTON COUNTY
TEXAS

PREPARED BY THE

TEXAS DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING AND PROGRAMMING DIVISION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

1990

1990 CENSUS FIGURES

HIGHWAYS REVISED TO

NOTICE

This map has been prepared for internal use within the Texas Department of Transportation. Accuracy is limited to the validity of available data as of dates shown.

STATE OF TEXAS
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2-28-12

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION ☐ CLIENT APPROVAL BY:	PREPARED FOR CITY OF FARMERS BRANCH	MAJOR PERMIT AMENDMENT SITE LOCATION MAP
DATE: 02/2012 FILE: 1339-351-11 CAD: 4.1-SITE LOC MAP.DWG	DRAWN BY: VRS DESIGN BY: CRM REVIEWED BY: JPY	CAMELOT LANDFILL DENTON COUNTY, TEXAS

REVISIONS

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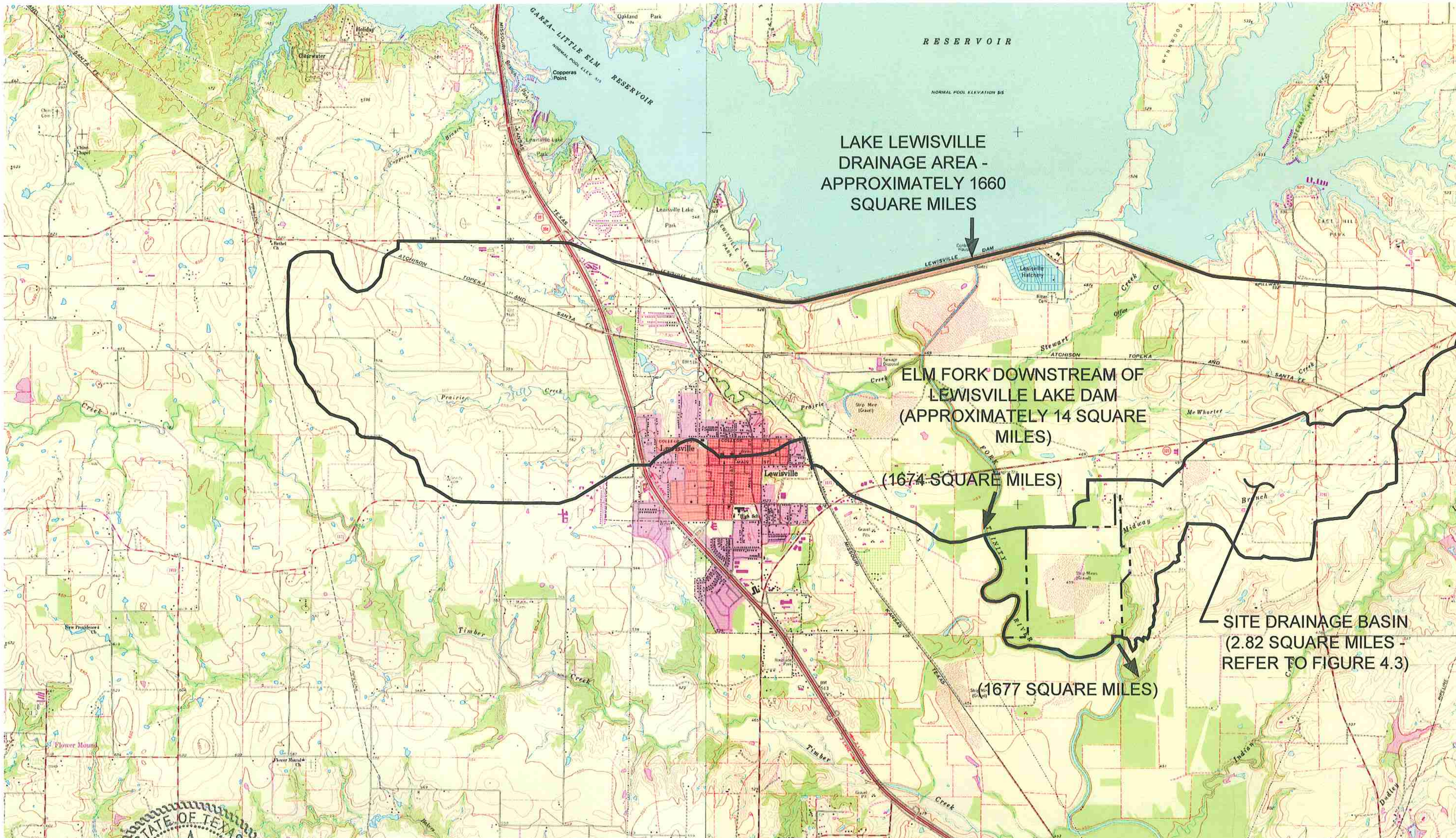
FIGURE 4.1

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\4.1-SITE LOCATION MAP.dwg, jwilson, 1:2



STATE OF TEXAS
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2-28-12

LEGEND

PERMIT BOUNDARY

DRAINAGE AREA BOUNDARY

0 2000 4000

SCALE IN FEET

NOTES:

1. TOPOGRAPHIC MAP SHOWN IS THE USGS 7.5 MINUTE QUADRANGLE MAPS:
   LEWISVILLE WEST, TEXAS PRINTED 1960 (PHOTOREVISED 1968)
   LEWISVILLE EAST, TEXAS PRINTED 1960 (PHOTOREVISED 1968)
2. WATERSHED BOUNDARIES SHOWN ONLY FOR THE AREAS DOWNSTREAM OF THE LEWISVILLE DAM AND ARE APPROXIMATED BY USING USGS TOPOGRAPHIC MAP.

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DATE: 02/2012
FILE: 1339-351-11
CAD: 4.2-REG WATERSHED.DWG

DRAWN BY: VRS
DESIGN BY: CRM
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MAJOR PERMIT AMENDMENT
REGIONAL WATERSHED MAP

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

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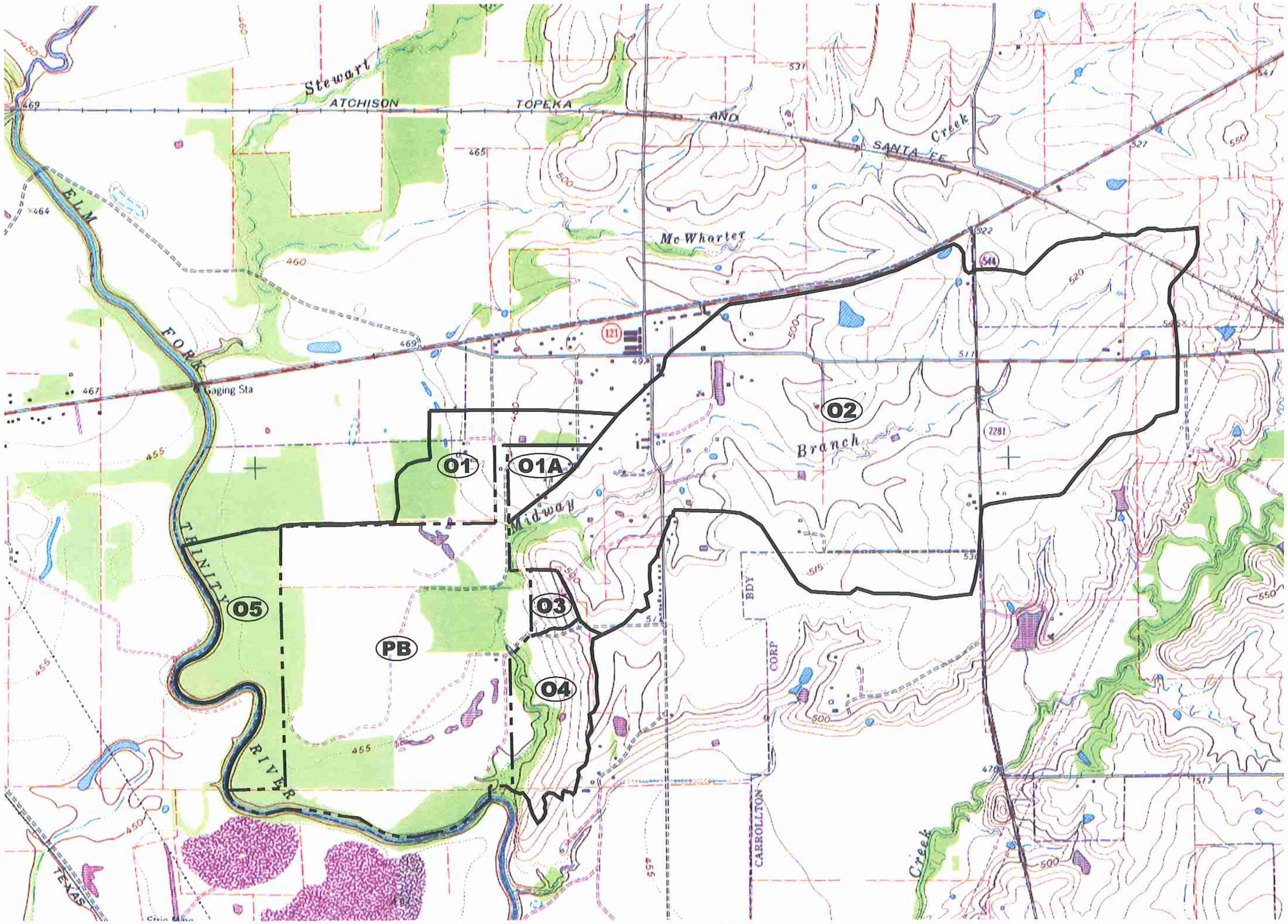
SPRINGFIELD, IL
ST. LOUIS, MO

FIGURE 4.2

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\4.2-REGIONAL WATERSHED MAP.dwg, jwilson, 1:2



N

0 1000 2000
SCALE IN FEET

LEGEND

PERMIT BOUNDARY
DRAINAGE AREA BOUNDARY
(02) DRAINAGE AREA LABEL

DRAINAGE AREA NO.	AREA (ACRES)
01	87.5
01A	23.4
02	1,008.4
03	16.2
04	86.0
05	116.5
PB	462.6
TOTAL	1,807.6

ROAD CLASSIFICATION

Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
Interstate Route — U.S. Route — State Route

LEWISVILLE EAST, TEX.
SW/4 FRISCO 15' QUADRANGLE
N3300—W9652.5/7.5
1960
PHOTOREVISED 1968
AMS 6650 III SW–SERIES V882

NOTES:

1. DRAINAGE AREA DELINEATION WITHIN THE PERMIT BOUNDARY IS INCLUDED IN APPENDICES IIIF–A AND IIIF–E.
2. TOPOGRAPHY PROVIDED BY USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (LEWISVILLE EAST, TX, PHOTO REVISED 1981).

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NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT OFFSITE DRAINAGE AREA MAP

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

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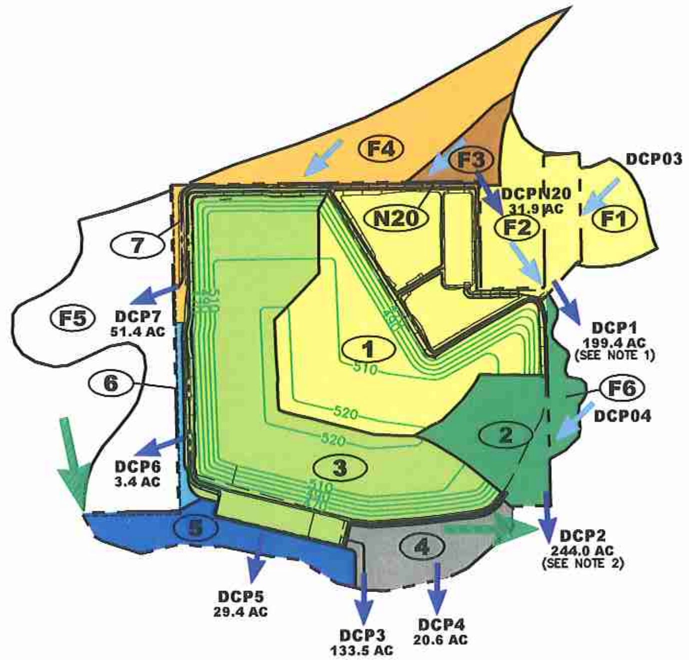
FIGURE 4.3

O:\1339\351\EXPANSION 2009\PART III-SDP\IIF\4.3-OFFSITE DRAINAGE.dwg, jwilson, 1:2



EXISTING PERMITTED CONDITION

ON–SITE AREAS (SEE NOTE 5)

1 = 131.3 ACRES
2 = 27.5 ACRES
3 = 133.5 ACRES
4 = 20.6 ACRES
5 = 29.4 ACRES
6 = 3.4 ACRES
7 = 6.5 ACRES
N20 = 2.5 ACRES

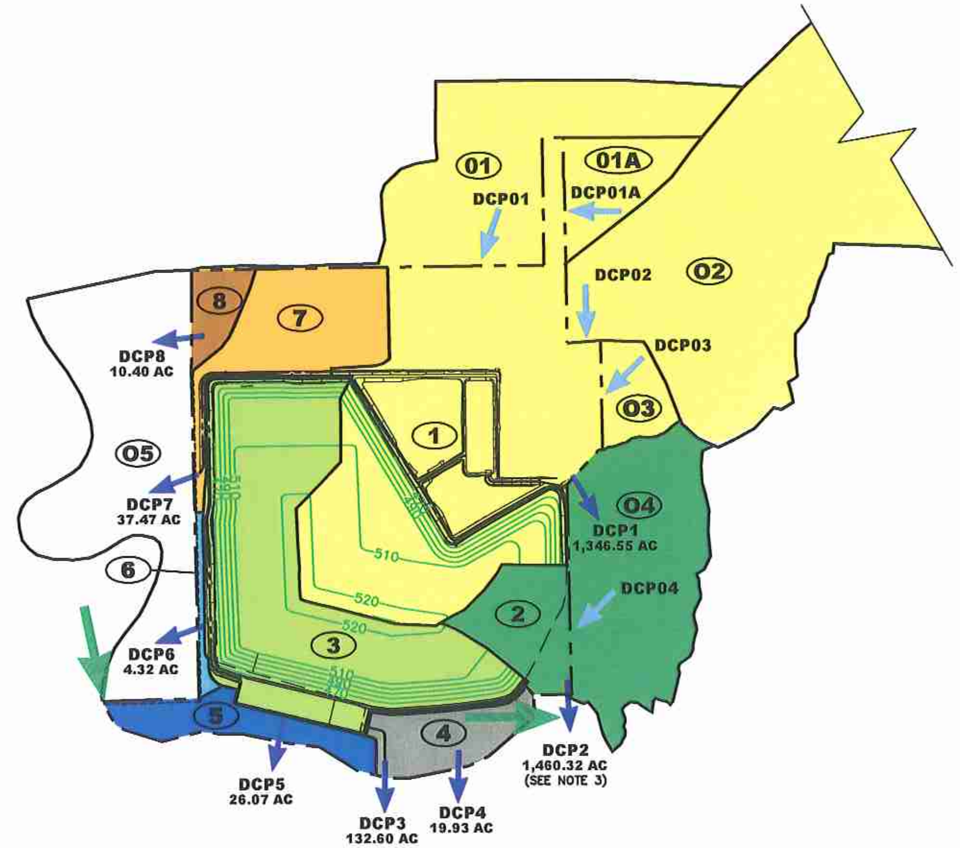
PERMIT BOUNDARY TOTAL = 354.7 ACRES

OFF–SITE AREAS (SEE NOTE 5)

F1 = 16.0 ACRES
F2 = 20.2 ACRES
F3 = 29.4 ACRES
F4 = 44.9 ACRES
F5 = 81.0 ACRES
F6 = 17.1 ACRES

OFF–SITE TOTAL = 208.6 ACRES

GRAND TOTAL = 563.3 ACRES



UPDATED PERMITTED CONDITION

ON–SITE AREAS

1 = 211.10 ACRES
2 = 27.73 ACRES
3 = 132.60 ACRES
4 = 19.93 ACRES
5 = 26.07 ACRES
6 = 4.32 ACRES
7 = 37.47 ACRES
8 = 10.40 ACRES

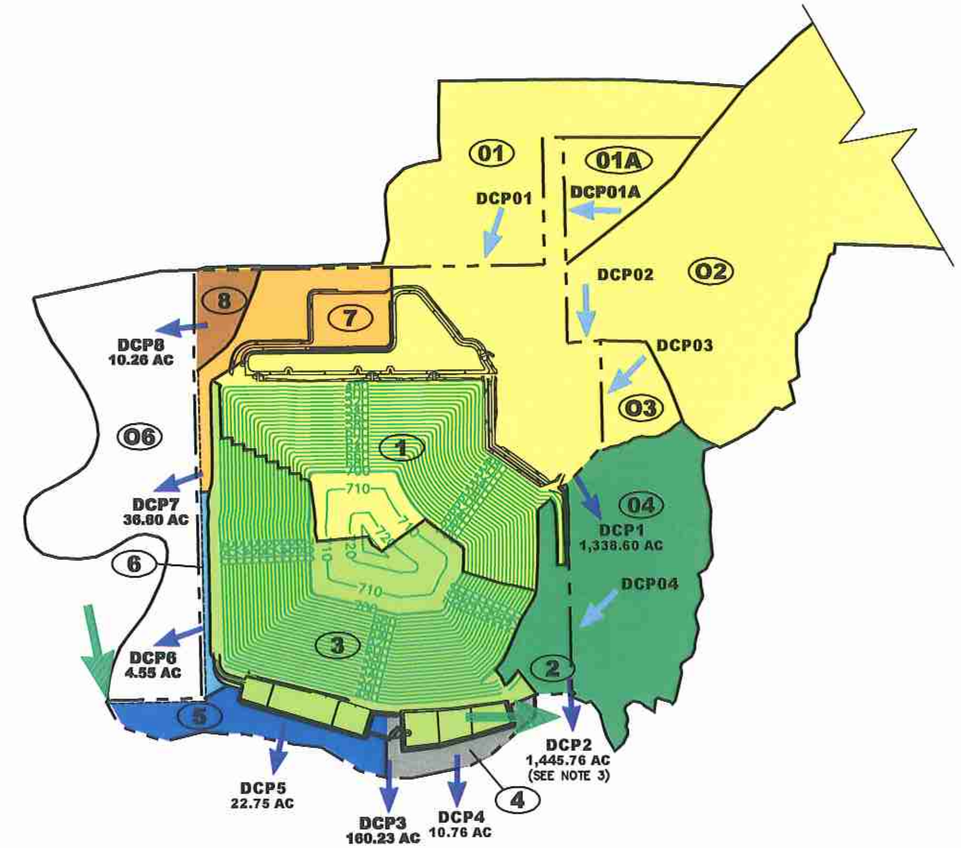
PERMIT BOUNDARY TOTAL = 469.62 ACRES

OFF–SITE AREAS

01 = 87.47 ACRES
01A = 23.42 ACRES
02 = 1,008.38 ACRES
03 = 16.18 ACRES
04 = 86.04 ACRES
05 = 116.47 ACRES

OFF–SITE TOTAL = 1,337.96 ACRES

GRAND TOTAL = 1,807.58 ACRES



POST–DEVELOPMENT CONDITION

ON–SITE AREAS

1 = 203.15 ACRES
2 = 21.12 ACRES
3 = 160.23 ACRES
4 = 10.76 ACRES
5 = 22.75 ACRES
6 = 4.55 ACRES
7 = 36.80 ACRES
8 = 10.26 ACRES

PERMIT BOUNDARY TOTAL = 469.62 ACRES

OFF–SITE AREAS

01 = 87.47 ACRES
01A = 23.42 ACRES
02 = 1,008.38 ACRES
03 = 16.18 ACRES
04 = 86.04 ACRES
05 = 116.47 ACRES

OFF–SITE TOTAL = 1,337.96 ACRES

GRAND TOTAL = 1,807.58 ACRES

LEGEND

PERMIT BOUNDARY
520 PERMITTED / PROPOSED FINAL COVER CONTOUR
1 DRAINAGE AREA DESIGNATION
DRAINAGE AREA BOUNDARY
UPLAND DRAINAGE ENTERING THE SITE
DCP3 132.60 AC STORMWATER DISCHARGE POINT
FLOW IN THE ELM FORK ENTERING/EXITING THE SITE

N

0 1000 2000
SCALE IN FEET

NOTES:

1. DCP1 AREA INCLUDES THE 31.9 ACRES DRAINING FROM DCPN20.
2. DCP2 AREA INCLUDES THE 199.4 ACRES DRAINING FROM DCP1.
3. DCP2 AREA INCLUDES THE 1,346.55 ACRES DRAINING FROM DCP1.
4. DCP2 AREA INCLUDES THE 1,338.60 ACRES DRAINING FROM DCP1.
5. AREAS SHOWN ARE OBTAINED FROM ATTACHMENT 6B–2 AND THE HEC–1 MODEL INCLUDED IN THE SDP FOR TCEQ PERMIT NO. MSW–1312A.

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MAJOR PERMIT AMENDMENT
SITE DRAINAGE PATTERNS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F–3727

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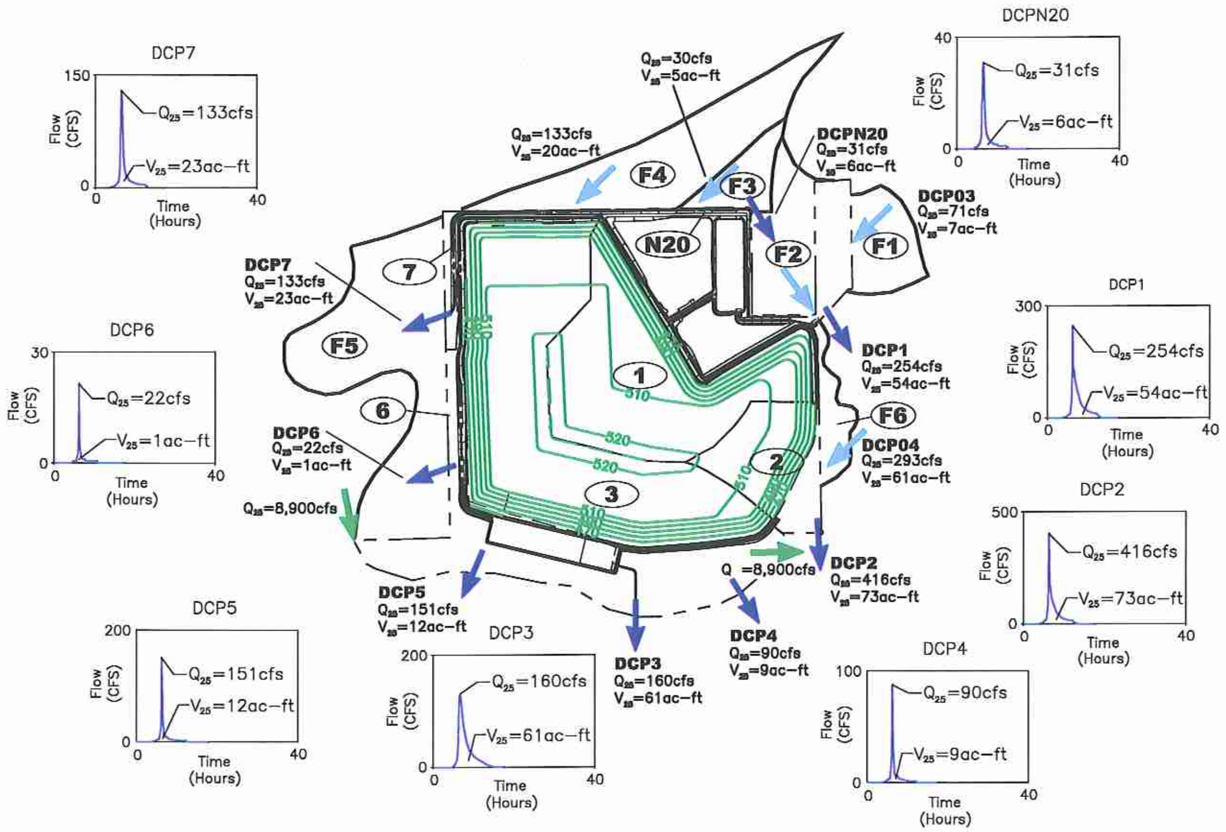
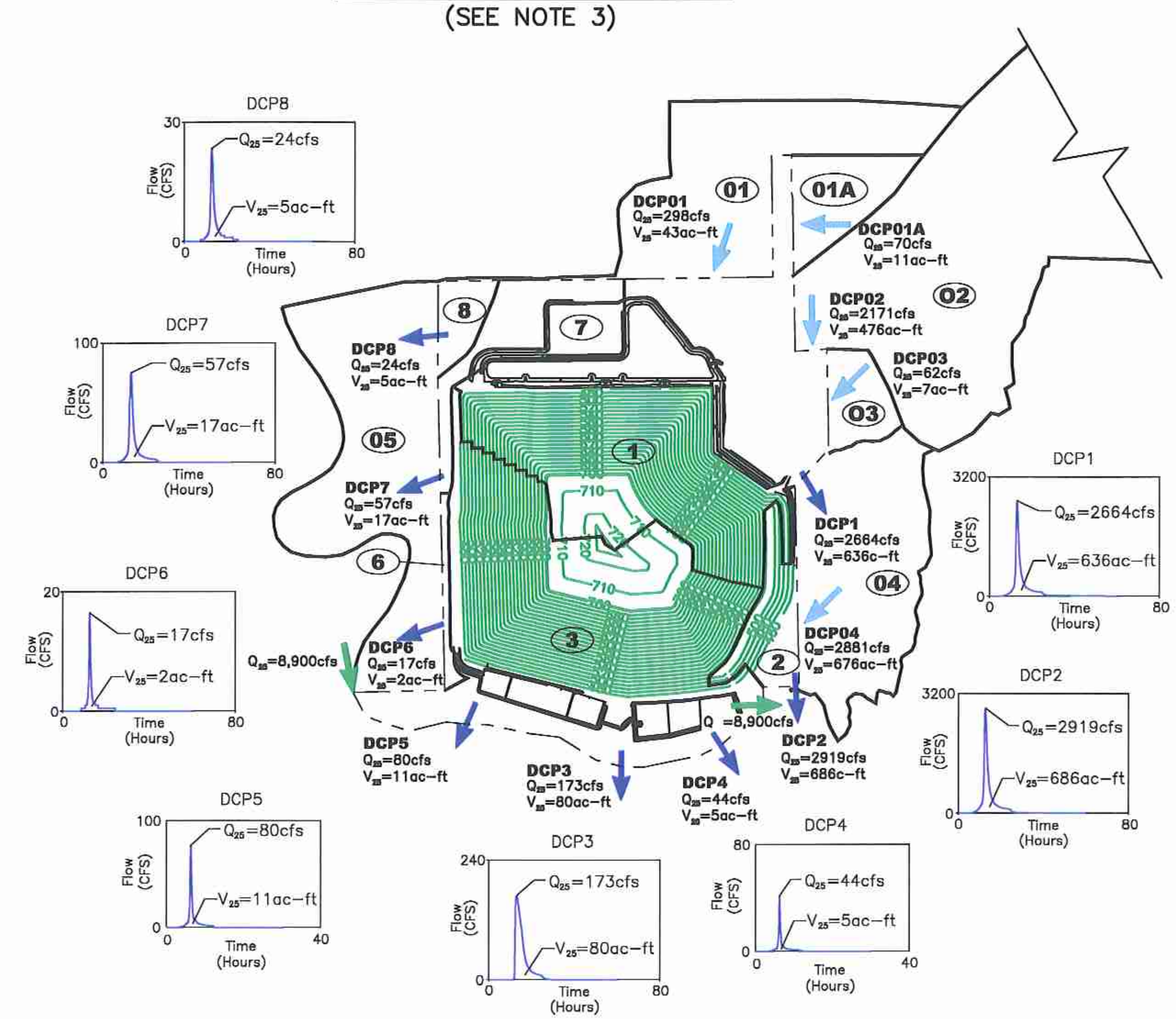
FIGURE 4.4

O:\1339\351\EXPANSION 2009\PART III–SDP\IIF\4.4–SITE DRAINAGE PATTERNS.dwg, jwilson, 1:2

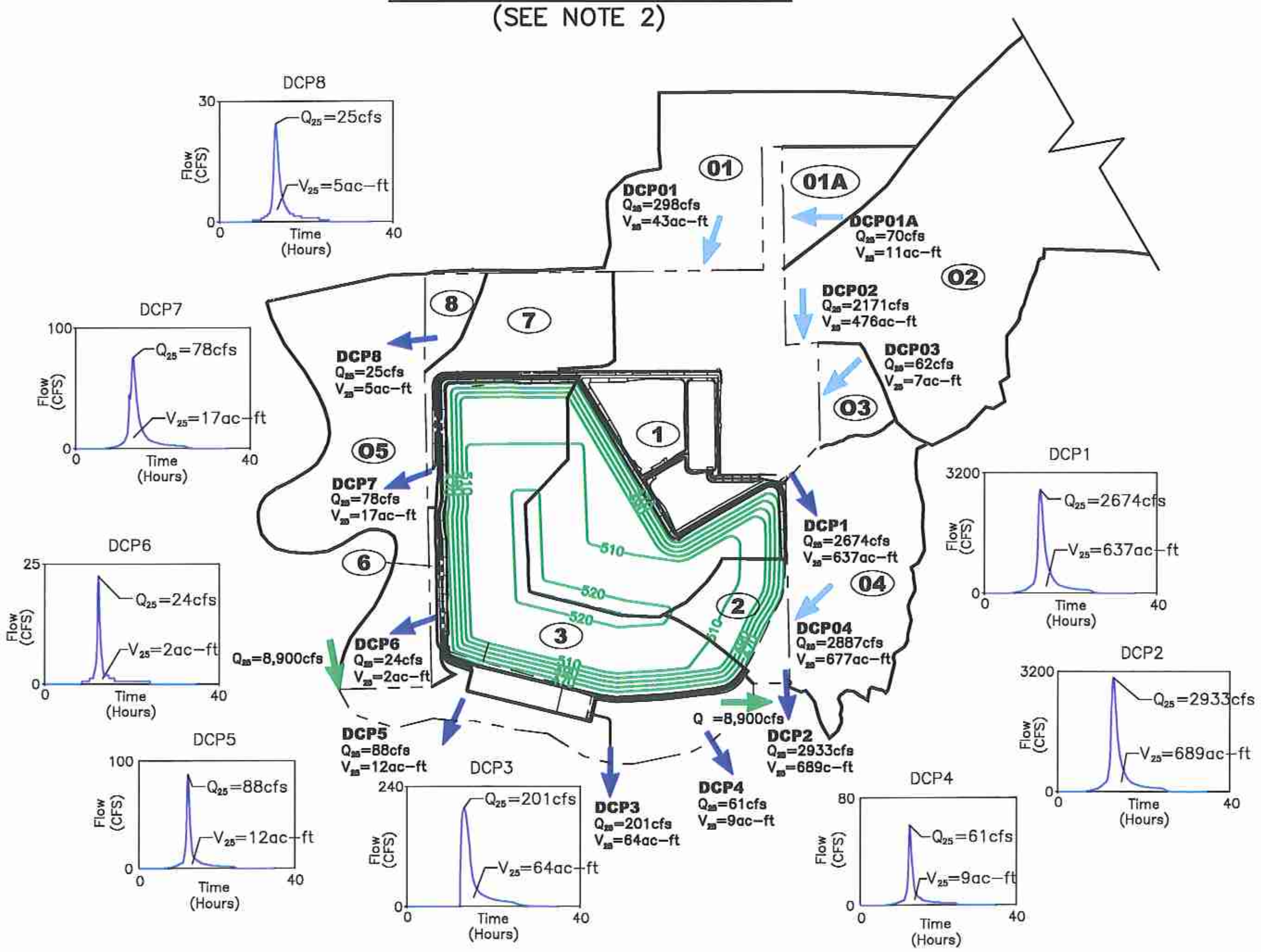
EXISTING PERMITTED CONDITION
(SEE NOTE 1)



POST-DEVELOPMENT CONDITION
(SEE NOTE 3)



UPDATED PERMITTED CONDITION
(SEE NOTE 2)



N

0 1000 2000
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- 520 PERMITTED / PROPOSED FINAL COVER CONTOUR
- (1) DRAINAGE AREA DESIGNATION
- UPLAND DRAINAGE ENTERING THE SITE
- STORMWATER DISCHARGE POINT
- DCP3 — Q_{25}=201cfs — 25-YEAR 24-HOUR STORM EVENT FLOW RATE
- V_{25}=64ac-ft — 25-YEAR 24-HOUR STORM EVENT VOLUME
- FLOW IN THE ELM FORK ENTERING/EXITING THE SITE (SEE NOTE 4)

NOTES:

1. PEAK FLOW RATES AND VOLUMES SHOWN ARE OBTAINED FROM ATTACHMENT 6B-2 AND THE HEC-1 MODEL INCLUDED IN THE SDP FOR TCEQ PERMIT NO. MSW-1312A.
2. HYDROLOGIC INFORMATION FOR THE 25-YEAR LANDFILL UPDATED PERMITTED CONDITION IS PROVIDED IN APPENDIX IIIF-E.
3. HYDROLOGIC INFORMATION FOR THE 25-YEAR LANDFILL POST-DEVELOPMENT CONDITION IS PROVIDED IN APPENDIX IIIF-A.
4. FLOW RATES WITHIN THE ELM FORK ARE REPRODUCED FROM THE CDC HYDRAULIC MODEL FOR ELM FORK TRINITY RIVER. REFER TO APPENDIX IIIO FOR MORE INFORMATION.

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CITY OF FARMERS BRANCH

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MAJOR PERMIT AMENDMENT
SITE DRAINAGE PATTERNS
RUNON/RUNOFF

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735-9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
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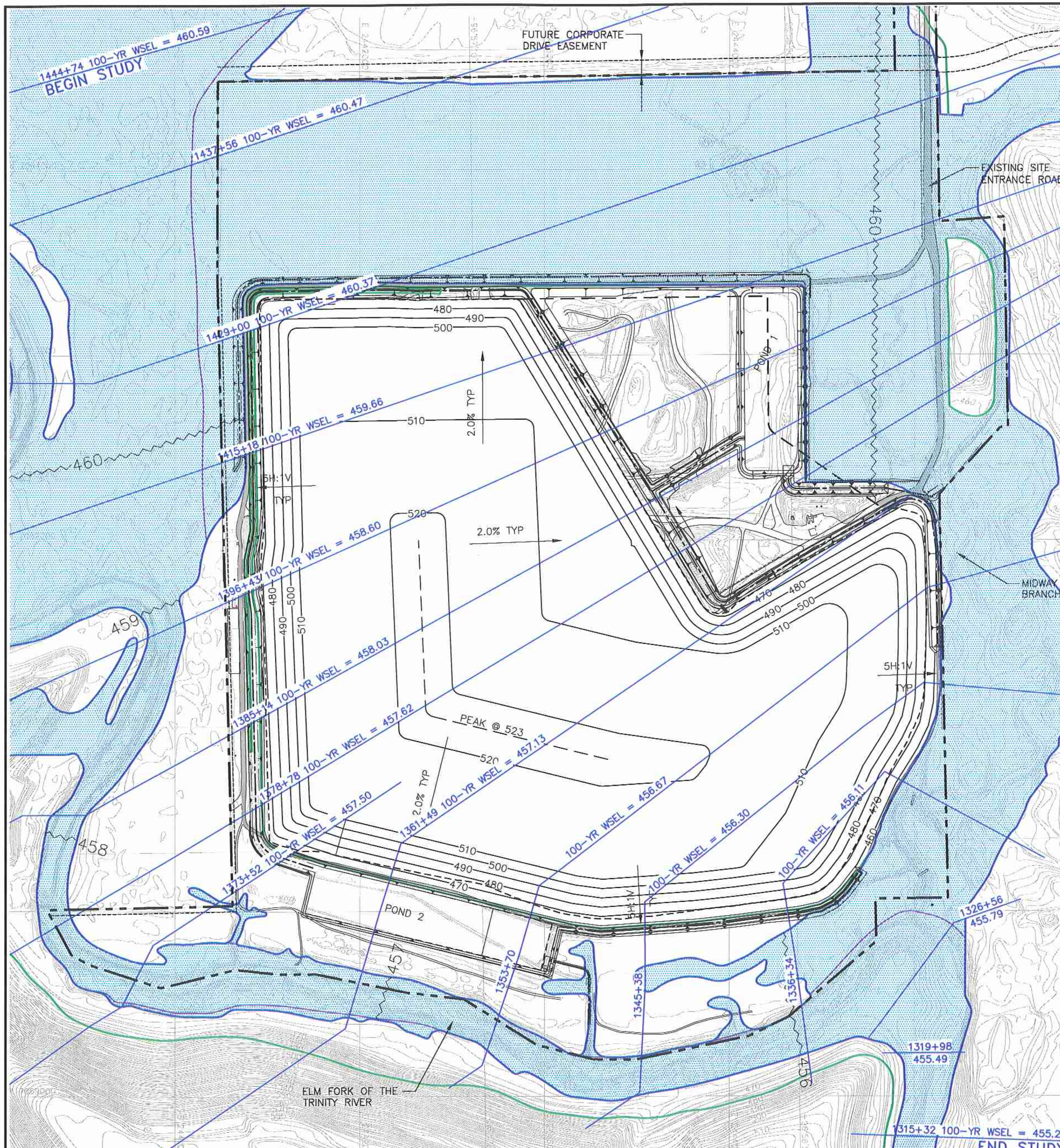
FIGURE 4.5

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\4.5-RUNON-RUNOFF.dwg, cellinger, 1:2



0 300 600

SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- AUTHORIZED LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°02'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOURS (SEE NOTE 1)
- 520 — EXISTING PERMITTED FINAL CONTOUR (SEE NOTE 3)
- 500-YEAR FLOODPLAIN (CLOMR CASE NO. 02-06-1950R)
- FLOODWAY BOUNDARY (CLOMR CASE NO. 02-06-1950R)
- 100-YEAR FLOODPLAIN (CLOMR CASE NO. 02-06-1950R)
- FILL/CUT SLOPE INDICATORS
- 1319+98 — FEMA/USACE CROSS SECTIONS

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988. OFF-SITE CONTOURS AND ELEVATIONS PROVIDED BY DFWMAPS.COM FROM AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN JANUARY TO MARCH 2007.
2. FLOODPLAIN BOUNDARIES REPRODUCED FROM WORK MAPS CREATED BY O'BRIEN ENGINEERING, INC. AND INCLUDED IN CLOMR CASE NO. 02-06-1950R, DEVELOPED FOR THE PROPOSED FINAL CONDITIONS IN TCEQ PERMIT NO. MSW-1312A..
3. PERMITTED CONDITIONS ARE TAKEN FROM THE PROPOSED FINAL CONDITIONS IN TCEQ PERMIT NO. MSW-1312A AND CLOMR CASE NO. 02-06-1950R.

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2-28-12

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CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
PERMITTED 100-YEAR FLOODPLAIN DELINEATION

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

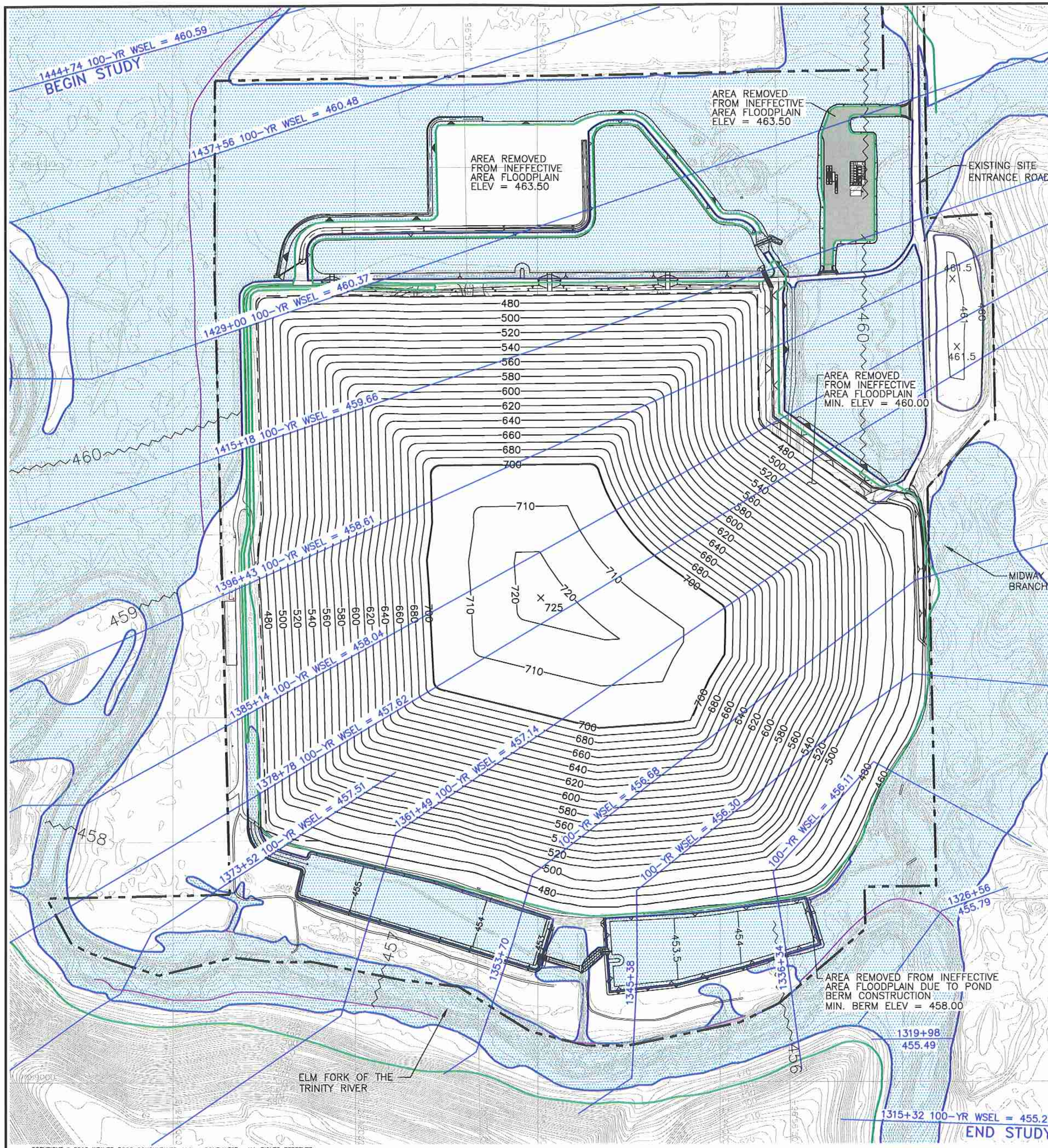
Weaver Boos Consultants

TBPE REGISTRATION NO. F-3727

CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO | FORT WORTH, TX (817) 735-9770 | GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

DRAWING 4.6

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\4.6-PERMITTED FLOODPLAIN.dwg, jwilson, 1:2



N

0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- STATE PLANE COORDINATE SYSTEM
- GEODETIC COORDINATE SYSTEM
- EXISTING CONTOURS (SEE NOTE 1)
- 520 PROPOSED FINAL CONTOUR
- 500-YEAR FLOODPLAIN (WBC JUNE, 2011)
- FLOODWAY BOUNDARY (WBC JUNE, 2011)
- 100-YEAR FLOODPLAIN (WBC JUNE, 2011)
- FILL/CUT SLOPE INDICATORS

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988. OFF-SITE CONTOURS AND ELEVATIONS PROVIDED BY DFWMAPS.COM FROM AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN JANUARY TO MARCH 2007.

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84059
LICENSED PROFESSIONAL ENGINEER
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FILE: 1339-351-11 DESIGN BY: CRM
CAD: 4.7-POST-DEV. FLOOD.DWG REVIEWED BY: JPY

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PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
POST-DEVELOPMENT
100-YEAR FLOODPLAIN
CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO
FORT WORTH, TX (817) 735-9770
GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

FIGURE 4.7

O:\1339\351\EXPANSION 2009\PART III-SDP\IIF\4.7-POST DEVELOPMENT CONDITIONS.dwg, jwilson, 1:2

Table 4-1
Flow Rates, Drainage Areas, Hydrograph Time to Peak Values, Runoff Volumes, and Velocities for the 25-Year Design Storm Event

	Existing Permitted Condition						Updated Permitted Condition					Post-Development Condition				
Stormwater Discharge Point[1]	Existing Permitted Location HEC-1 ID	Flow Rate (cfs)	Drainage Area (acres)	Time to Peak (hrs)	Runoff Volume (ac-ft)	Velocity at Permit Boundary (fps)	Flow Rate (cfs)	Drainage Area (acres)	Time to Peak (hrs)	Runoff Volume[1] (ac-ft)	Velocity at Permit Boundary[3] (fps)	Flow Rate (cfs)	Drainage Area (acres)	Time to Peak (hrs)	Runoff Volume[1] (ac-ft)	Velocity at Permit Boundary[3] (fps)
Flow onto the Site																
DCPO1	---	---	---	---	---	---	298	87	12.42	43	1.38	298	87	12.42	43	1.38
DCPO1A	---	---	---	---	---	---	70	23	12.58	11	3.27	70	23	12.58	11	3.27
DCPO2	---	---	---	---	---	---	2,171	1,008	12.75	476	8.08	2,171	1,008	12.75	476	8.08
DCPO3	APF1	71	16	12.25	7	---	62	16	12.33	7	4.38	62	16	12.33	7	4.38
DCPO4[4]	C4MWY	293	198	12.25	61	---	2,887	1,433	12.75	677	8.29	2,881	1,425	12.67	676	8.28
Discharge from the Site																
DCP1 (Southeast-Midway)[5]	MWY@RD	254	181	12.17	54	---	2,674	1,347	12.75	637	7.64	2,664	1,339	12.75	636	7.63
DCP2 (South-Midway)[6]	CABELM	416	225	12.25	74	---	2,933	1,460	12.75	689	12.64	2,919	1,446	12.67	686	12.63
DCP3 (South-Elm Fork)[7]	PD2OUT	160	134	13.17	61	---	201	133	13.00	64	11.00	173	160	12.75	80	10.60
DCP4 (Southeast-Elm Fork)[8]	AN15	90	21	12.25	9	---	61	20	12.50	9	2.89	44	11	12.33	5	2.67
DCP5 (Southwest-Elm Fork)[9]	APN14	151	29	12.17	12	---	88	26	12.42	12	10.64	80	23	12.42	11	10.39
DCP6 (Southwest-O5)[10]	APN17	22	3	12.08	1	---	24	4	12.17	2	3.76	17	5	12.42	2	3.44
DCP7 (West-O5)[11]	C2D1	133	54	12.67	23	---	78	37	13.00	17	1.91	57	37	13.33	17	1.72
DCP8 (Northwest)[12]	---	---	---	---	---	---	25	10	12.75	5	0.70	24	10	12.83	5	0.69

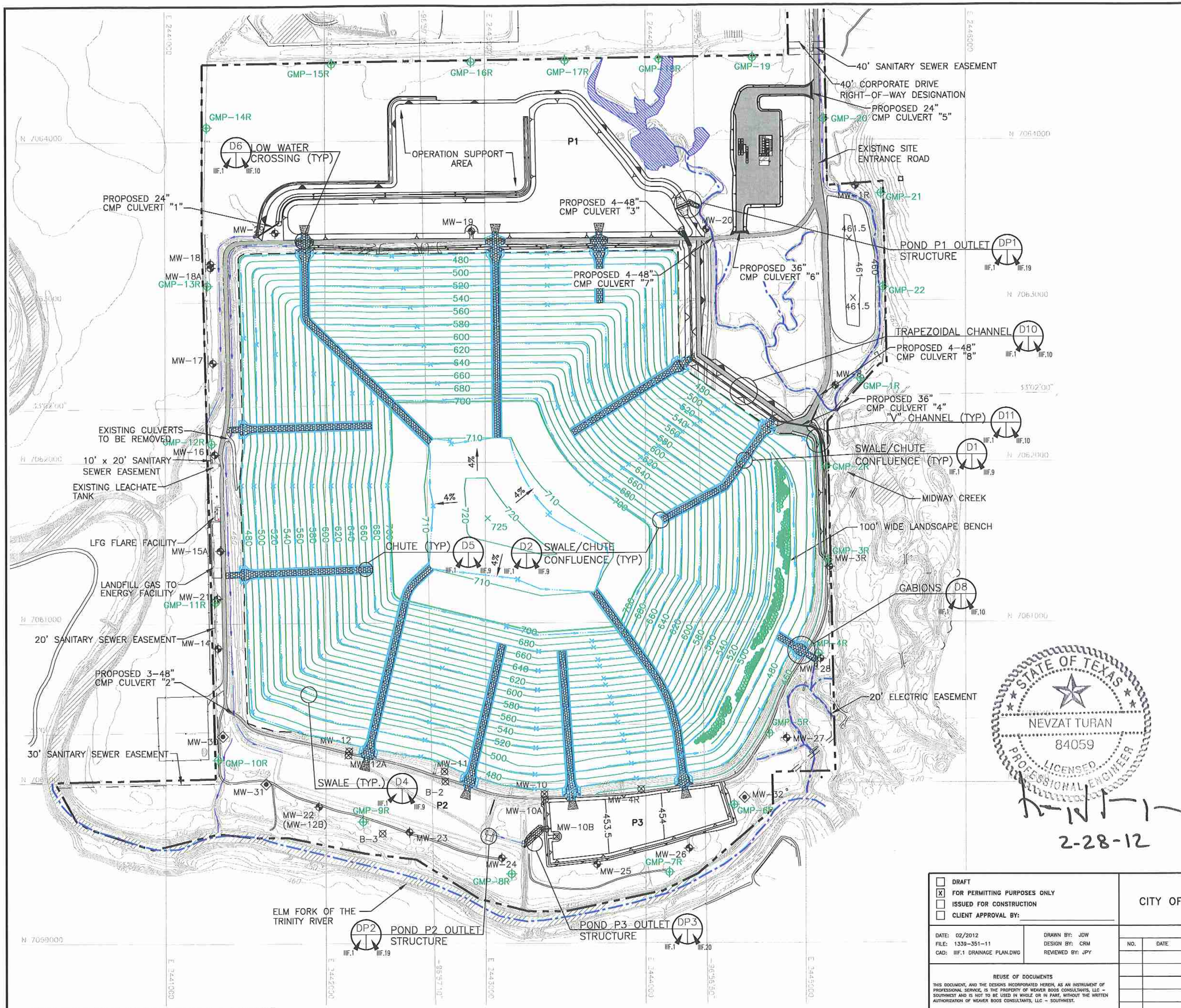
[1] Stormwater discharge points are shown on Figure 4.4. The volume shown is the total volume of runoff for the hydrograph duration.
[2] Existing permitted location HEC-1 ID is included for certain areas, as some locations were not included in the previously developed drainage analysis. Only available information is shown for the existing permitted conditions (e.g., if velocities are not already estimated in the currently approved documents, they are not listed).
[3] Runoff volume and velocity calculations are provided in Appendix IIIF-A and IIIF-E.
[4] Discharge Point DCPO4 includes all of Discharge Point DCP1 and offsite Drainage Area O4.
[5] Discharge Point DCP1 includes several drainage areas within the permit boundary and DCPO1, DCPO2, and DCPO3 for the post-development and updated permitted cases. For the existing permitted case, DCP1 includes onsite drainage areas and DCPO3.
[6] Discharge point DCP2 includes all of discharge point DCPO4 and DCP1 and onsite drainage areas.
[7] Discharge Point DCP3 contains only onsite drainage areas.
[8] Discharge Point DCP4 contains only onsite Drainage Area N15 for the existing and updated permitted conditions and only S10 for the post-development condition.
[9] Discharge Point DCP5 contains only onsite Drainage Area N14 for the existing and updated permitted conditions and only S9 for the post-development condition.
[10] Discharge Point DCP6 contains only onsite Drainage Area N17 for the existing and updated permitted conditions and only S3 for the post-development condition.
[11] Discharge Point DCP7 contains onsite Drainage Areas F4, N18, and N19 for the existing permit condition, onsite Drainage Areas S2, N18, and N19 for the updated permitted condition, and onsite Drainage Areas S2 and CH1 for the post-development condition.
[12] Discharge Point DCP8 contains only onsite Drainage Area S1.

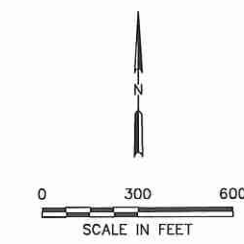
Table 4-2
100-Year Floodplain Elevation Comparison

Section No[1]	CDC APPLICATION			CLOMR REQUEST		
	100-Year Peak Flow Rate (cfs)	100-Year Water Surface Elevations (ft-msl)		100-Year Peak Flow Rate (cfs)	100-Year Water Surface Elevations (ft-msl)	
		Existing Permitted	Proposed Expansion		Existing Permitted	Proposed Expansion
1315+32	10300	455.22	455.22	10300	455.10	455.10
1319+98	10300	455.49	455.49	10300	455.35	455.35
1326+56	10300	455.79	455.79	10300	455.67	455.67
1336+34	10300	456.11	456.11	10300	455.99	455.99
1345+38	10300	456.30	456.30	10300	456.22	456.22
1353+70	10300	456.68	456.67	10300	456.61	456.60
1361+49	10300	457.14	457.13	10300	457.07	457.07
1373+52	10300	457.51	457.50	10300	457.44	457.44
1378+78	10300	457.62	457.62	10300	457.56	457.55
1385+14	10300	458.04	458.03	10300	458.17	458.17
1396+43	21000	458.61	458.60	21000	458.78	458.78
1415+18	21000	459.66	459.66	21000	459.76	459.76
1429+00	21000	460.37	460.37	21000	460.35	460.34
1437+56	21000	460.48	460.47	21000	460.44	460.44
1444+74	21000	460.59	460.59	21000	460.57	460.57

[1] Section locations are shown on Figure 4.6 and Appendix IIIO.

DRAWINGS





LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°03'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- 600 — FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- EASEMENT BOUNDARY
- MW-8 — GROUNDWATER MONITORING WELL
- MW-30 — PROPOSED GROUNDWATER MONITORING WELL
- GMP-20 — PROPOSED LANDFILL GAS MONITORING PROBE
- MW-12 — OBSERVATION WELL
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 4)
- USACE JURISDICTIONAL WETLANDS

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.
3. MAXIMUM FINAL COVER ELEVATION IS 725 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 721.5 FT-MSL.
4. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.
5. FINAL COVER DETAILS ARE PROVIDED IN APPENDIX IIIA-A LINER, OVERLINER, AND FINAL COVER SYSTEM DETAILS.

STATE OF TEXAS
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84059
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2-28-12

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DRAWN BY: JDW
DESIGN BY: CRM
REVIEWED BY: JPY

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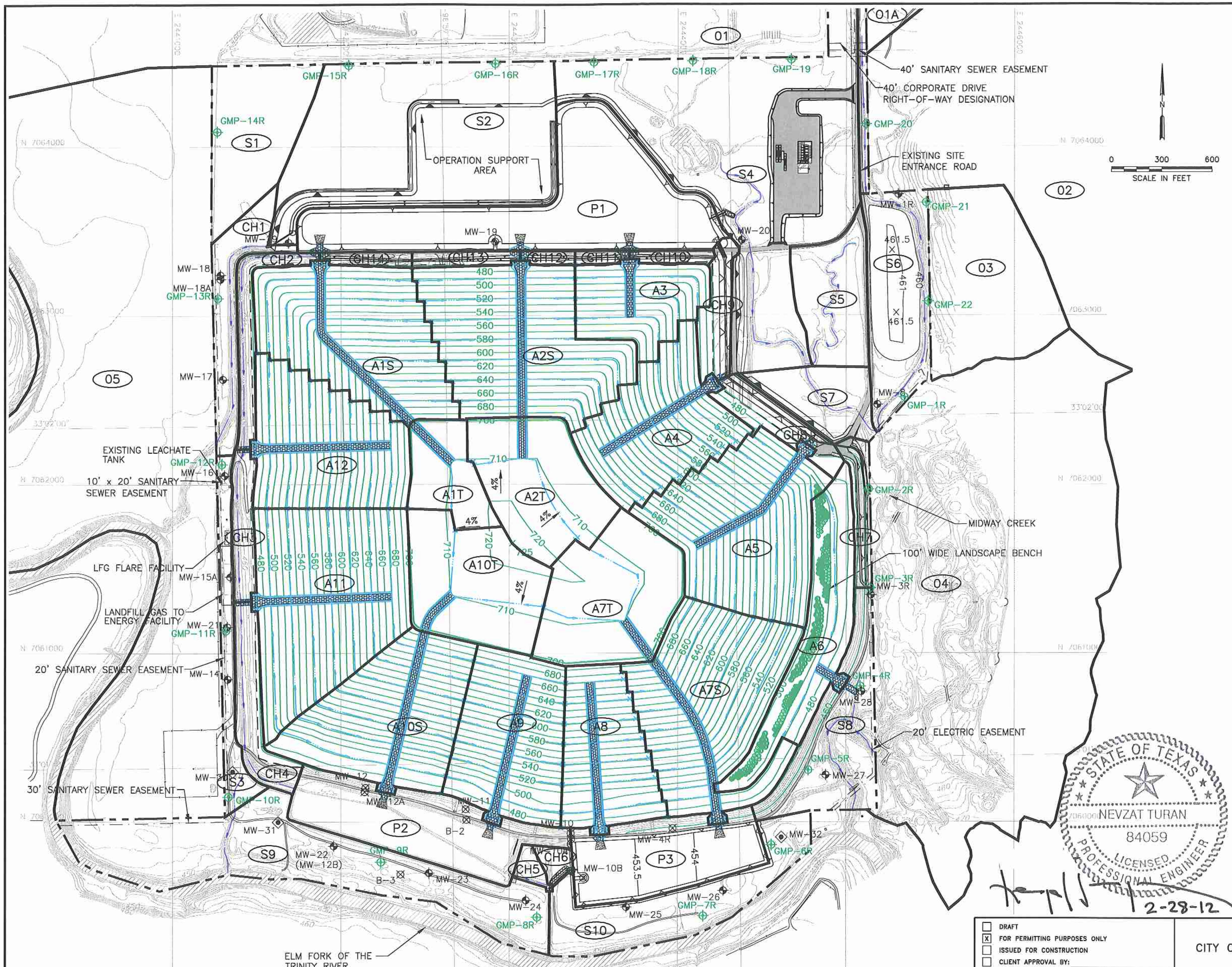
MAJOR PERMIT AMENDMENT
DRAINAGE STRUCTURE PLAN
CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL; NAPERVILLE, IL; COLUMBUS, OH; DENVER, CO; FORT WORTH, TX (817) 735-9770; GRIFFITH, IN; SOUTH BEND, IN; SPRINGFIELD, IL; ST. LOUIS, MO

DRAWING IIIF.1

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF.1-DRAINAGE PLAN.dwg, jwilson, 1:2



LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°02'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- 600 — REGRADED BUFFER ZONE AREA
- 600 — FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- EASEMENT BOUNDARY
- MW-8 — EXISTING GROUNDWATER MONITORING WELL
- MW-30 — PROPOSED GROUNDWATER MONITORING WELL
- GMP-20 — PROPOSED LANDFILL GAS MONITORING PROBE
- MW-12 — OBSERVATION WELL
- DRAINAGE AREA BOUNDARY
- A7T — DRAINAGE AREA DESIGNATION

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.
3. MAXIMUM FINAL COVER ELEVATION IS 725 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 721.5 FT-MSL.
4. REFER TO DRAWING IIIF.3 FOR COMPLETE OFFSITE DRAINAGE AREA DELINEATIONS.

DRAINAGE AREA NO.	AREA (ACRES)	DRAINAGE AREA NO.	AREA (ACRES)
S1	10.26	A10T	12.37
S2	30.86	A10S	16.60
S3	4.55	A11	22.08
S4	43.34	A12	15.17
S5	7.34	CH1	5.94
S6	13.92	CH2	3.29
S7	5.39	CH3	2.71
S8	10.12	CH4	4.45
S9	22.75	CH5	0.76
S10	10.76	CH6	0.83
A1T	5.47	CH7	2.33
A1S	18.48	CH8	3.37
A2T	11.83	CH9	3.09
A2S	20.59	CH10	0.85
A3	8.07	CH11	0.56
A4	13.51	CH12	0.59
A5	19.01	CH13	1.29
A6	11.00	CH14	1.02
A7T	13.58	P1	23.10
A7S	20.36	P2	12.55
A8	10.75	P3	10.74
A9	13.99		

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MAJOR PERMIT AMENDMENT POST DEVELOPMENT DRAINAGE

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727
CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO FORT WORTH, TX (817) 735-9770 GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

DRAWING IIIF.2

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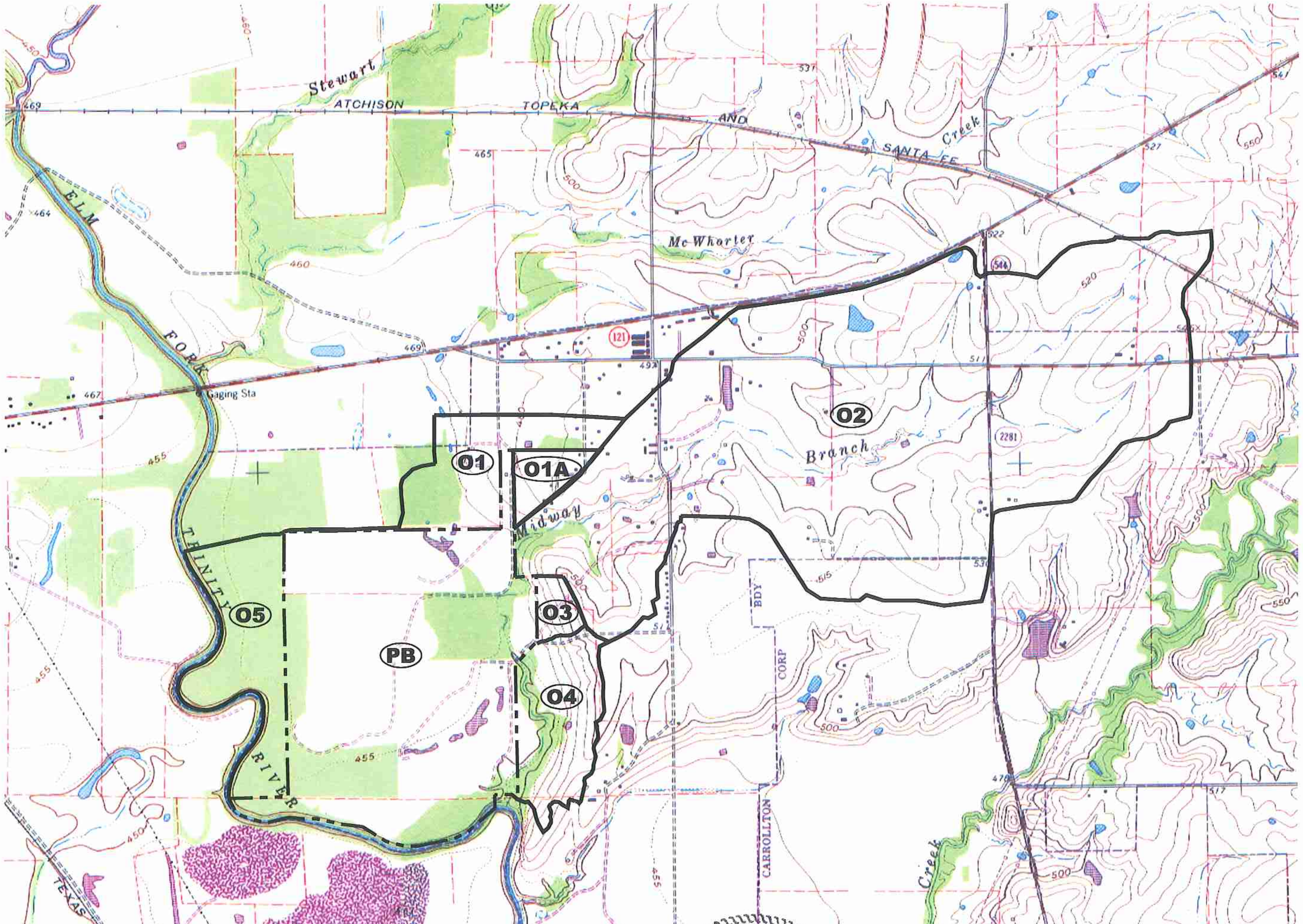

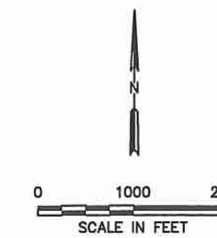

LEGEND

- PERMIT BOUNDARY
- DRAINAGE AREA BOUNDARY
- (02) DRAINAGE AREA LABEL

DRAINAGE AREA NO.	AREA (ACRES)
01	87.5
01A	23.4
02	1,008.4
03	16.2
04	86.0
05	116.5
PB	462.6
TOTAL	1,807.6

ROAD CLASSIFICATION

Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
Interstate Route — U.S. Route — State Route

LEWISVILLE EAST, TEX.
SW/4 FRISCO 15' QUADRANGLE
N3300—W9652.5/7.5
1960
PHOTOREVISED 1968
AMS 6650 III SW—SERIES V882

NOTES:

1. REFER TO DRAWING IIIF.2 DRAINAGE AREA DELINEATION WITHIN THE PERMIT BOUNDARY.
2. TOPOGRAPHY IS REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (LEWISVILLE EAST, TX, PHOTO REVISED 1981).

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DRAWN BY: JDW
DESIGN BY: CRM
REVIEWED BY: JPY

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MAJOR PERMIT AMENDMENT OFFSITE DRAINAGE AREA MAP

CAMELOT LANDFILL
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COLUMBUS, OH
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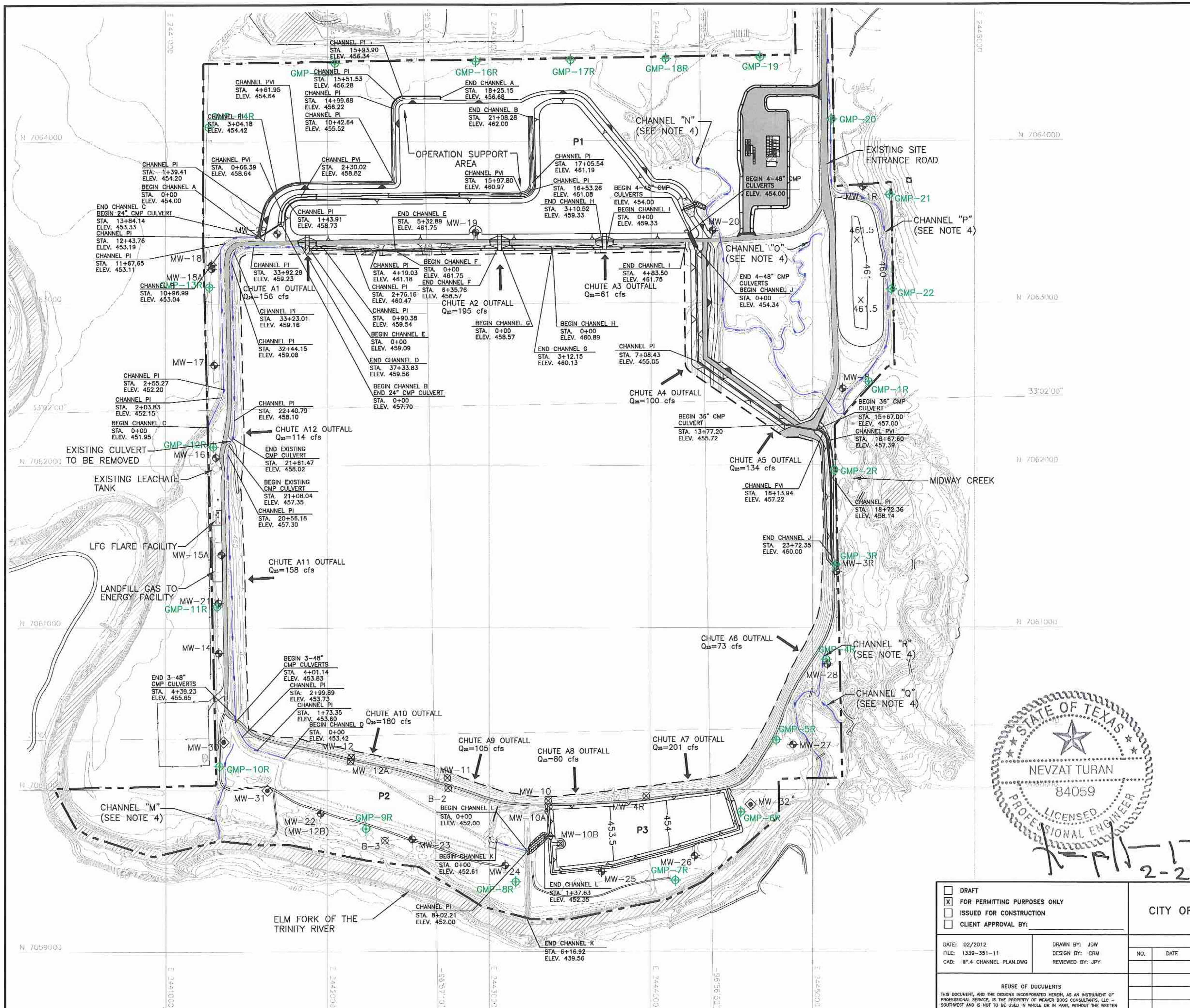
(817) 735-9770
GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWING IIIF.3



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°02'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- STA. — STATION (FT)
- ELEV. — ELEVATION (FT-MSL)
- Q25=60 cfs — 25-YEAR PEAK FLOW RATE (CUBIC FEET/SECOND)
- MW-8 — EXISTING GROUNDWATER MONITORING WELL
- MW-30 — PROPOSED GROUNDWATER MONITORING WELL
- GMP-20 — PROPOSED LANDFILL GAS MONITORING PROBE
- MW-12 — OBSERVATION WELL
- PROPOSED CHANNEL CENTERLINE
- EXISTING CHANNEL CENTERLINE
- GABIONS
- 600 — REGRADED BUFFER ZONE AREA

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PROPOSED PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.
3. CHANNEL PROFILE INFORMATION BASED ON THE STATIONS SHOWN IS PROVIDED ON DRAWINGS IIIF.5 THROUGH IIIF.8.
4. ANALYSIS OF CHANNELS K,M,N,O,P,Q, AND R IS INCLUDED IN APPENDIX IIIF.B.

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MAJOR PERMIT AMENDMENT PERIMETER DRAINAGE PLAN

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

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DRAWING IIIF.4

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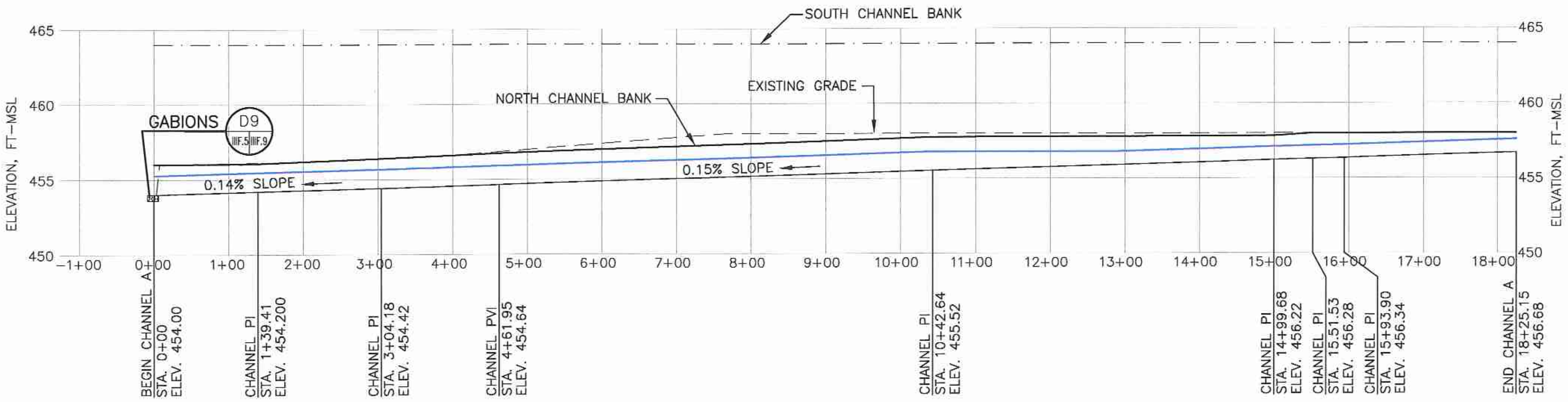


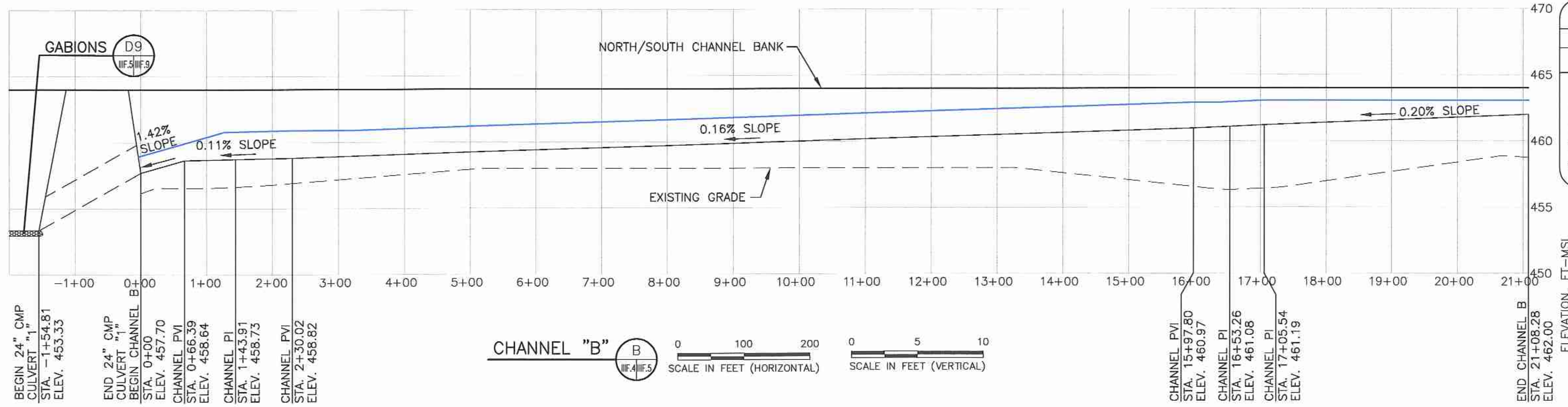
CHANNEL "A" (A, IIF.4 IIF.5)

SCALE IN FEET (HORIZONTAL) 0 100 200 — SCALE IN FEET (VERTICAL) 0 5 10

25–YEAR CHANNEL "A" INFORMATION

CHANNEL STATION FROM	TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	4+61.95	10	31	0.14	1.25	1.80
4+61.95	10+42.64	10	31	0.15	1.23	1.85
10+42.64	18+25.15	20	31	0.15	0.86	1.60

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.



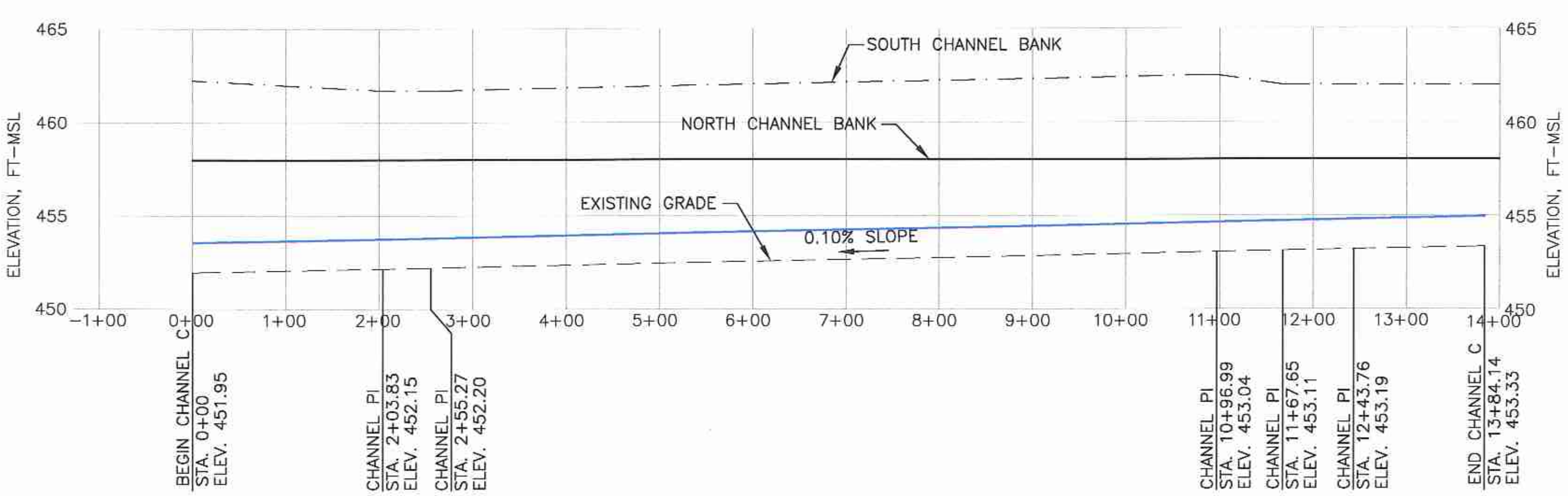
CHANNEL "B" (B, IIF.4 IIF.5)

SCALE IN FEET (HORIZONTAL) 0 100 200 — SCALE IN FEET (VERTICAL) 0 5 10

25–YEAR CHANNEL "B" INFORMATION

CHANNEL STATION FROM	TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	0+66.39	0	21	1.42	1.28	4.24
0+66.39	2+30.02	0	21	0.11	2.07	1.63
2+30.02	15+97.80	0	21	0.16	1.93	1.87
15+97.80	17+05.54	0	21	0.20	1.85	2.04
17+05.54	21+08.28	15	21	0.20	0.74	1.66

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.



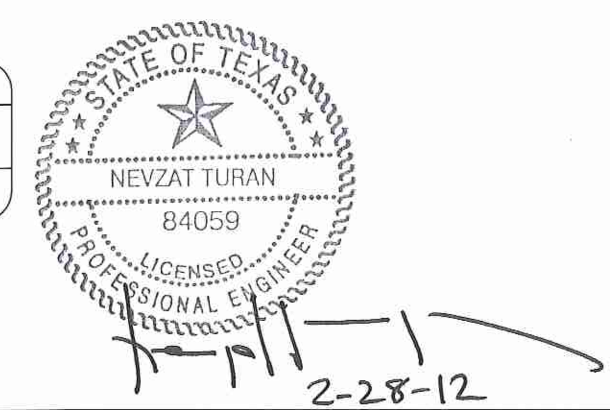
CHANNEL "C" (C, IIF.4 IIF.5)

SCALE IN FEET (HORIZONTAL) 0 100 200 — SCALE IN FEET (VERTICAL) 0 5 10

25–YEAR CHANNEL "C" INFORMATION

CHANNEL STATION FROM	TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	13+84.14	15	57	0.10	1.59	1.82

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.



NOTES:

1. REFER TO DRAWING IIIF.4 FOR PROFILE LOCATIONS.
2. EXISTING GROUND CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8–28–2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
3. HYDRAULIC CALCULATIONS INCLUDED IN APPENDIX IIIF–B.
4. GABIONS SHALL BE USED FOR VELOCITIES OF 13 FT/SEC OR HIGHER.
5. CULVERT CALCULATIONS INCLUDED IN APPENDIX IIIF–B.

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CAD: IIIF.5 CHANNEL PLAN.DWG — REVIEWED BY: JPY

PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
PERIMETER CHANNEL PROFILE

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F–3727

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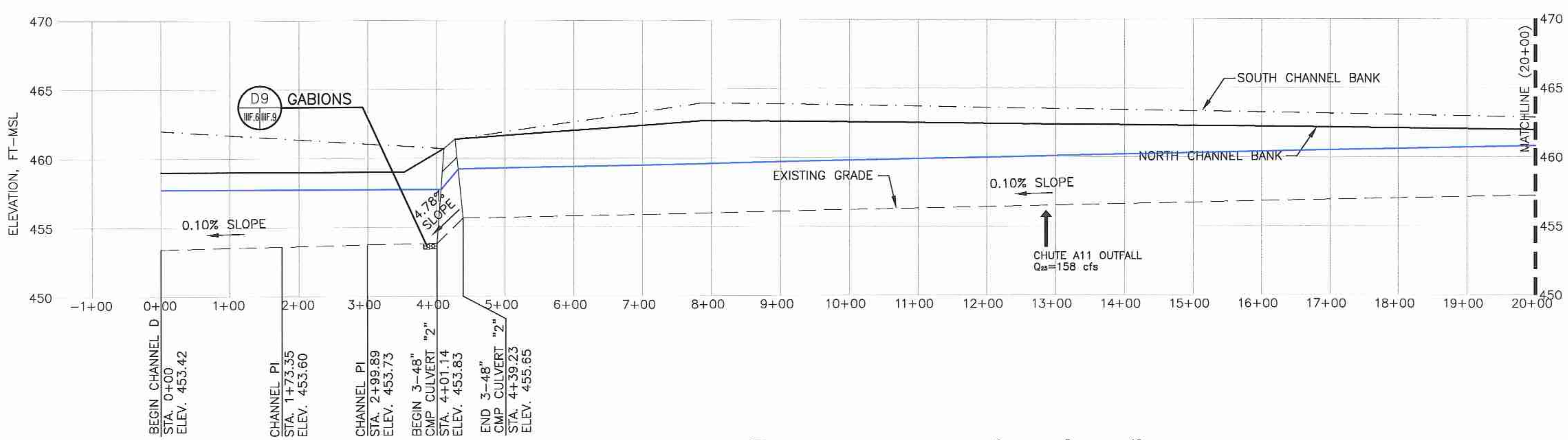
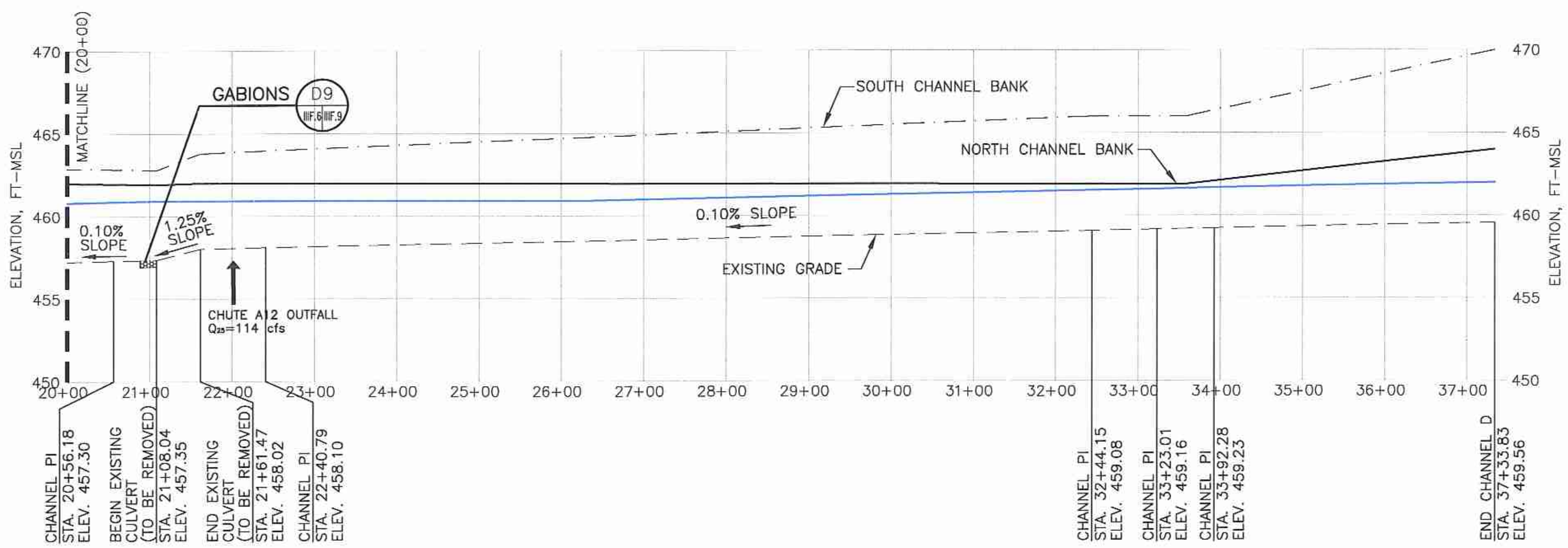
DRAWING IIIF.5



CHANNEL "D" (D IIIF.4 IIIF.6)

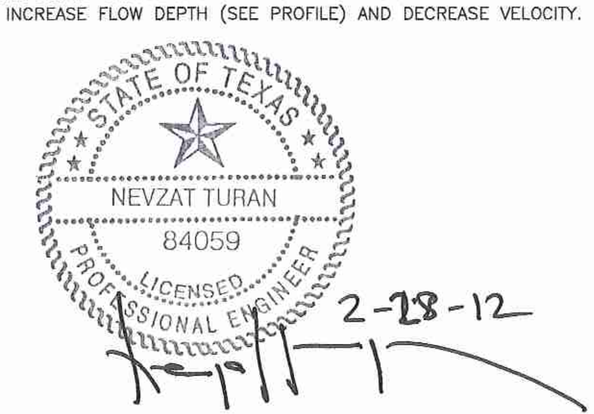


CHANNEL "D" (D IIIF.4 IIIF.6)

25–YEAR CHANNEL "D" INFORMATION

CHANNEL STATION FROM	TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	4+01.14	15	261	0.10	3.57	2.84
4+01.14	4+39.23	42" CMP CULVERT "2"				
4+39.23	21+08.04	15	261	0.10	3.57	2.84
21+08.04	21+61.47	15	126	1.25	1.22	5.54
21+61.47	37+33.83	15	126	0.10	2.44	2.31

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.



NOTES:

1. REFER TO DRAWING IIIF.4 FOR PROFILE LOCATIONS.
2. EXISTING GROUND CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8–28–2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
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4. GABIONS SHALL BE USED FOR VELOCITIES OF 13 FT/SEC OR HIGHER.
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CAD: IIIF.5 CHANNEL PLAN.DWG REVIEWED BY: JPY

REUSE OF DOCUMENTS

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CITY OF FARMERS BRANCH

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MAJOR PERMIT AMENDMENT
PERIMETER CHANNEL PROFILE

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
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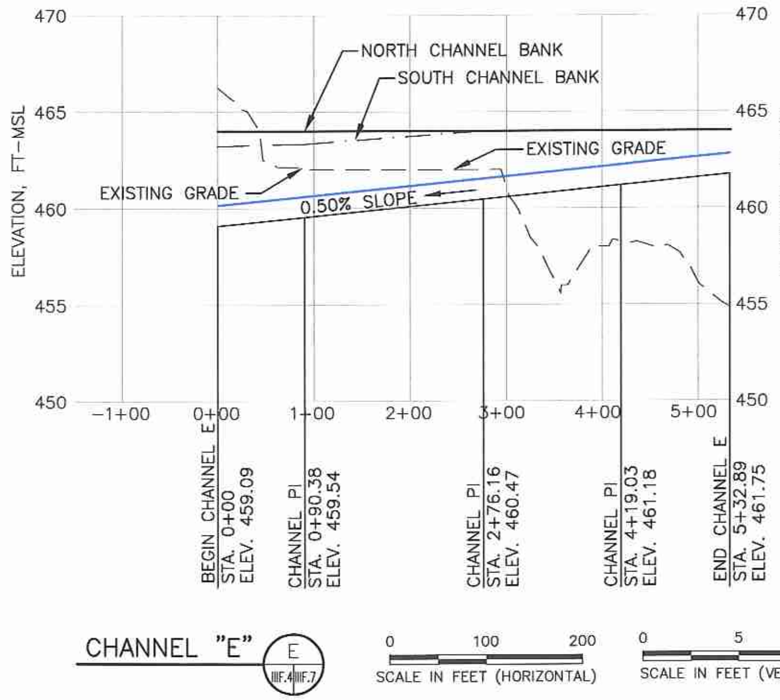
DRAWING IIIF.6

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF.5-8-PROFILES.dwg, jwilson, 1:2



25-YEAR CHANNEL "E" INFORMATION

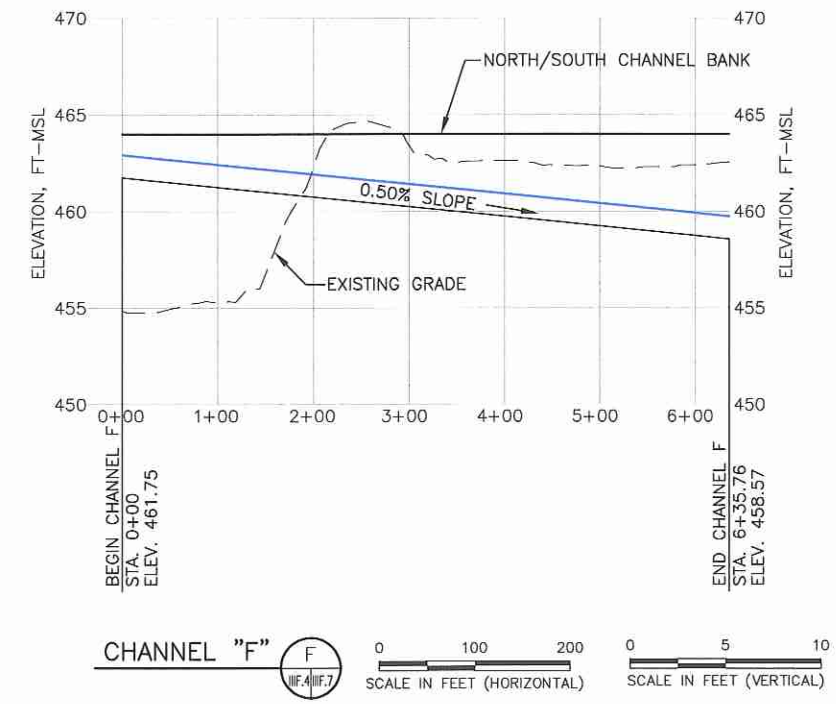
CHANNEL STATION FROM	CHANNEL STATION TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	5+32.89	0	7	0.50	1.04	2.18

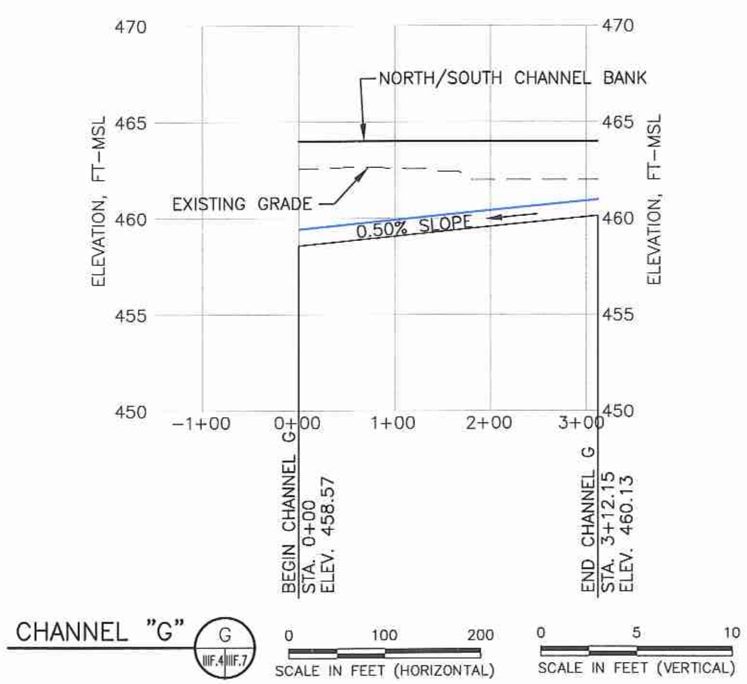
NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.

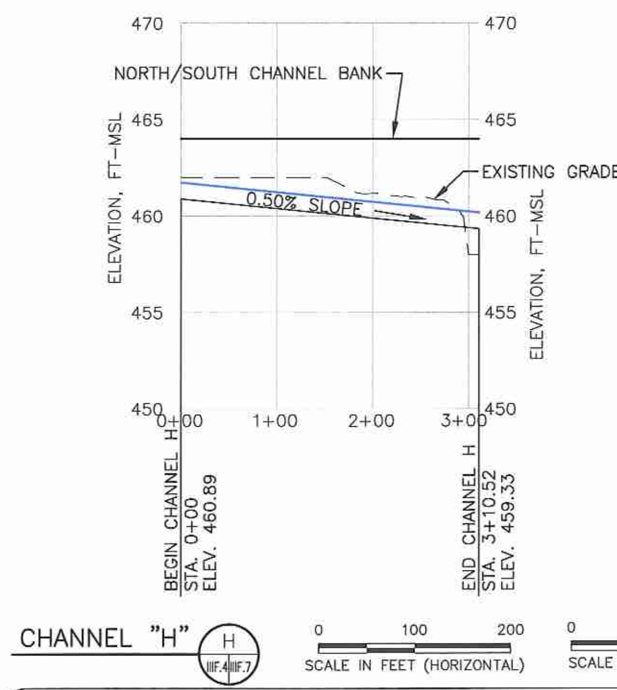
25-YEAR CHANNEL "F" INFORMATION

CHANNEL STATION FROM	CHANNEL STATION TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	6+35.76	0	9	0.50	1.14	2.32

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.







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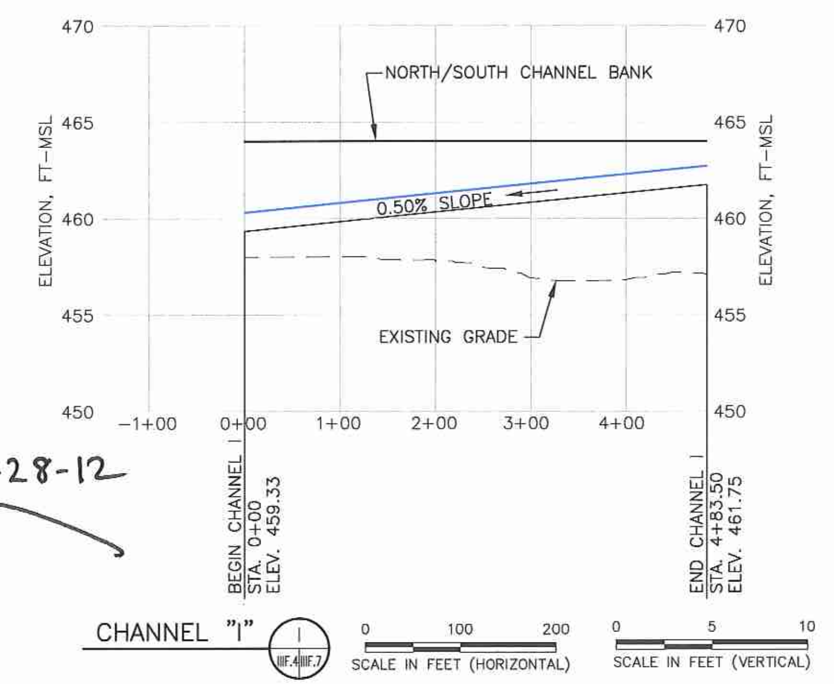

25-YEAR CHANNEL "G" INFORMATION

CHANNEL STATION FROM	CHANNEL STATION TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	3+12.15	0	4	0.50	0.84	1.89

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.

25-YEAR CHANNEL "H" INFORMATION

CHANNEL STATION FROM	CHANNEL STATION TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	3+10.52	0	4	0.50	0.84	1.89

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.

25-YEAR CHANNEL "I" INFORMATION

CHANNEL STATION FROM	CHANNEL STATION TO	BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
0+00	4+83.50	0	6	0.50	0.98	2.10

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.

NOTES:

1. REFER TO DRAWING IIIF.4 FOR PROFILE LOCATIONS.
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CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT PERIMETER CHANNEL PROFILE

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727
CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO | FORT WORTH, TX (817) 735-9770 | GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

DRAWING IIIF.7

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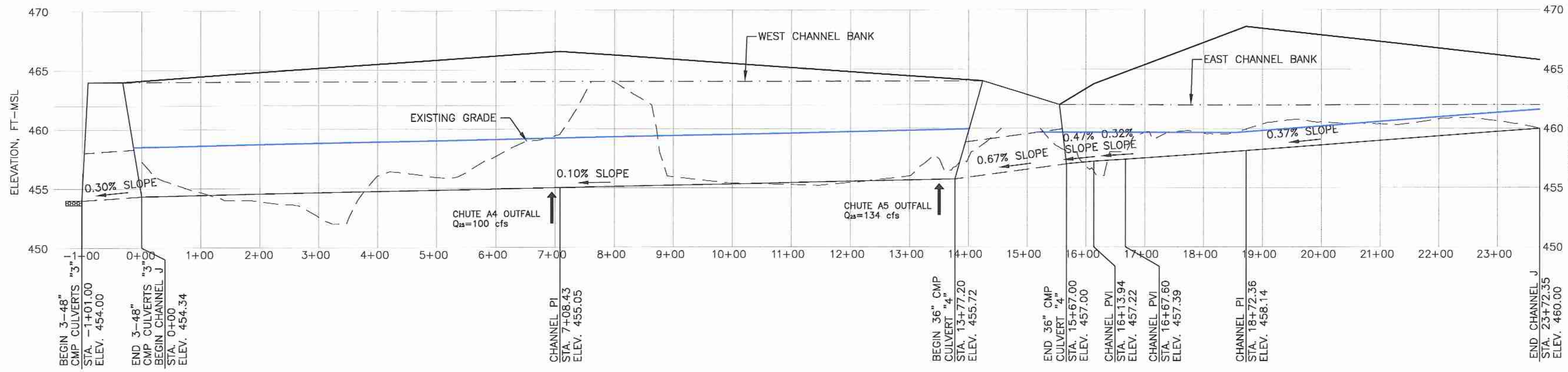
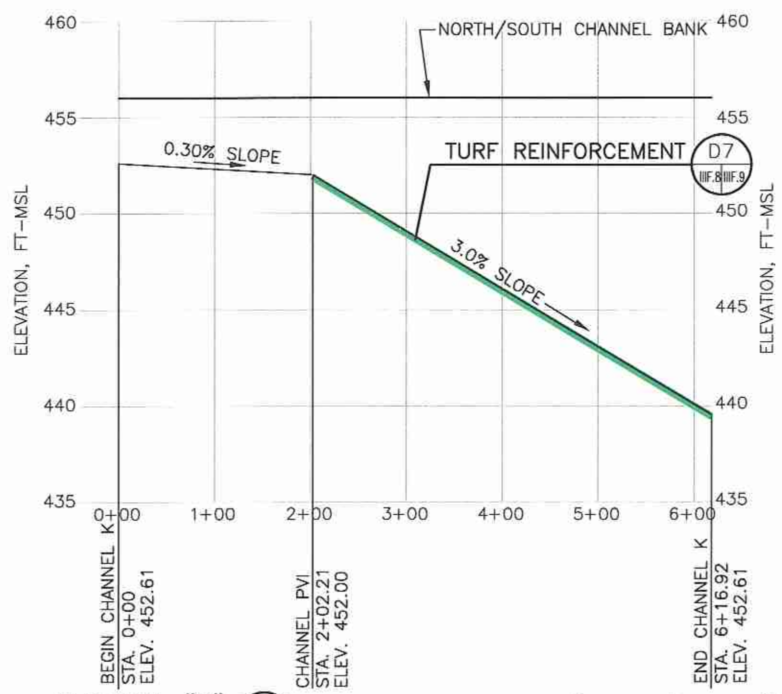


CHANNEL "J" (J, IIIF.4 IIIF.8)

SCALE IN FEET (HORIZONTAL) 0 100 200 — SCALE IN FEET (VERTICAL) 0 5 10

25-YEAR CHANNEL "J" INFORMATION						
CHANNEL STATION		BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
FROM	TO					
0+00	13+77.20	10	275	0.10	4.16	2.94
13+77.20	15+67.00	36" CMP CULVERT "4"				
15+67.00	16+13.94	0	17	0.47	1.46	2.66
16+13.94	16+67.60	0	17	0.32	1.57	2.30
16+67.60	23+72.35	0	17	0.37	1.53	2.43

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.

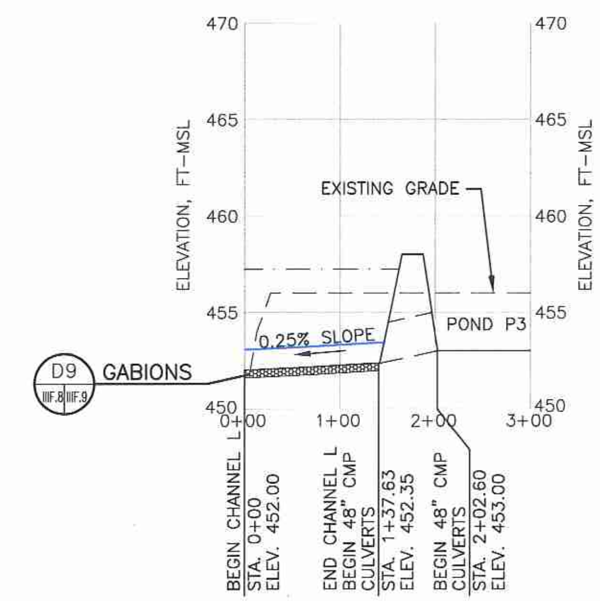


CHANNEL "K" (K, IIIF.4 IIIF.8)

SCALE IN FEET (HORIZONTAL) 0 100 200 — SCALE IN FEET (VERTICAL) 0 5 10

25-YEAR CHANNEL "K" INFORMATION						
CHANNEL STATION		BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
FROM	TO					
0+00	2+02.21	15	118	0.30	1.75	3.33
2+02.21	6+16.92	0	173	3.00	2.46	9.51

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.



CHANNEL "L" (L, IIIF.4 IIIF.8)

SCALE IN FEET (HORIZONTAL) 0 100 200 — SCALE IN FEET (VERTICAL) 0 5 10

25-YEAR CHANNEL "L" INFORMATION						
CHANNEL STATION		BOTTOM WIDTH (FT)	PEAK INFLOW (CFS)	SLOPE (%)	FLOW DEPTH (FT.)	VELOCITY (FT/S)
FROM	TO					
0+00	1+37.63	25	53	0.25	1.06	1.78

NOTE: NORMAL DEPTH CALCULATION DOES NOT ACCOUNT FOR BACK WATER WHICH WILL INCREASE FLOW DEPTH (SEE PROFILE) AND DECREASE VELOCITY.

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CAMELOT LANDFILL
DENTON COUNTY, TEXAS

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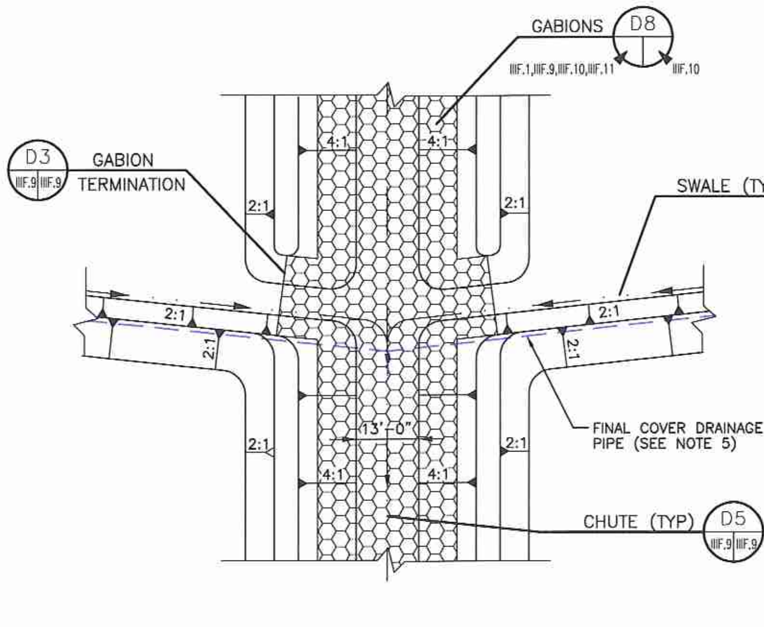
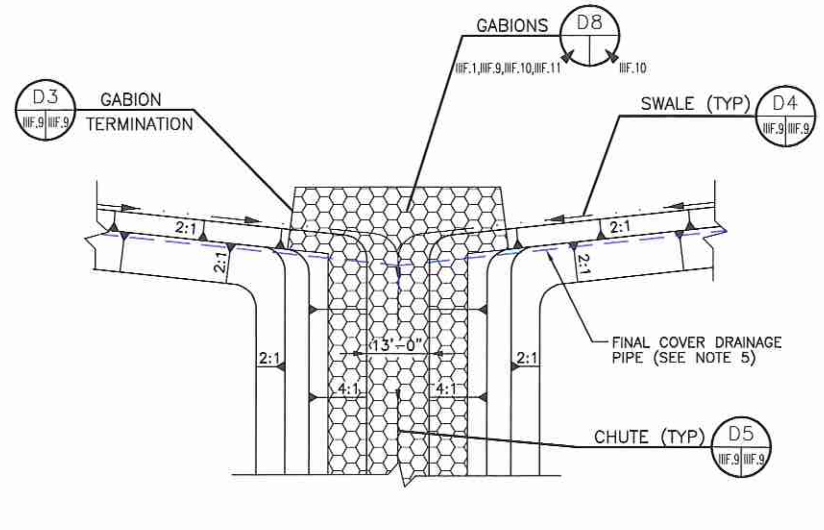
DRAWING IIIF.8



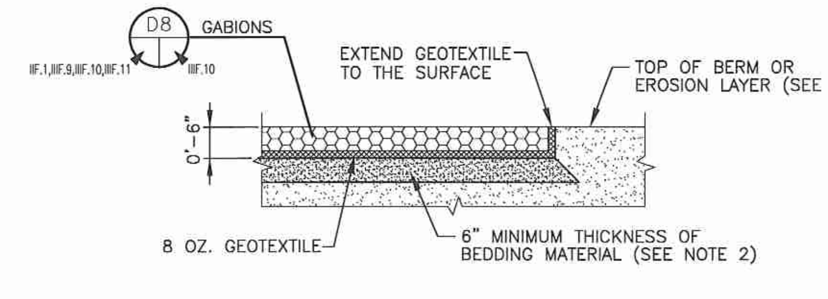
SWALE/CHUTE CONFLUENCE (TYP) D1

SCALE IN FEET



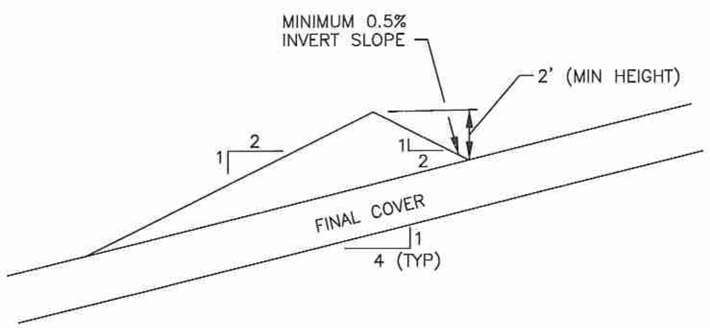
SWALE/CHUTE CONFLUENCE (TYP) D2

SCALE IN FEET



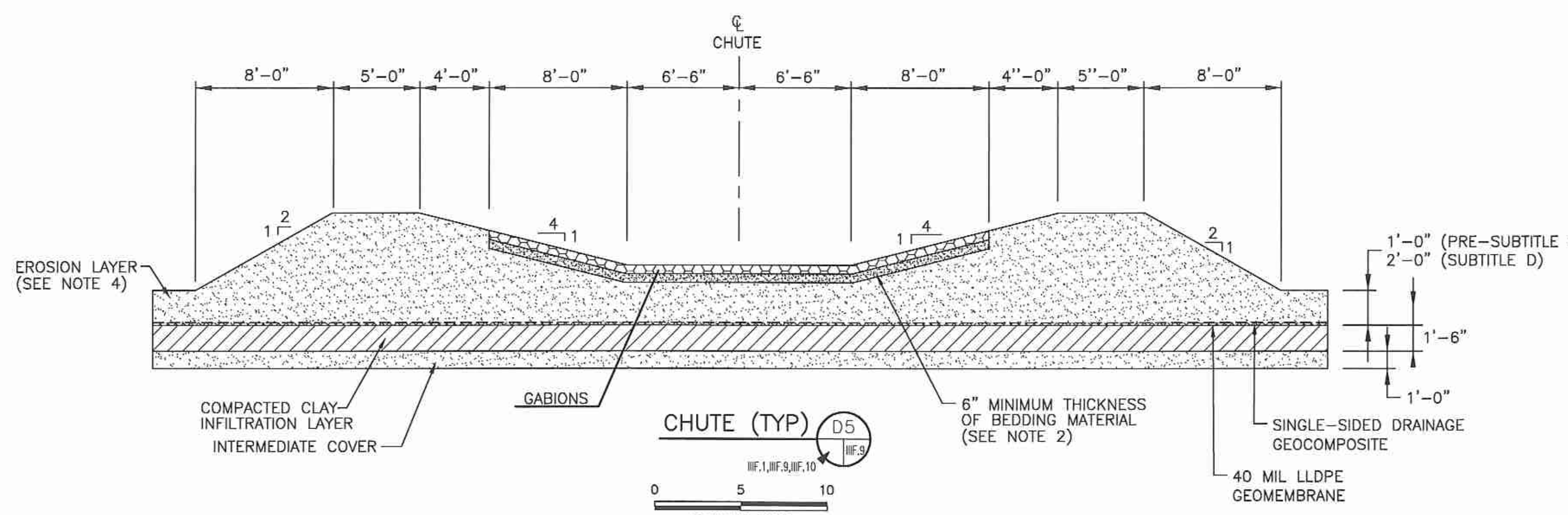
GABION TERMINATION D3

SCALE IN FEET



SWALE (TYP) D4

SCALE IN FEET

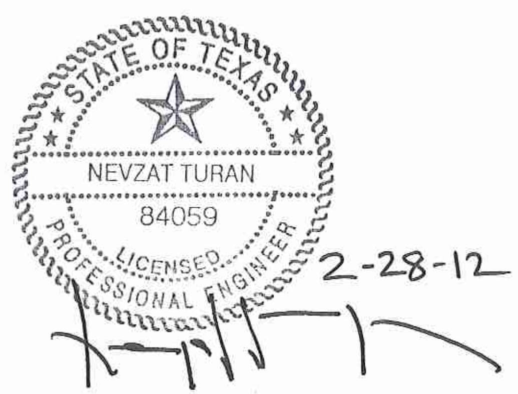


CHUTE (TYP) D5

SCALE IN FEET

NOTES:

1. REFER TO DRAWING IIIF.1-DRAINAGE STRUCTURE PLAN FOR LOCATION OF DETAILS.
2. BEDDING MATERIAL WILL CONSIST OF CLAYEY SOILS COMPACTED TO PROVIDE FIRM BASE THAT WILL BE OVERLAIN BY 8 oz/sy GEOTEXTILE PRIOR TO PLACEMENT OF GABIONS.
3. CHUTE DETAILS ARE SHOWN WITH 13 FEET OF BOTTOM WIDTH. SEE APPENDIX IIIF-C AND THE TABLE ON DRAWING IIIF.11 FOR ACTUAL BOTTOM WIDTHS OF INDIVIDUAL CHUTES.
4. EROSION LAYER WILL BE CAPABLE OF SUSTAINING VEGETATIVE GROWTH.
5. REFER TO APPENDIX IIIJ-A-A FOR FINAL COVER DRAINAGE PIPE DESIGN AND TO DRAWING IIIJ-A-A-22 FOR FINAL COVER DRAINAGE PIPE LAYOUT. THE PIPE WILL EXTEND A MINIMUM OF 3-INCHES ABOVE THE TOP OF GABIONS.
6. THE EDGES OF THE INSTALLED GABIONS TIE EITHER TO THE TOP OF THE EROSION LAYER (i.e., AT UPSTREAM END OF DRAINAGE LETDOWN) OR TO SOIL BERMS THAT ESTABLISH THE TOP OF THE DRAINAGE LETDOWN SIDE SLOPES.



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DENTON COUNTY, TEXAS

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DRAWING IIIF.9

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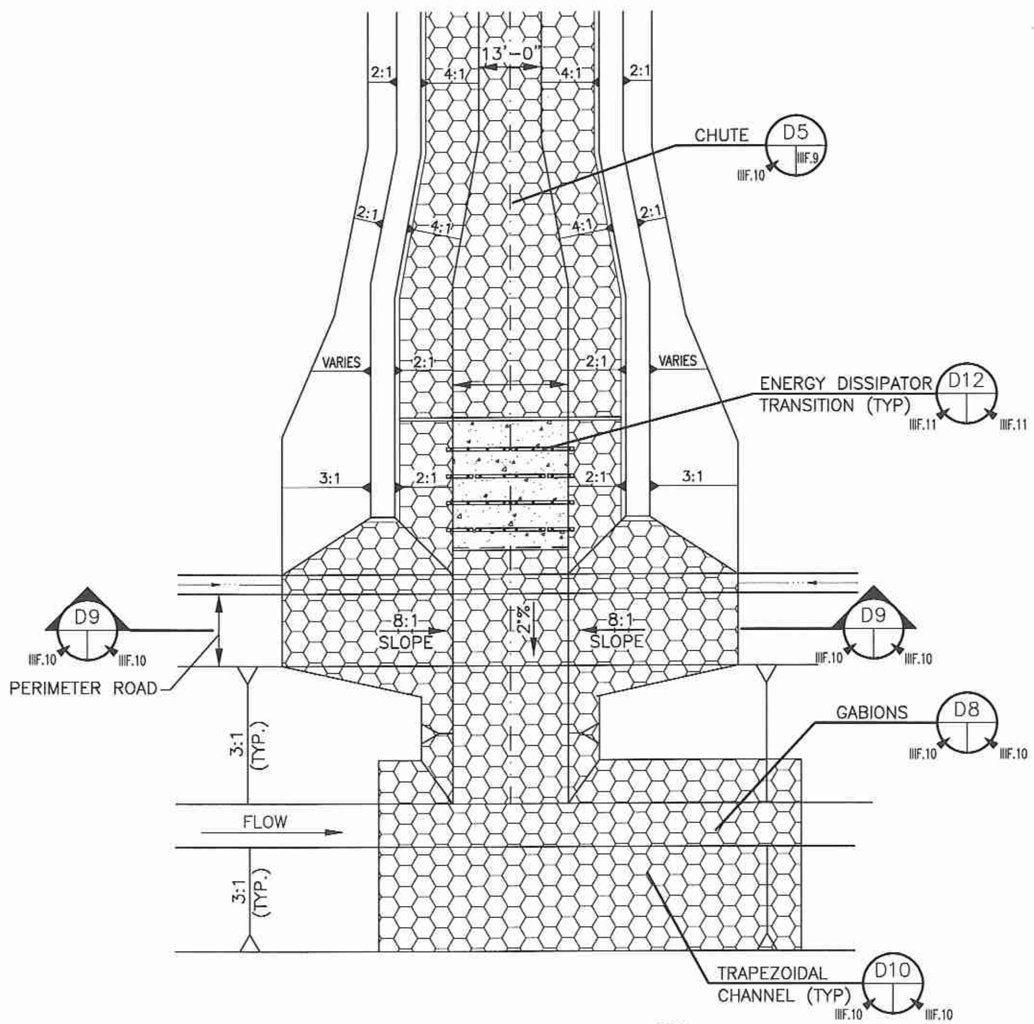
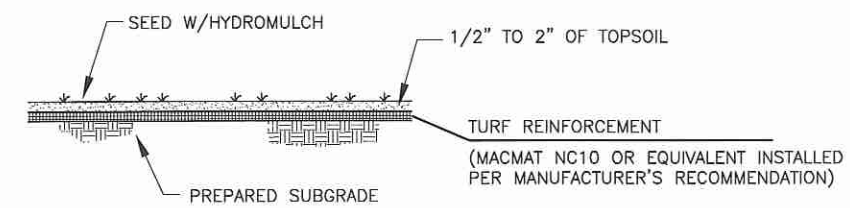


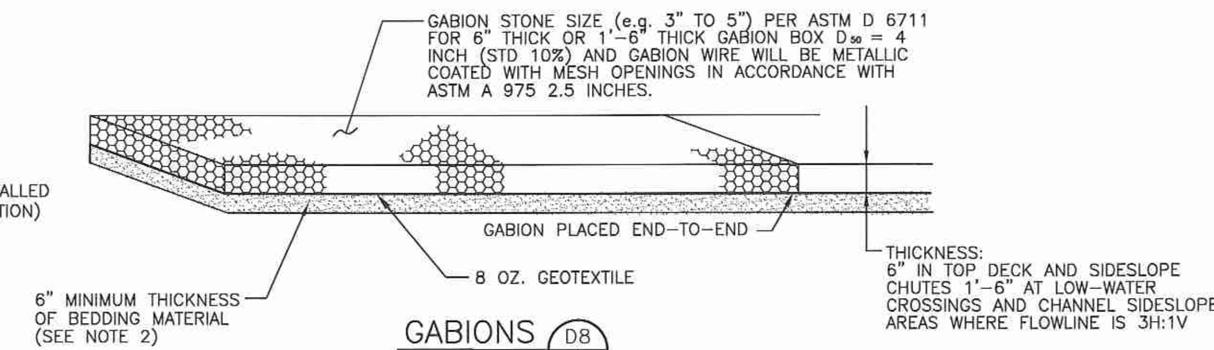
LOW-WATER CROSSING D6 IIF.1,IIF.10,IIF.11 IIF.10

0 20 40 SCALE IN FEET



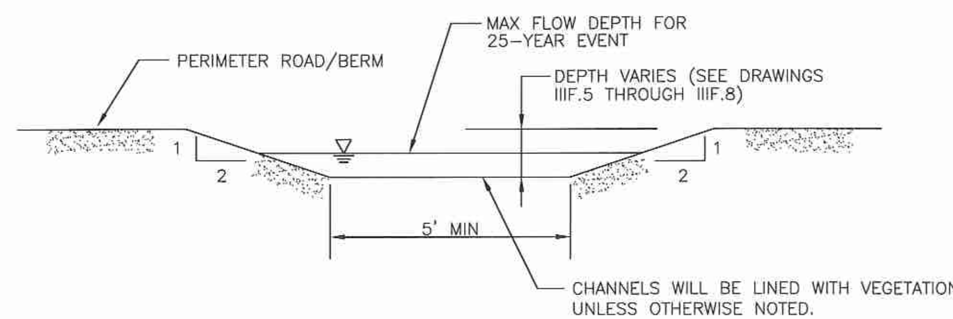
TURF REINFORCEMENT D7 IIF.8 IIF.10

NOT TO SCALE (SEE NOTE 2)



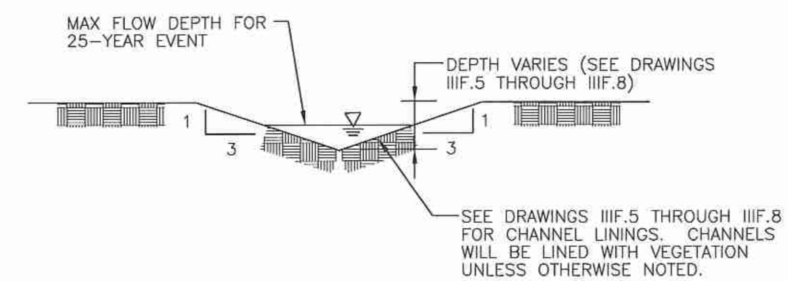
GABIONS D8 IIF.1 IIF.10

0 2 4 SCALE IN FEET



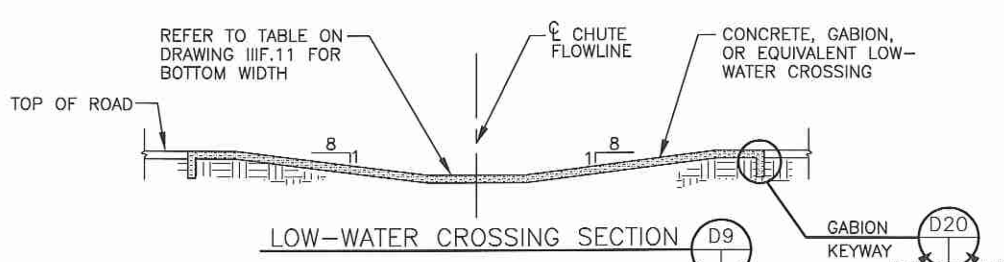
TRAPEZOIDAL CHANNEL (TYP) D10 IIF.1,IIF.10 IIF.10

0 2 4 SCALE IN FEET



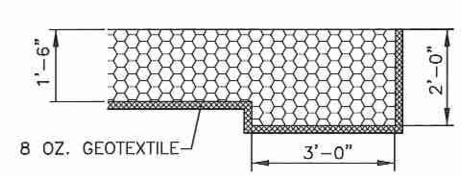
"V" CHANNEL (TYP) D11 IIF.1 IIF.10

0 2 4 SCALE IN FEET



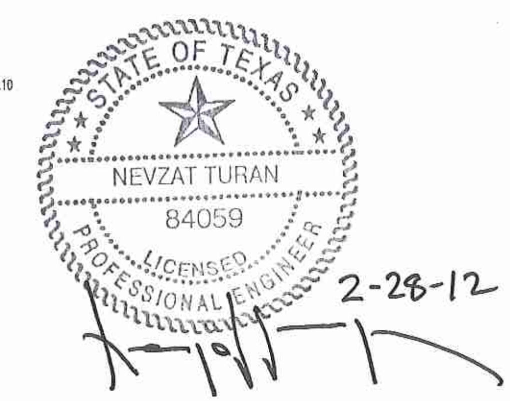
LOW-WATER CROSSING SECTION D9 IIF.1,IIF.10 IIF.10

0 10 20 SCALE IN FEET



GABION KEYWAY (TYP) D20 IIF.10 IIF.10

0 2 4 SCALE IN FEET



NOTES:

1. REFER TO DRAWING IIIF.1–DRAINAGE STRUCTURE PLAN FOR LOCATION OF DETAILS.
2. BEDDING MATERIAL WILL CONSIST OF CLAYEY SOILS COMPACTED TO PROVIDE A FIRM BASE THAT WILL BE OVERLAIN BY 8 oz/sy GEOTEXTILE PRIOR TO PLACEMENT OF GABIONS.

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DRAWING IIIF.10

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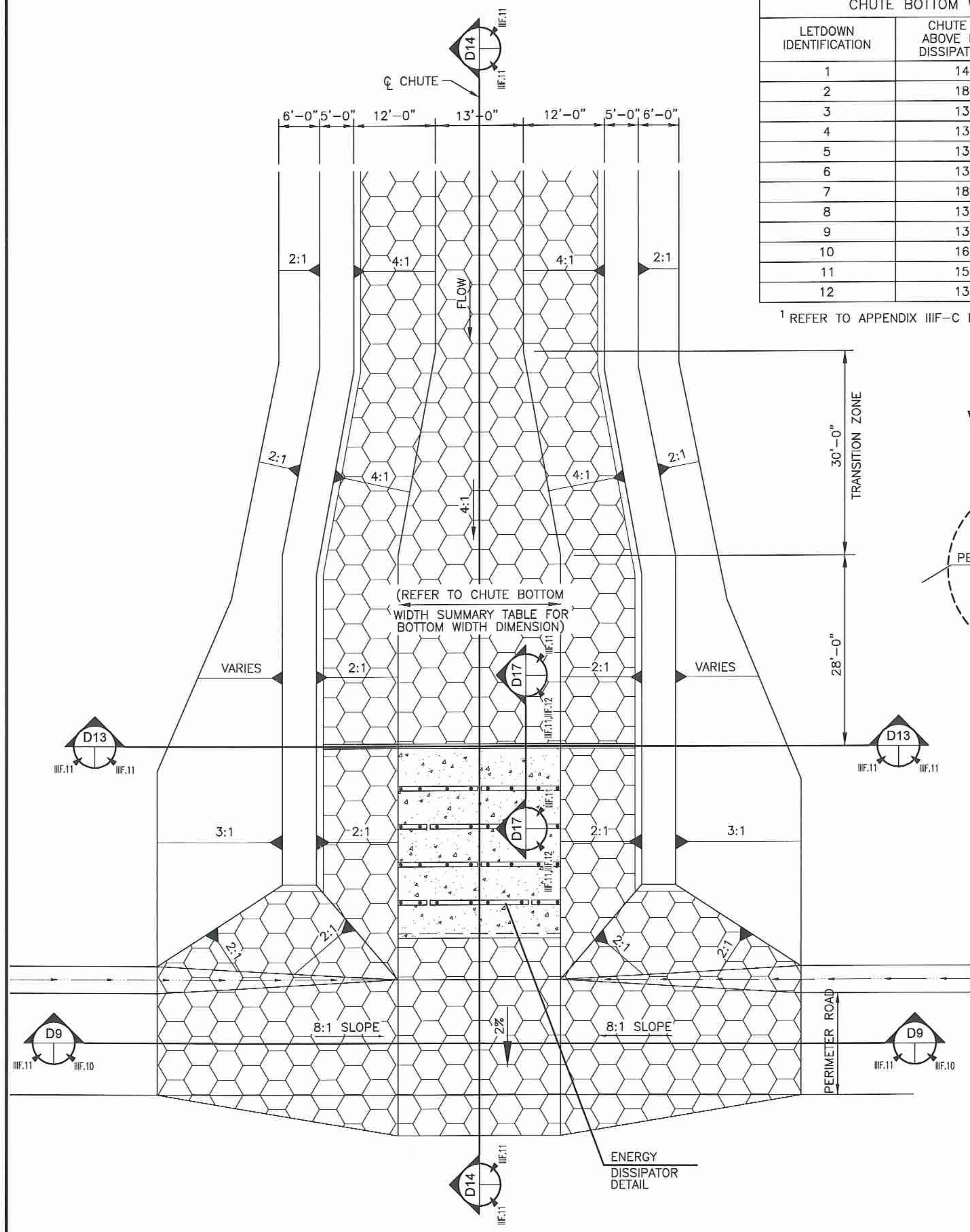
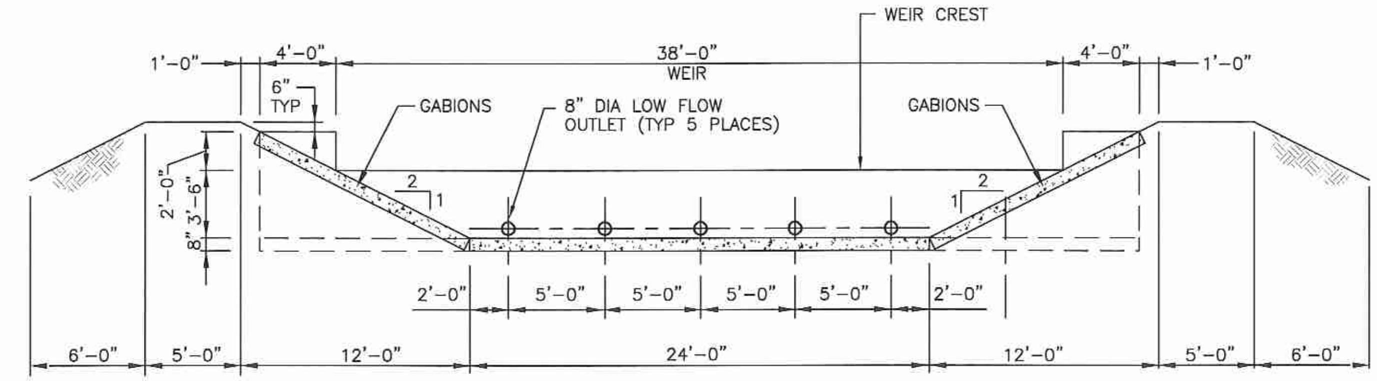


ENERGY DISSIPATOR TRANSITION (TYP) D12

0 10 20 SCALE IN FEET

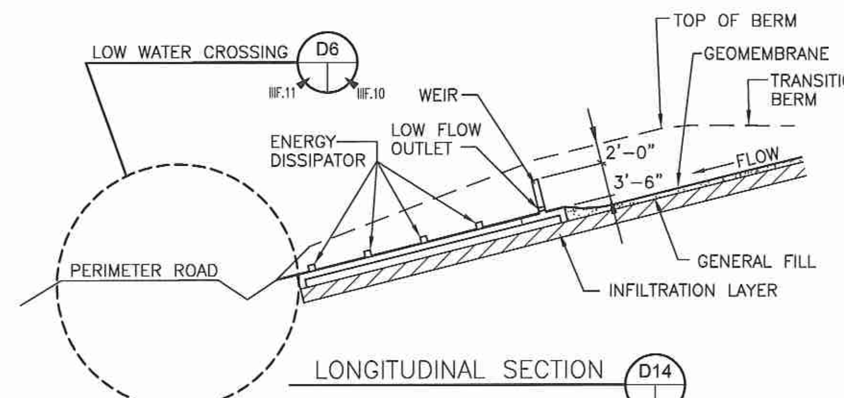
CHUTE BOTTOM WIDTH SUMMARY [1]		
LETDOWN IDENTIFICATION	CHUTE WIDTH ABOVE ENERGY DISSIPATOR (FT)	CHUTE WIDTH ABOVE TRANSITION ZONE (FT)
1	14.0	13.0
2	18.0	13.0
3	13.0	13.0
4	13.0	13.0
5	13.0	13.0
6	13.0	13.0
7	18.0	13.0
8	13.0	13.0
9	13.0	13.0
10	16.0	13.0
11	15.0	13.0
12	13.0	13.0

[1] REFER TO APPENDIX IIIF–C FOR SUPPORTING CALCULATIONS



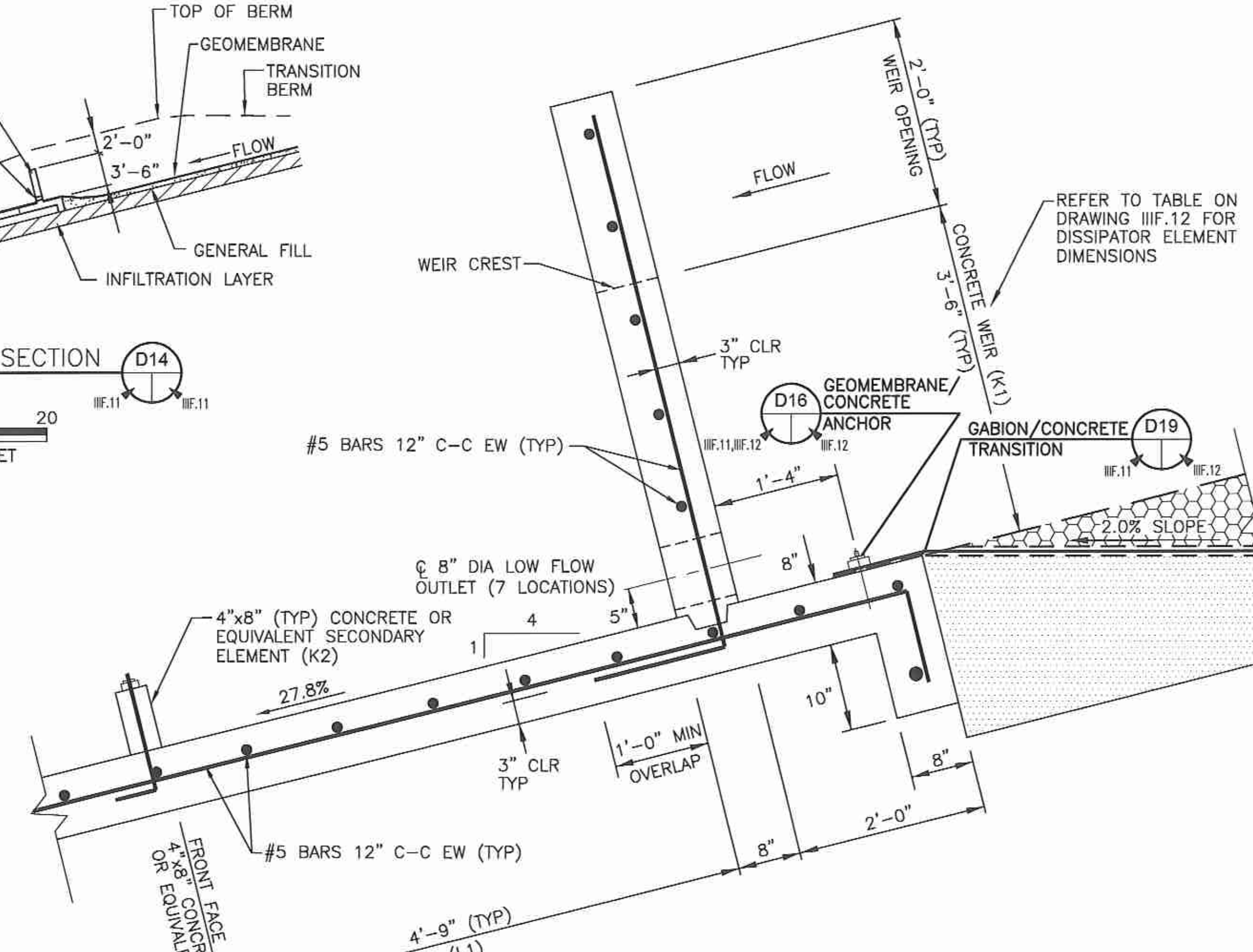
SECTION D13

0 5 10 SCALE IN FEET



LONGITUDINAL SECTION D14

0 10 20 SCALE IN FEET



WEIR SECTION D17

0 1 2 SCALE IN FEET

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER
2-28-12

NOTES:

1. REFER TO DRAWING IIIF.1–DRAINAGE STRUCTURE PLAN FOR LOCATION OF DETAILS.

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CAD: IIIF.11–DRAINAGE.DWG
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DESIGN BY: CRM
REVIEWED BY: JPY

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CITY OF FARMERS BRANCH

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MAJOR PERMIT AMENDMENT
DRAINAGE DETAILS

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DENTON COUNTY, TEXAS

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GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWING IIIF.11

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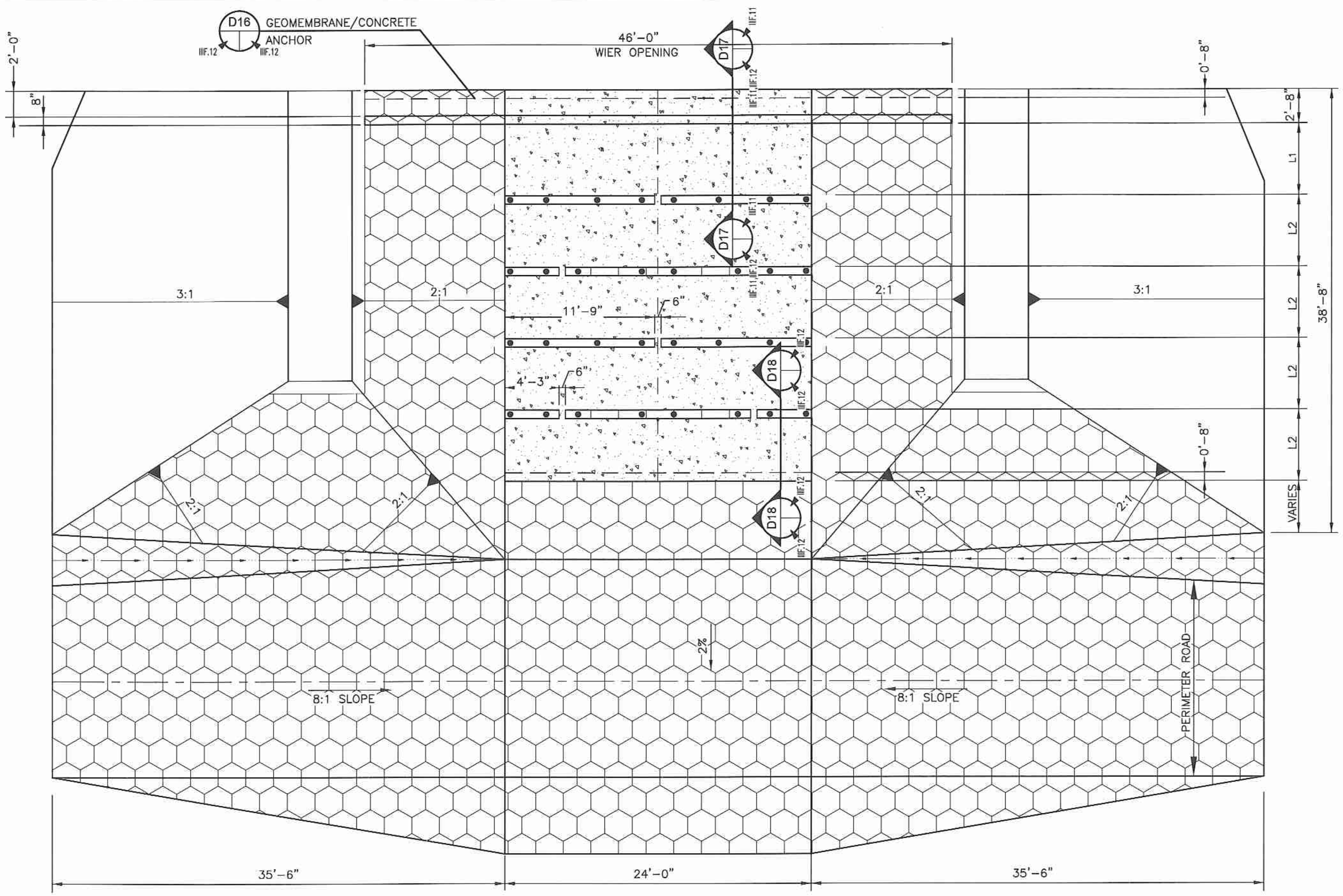


ENERGY DISSIPATOR DETAIL (D15)

(SEE NOTE 1)

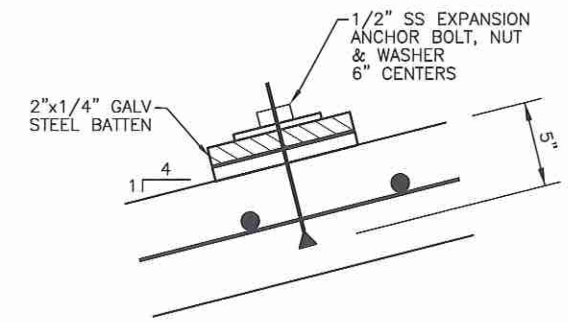
IIIF.11,IIIF.12 IIIF.12

0 5 10

SCALE IN FEET

DISSIPATOR DESIGN SUMMARY [1]				
LETDOWN IDENTIFICATION	HEIGHT OF		LENGTH BETWEEN	
	CONCRETE WEIR (K1) (FT)	SECONDARY ELEMENT (K2) (FT)	WEIR AND FIRST ELEMENT (L1) (FT)	ELEMENTS (L2) (FT)
1	3.5	0.96	4.83	8.9
2	3.5	0.95	4.73	8.8
3	3.0	0.75	2.55	5.0
4	3.0	0.75	3.67	7.0
5	3.5	0.92	4.56	8.5
6	3.0	0.75	2.91	5.6
7	3.5	0.97	4.84	8.9
8	3.0	0.75	3.11	6.0
9	3.0	0.78	3.80	7.2
10	3.5	0.97	4.86	9.0
11	3.5	0.93	4.63	8.6
12	3.0	0.82	4.04	7.6

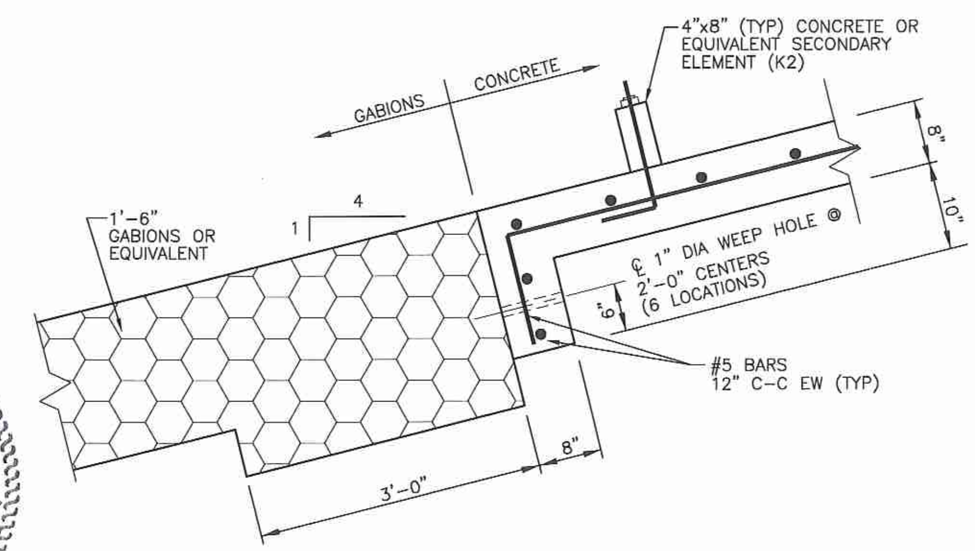
[1] REFER TO APPENDIX IIIF–C FOR SUPPORTING CALCULATIONS



GEOMEMBRANE/CONCRETE ANCHOR (D16)

NTS

IIIF.11,IIIF.12 IIIF.12

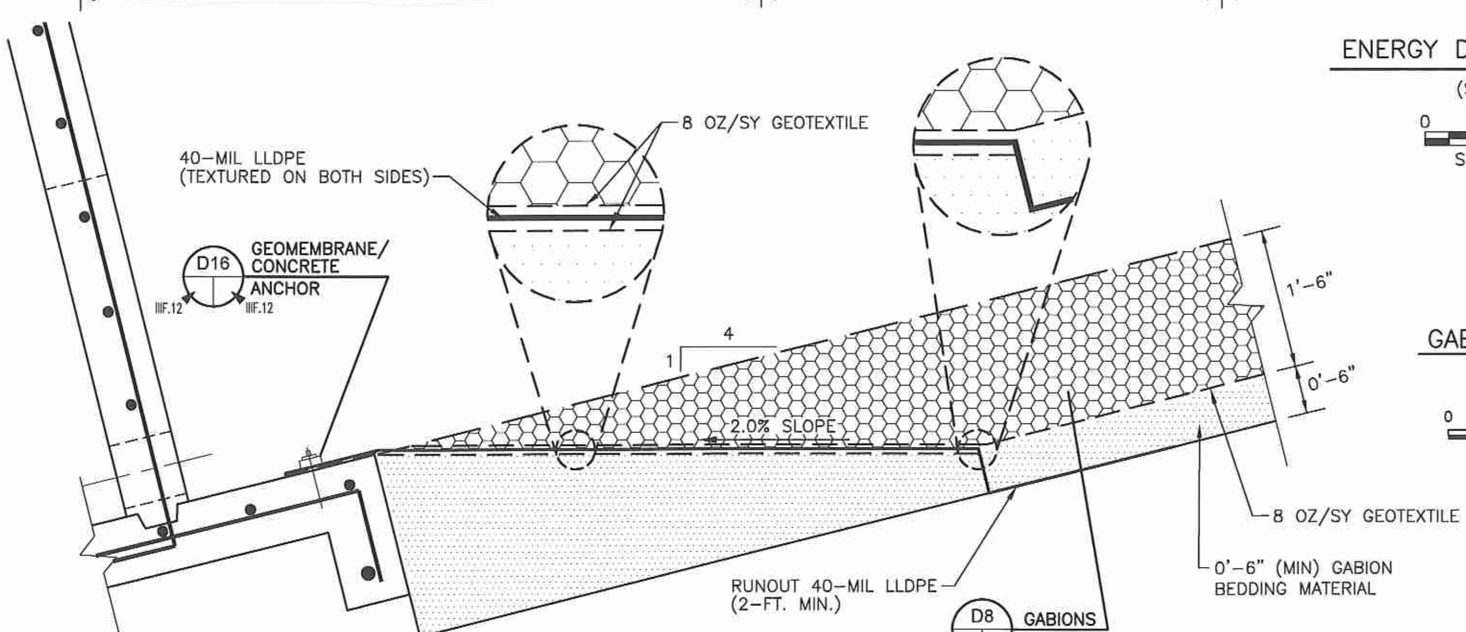


DISSIPATOR SECTION (TYP) (D18)

0 1 2

SCALE IN FEET

IIIF.12 IIIF.12



GABION/CONCRETE TRANSITION (D19)

IIIF.11 IIIF.12

0 1 2

SCALE IN FEET

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NEVZAT TURAN
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LICENSED PROFESSIONAL ENGINEER

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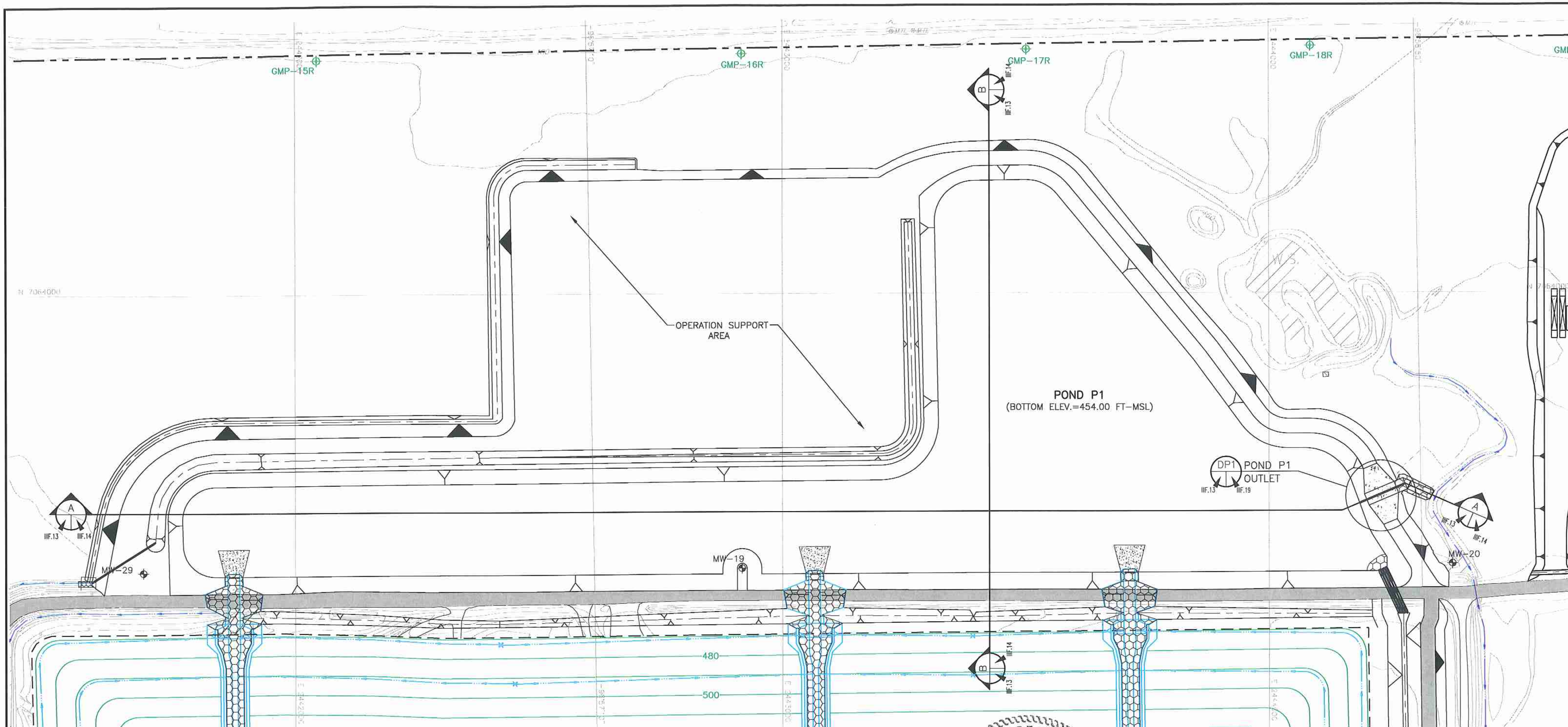
DRAWING IIIF.12

O:\1339\351\EXPANSION 2009\PART III–SDP\IIIF\IIIF.12–DRAINAGE DETAILS.dwg, jwilson, 1:2



POND P1	
ELEVATION (FT-MSL)	SURFACE AREA (AC)
454	17.18
455	17.75
456	18.16
457	18.58
458	18.99
459	19.41
460	19.82

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 STATE PLANE COORDINATE SYSTEM
- 96°56'30" GEODETIC COORDINATE SYSTEM
- 460 EXISTING CONTOUR (SEE NOTE 1)
- 500 FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- MW-29 PERMITTED GROUNDWATER MONITORING WELL
- GMP-14R PROPOSED GAS MONITORING PROBE

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.

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0 100 200
SCALE IN FEET

N

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MAJOR PERMIT AMENDMENT
POND P1 PLAN

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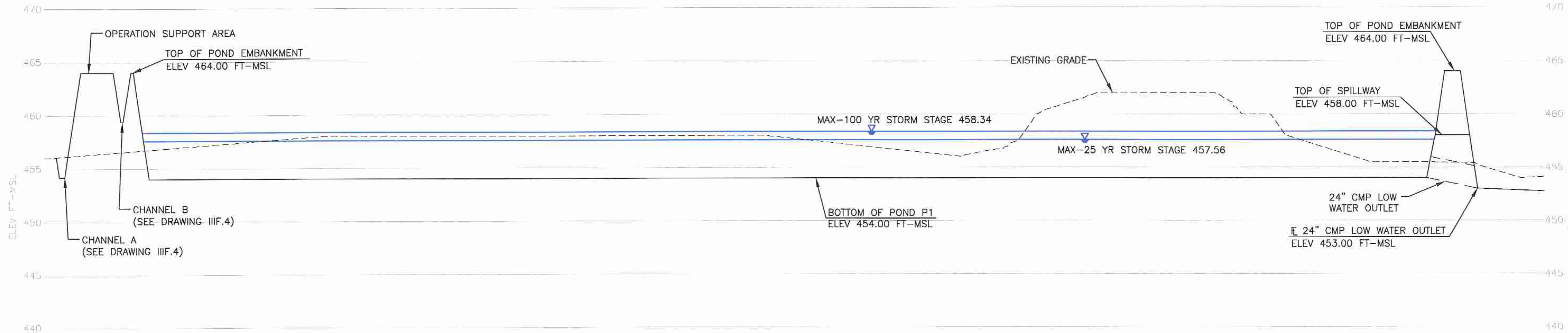
DRAWING IIIF.13

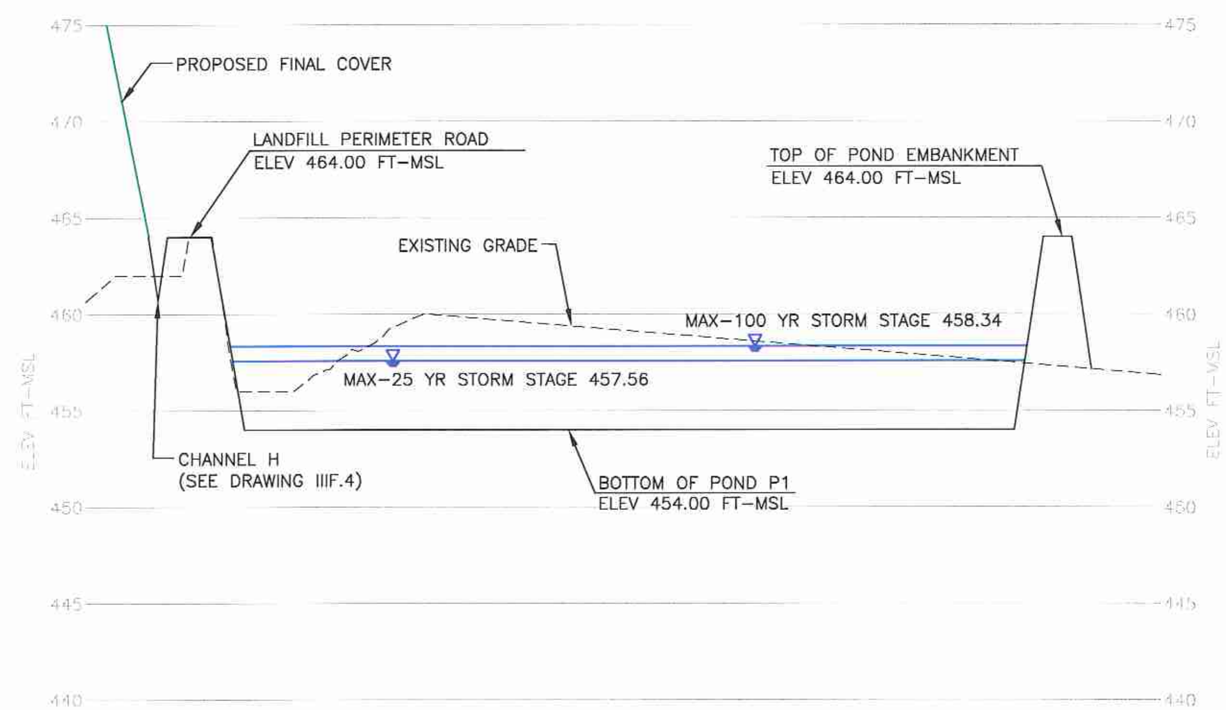
O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF.13-18 PONDS.dwg, jwilson, 1:2



DETENTION POND P1 SECTION A (IIF.13, IIF.14)

0 100 200 HORIZONTAL SCALE IN FEET

0 5 10 VERTICAL SCALE IN FEET



DETENTION POND P1 SECTION B (IIF.13, IIF.14)

0 100 200 HORIZONTAL SCALE IN FEET

0 5 10 VERTICAL SCALE IN FEET

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POND P1 SECTIONS

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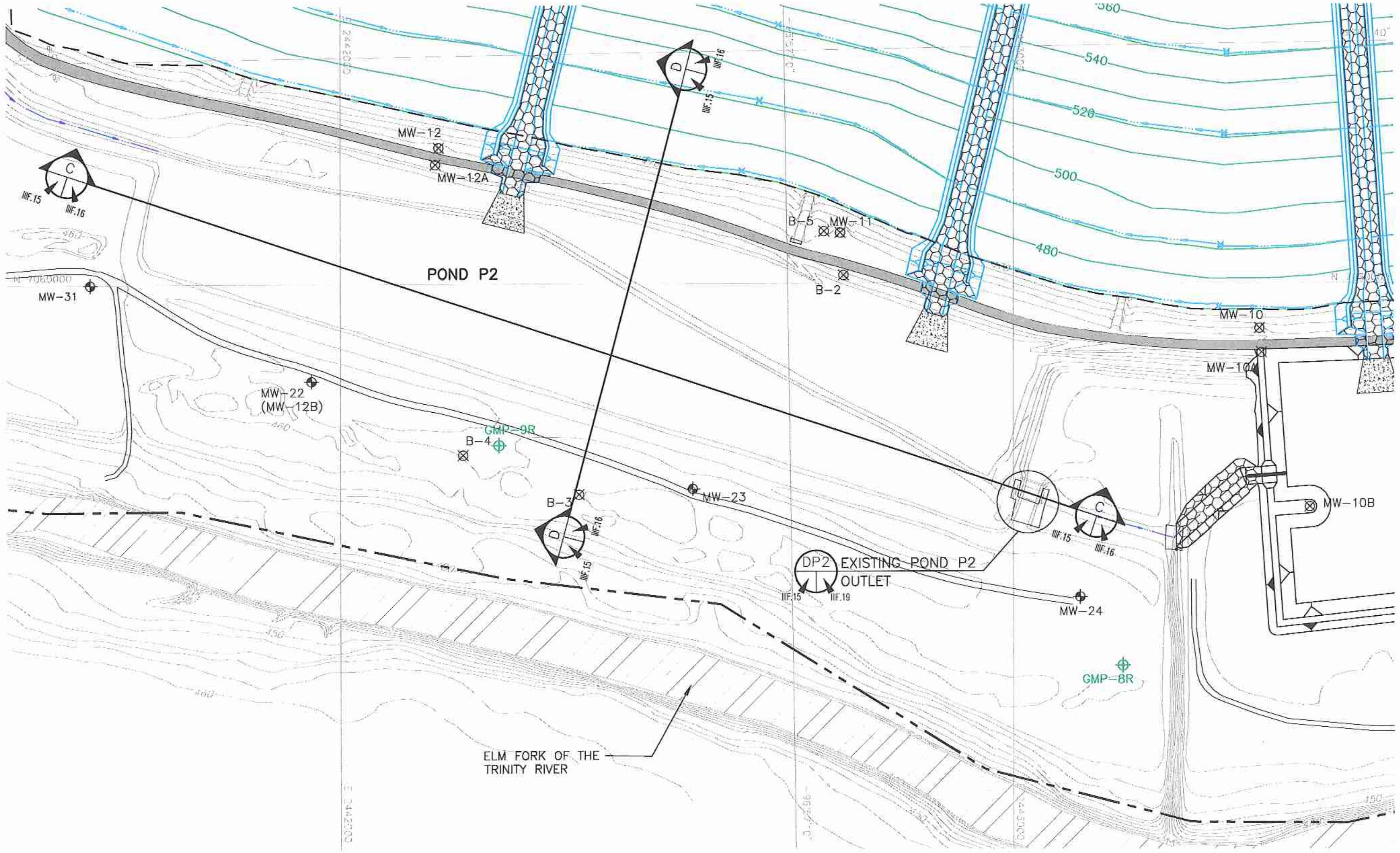

SCALE IN FEET 0 100 200

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7060000 STATE PLANE COORDINATE SYSTEM
- 96°57'10" GEODETIC COORDINATE SYSTEM
- 460 EXISTING CONTOUR (SEE NOTE 1)
- 500 FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- MW-22 PERMITTED GROUNDWATER MONITORING WELL
- GMP-9 PERMITTED GAS MONITORING PROBE
- MW-12 PERMITTED OBSERVATION WELL

POND P2

ELEVATION (FT-MSL)	SURFACE AREA (AC)
454	4.08
455	6.79
456	8.38
457	8.62
458	8.87
459	9.12

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.

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MAJOR PERMIT AMENDMENT
POND P2 PLAN

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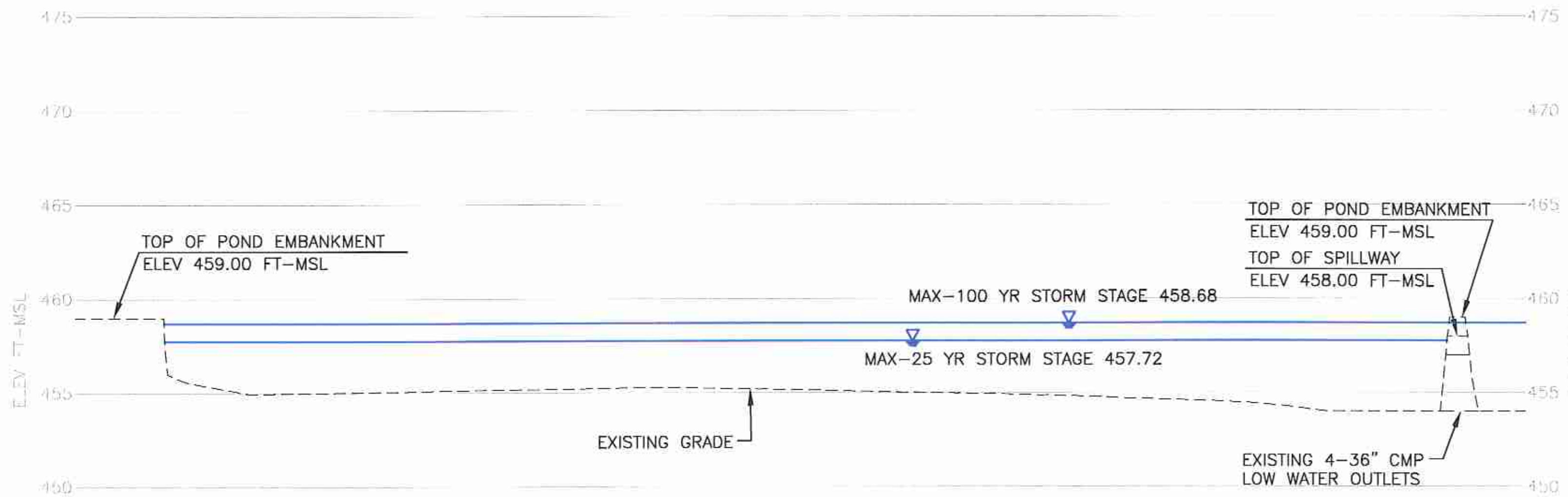
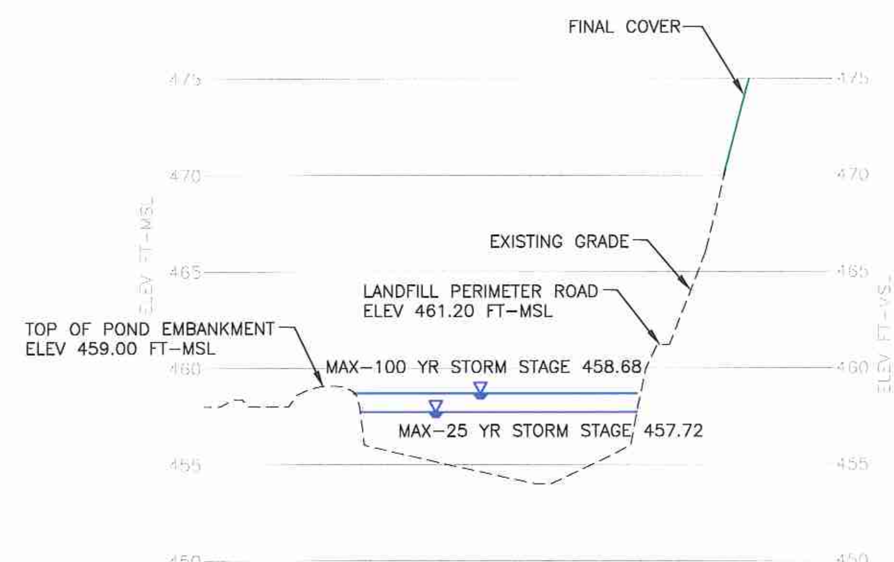


DETENTION POND P2 SECTION C (IIIF.15 / IIIF.16)

0 100 200 HORIZONTAL SCALE IN FEET

0 5 10 VERTICAL SCALE IN FEET



DETENTION POND P2 SECTION D (IIIF.15 / IIIF.16)

0 100 200 HORIZONTAL SCALE IN FEET

0 5 10 VERTICAL SCALE IN FEET

STATE OF TEXAS
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MAJOR PERMIT AMENDMENT
POND P2 SECTIONS

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DRAWING IIIF.16

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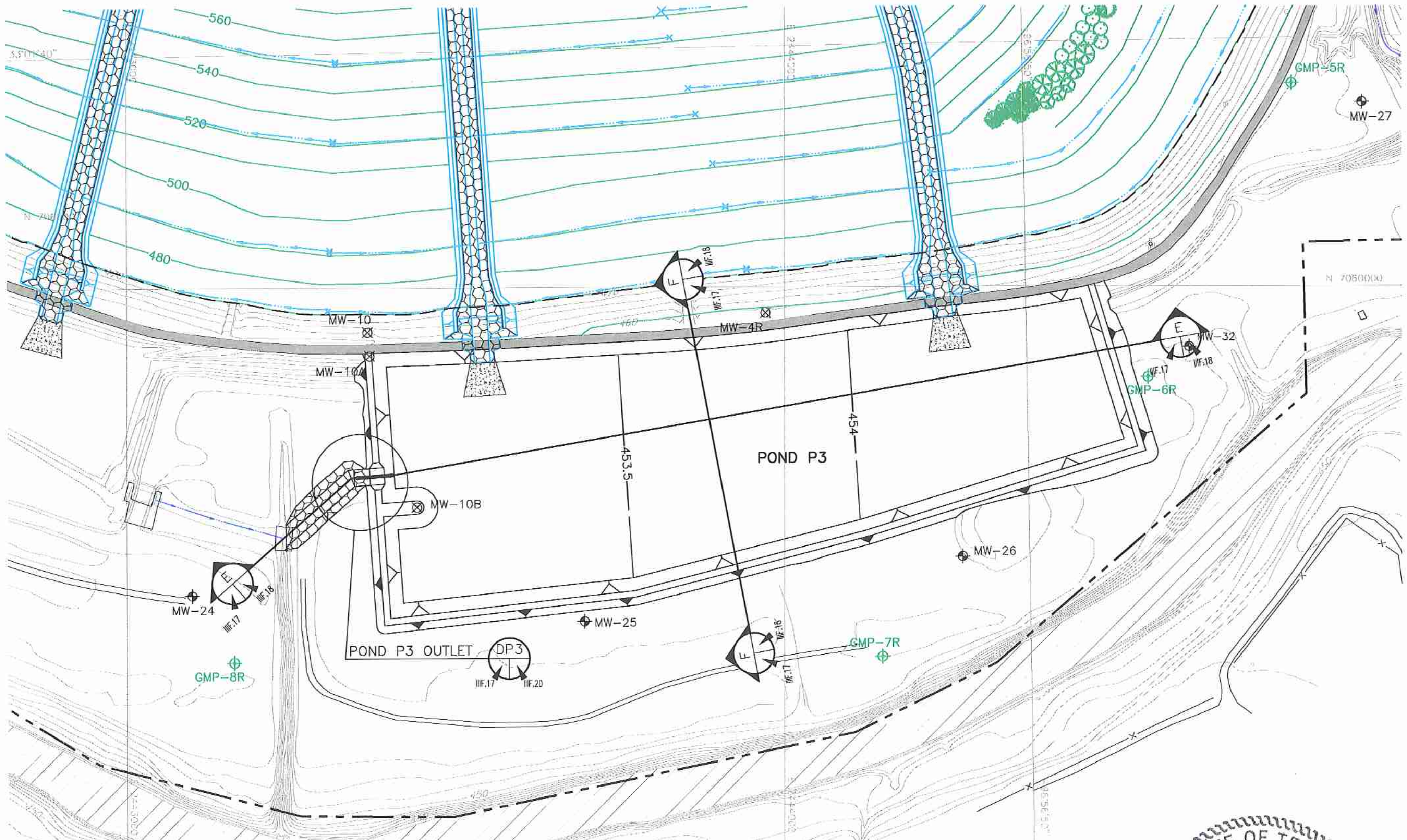

POND P3

ELEVATION (FT-MSL)	SURFACE AREA (AC)
453.5	2.73
454	5.36
455	7.71
456	7.97
457	8.16
458	8.36
459	8.56

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

2-28-12

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7060000 — STATE PLANE COORDINATE SYSTEM
- 33°01'40" — GEODETIC COORDINATE SYSTEM
- 450 — EXISTING CONTOUR (SEE NOTE 1)
- 500 — FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- MW-25 — PERMITTED GROUNDWATER MONITORING WELL
- MW-30 — PROPOSED GROUNDWATER MONITORING WELL
- GMP-14R — PROPOSED GAS MONITORING PROBE

N

0 100 200
SCALE IN FEET

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.

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MAJOR PERMIT AMENDMENT
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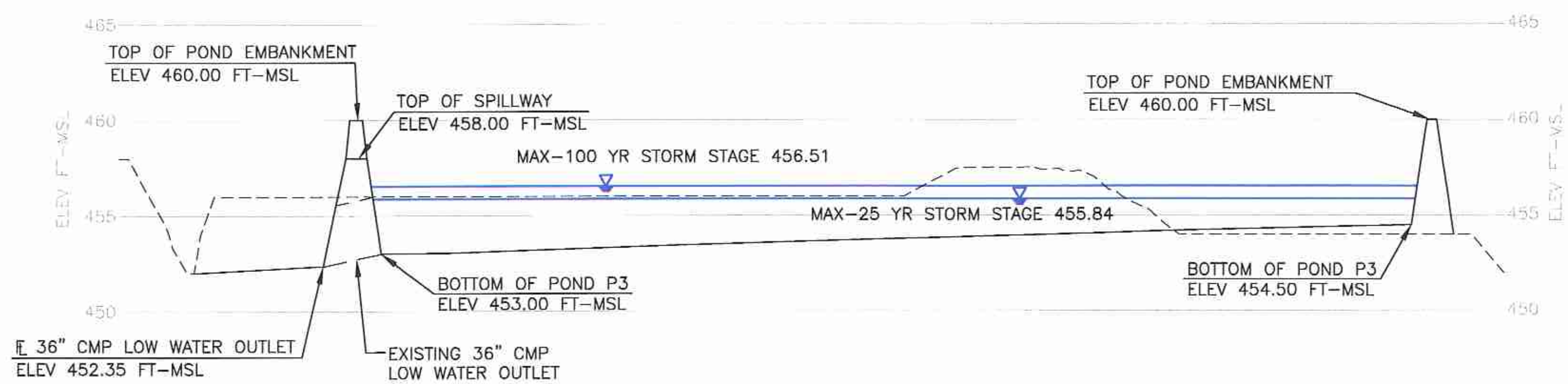

DETENTION POND P3 SECTION DP3 (IIIF.17 / IIIF.18)

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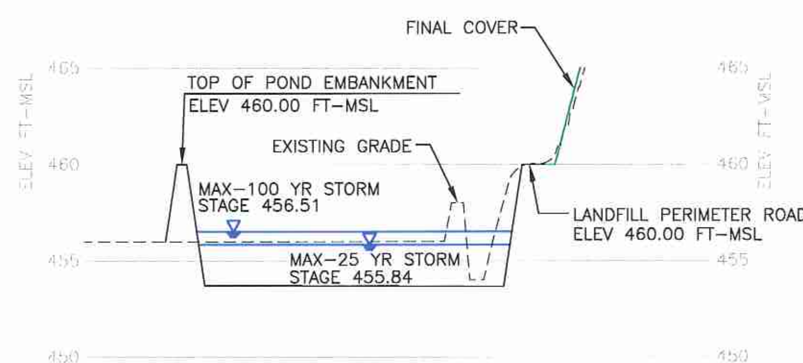
0 5 10 VERTICAL SCALE IN FEET



DETENTION POND P3 SECTION DP3 (IIIF.17 / IIIF.18)

0 100 200 HORIZONTAL SCALE IN FEET

0 5 10 VERTICAL SCALE IN FEET

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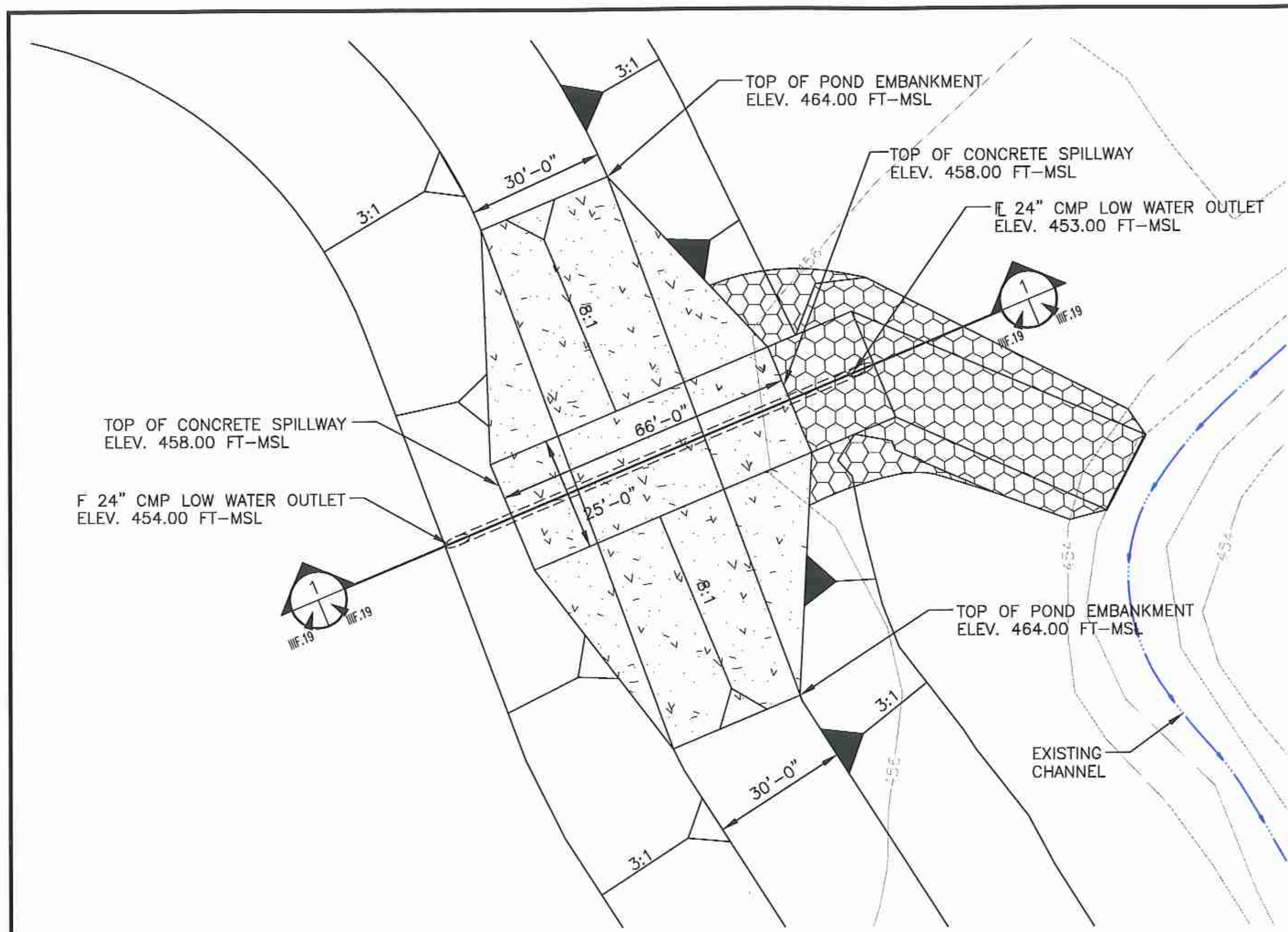
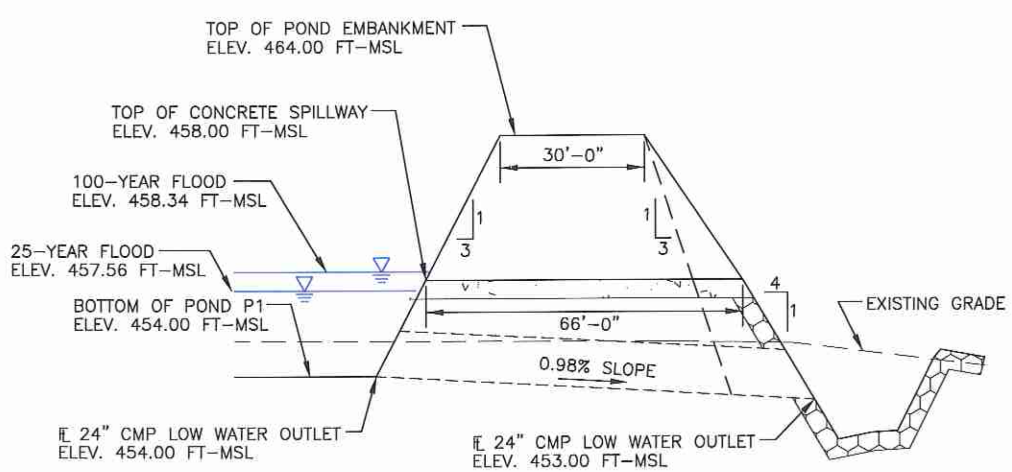


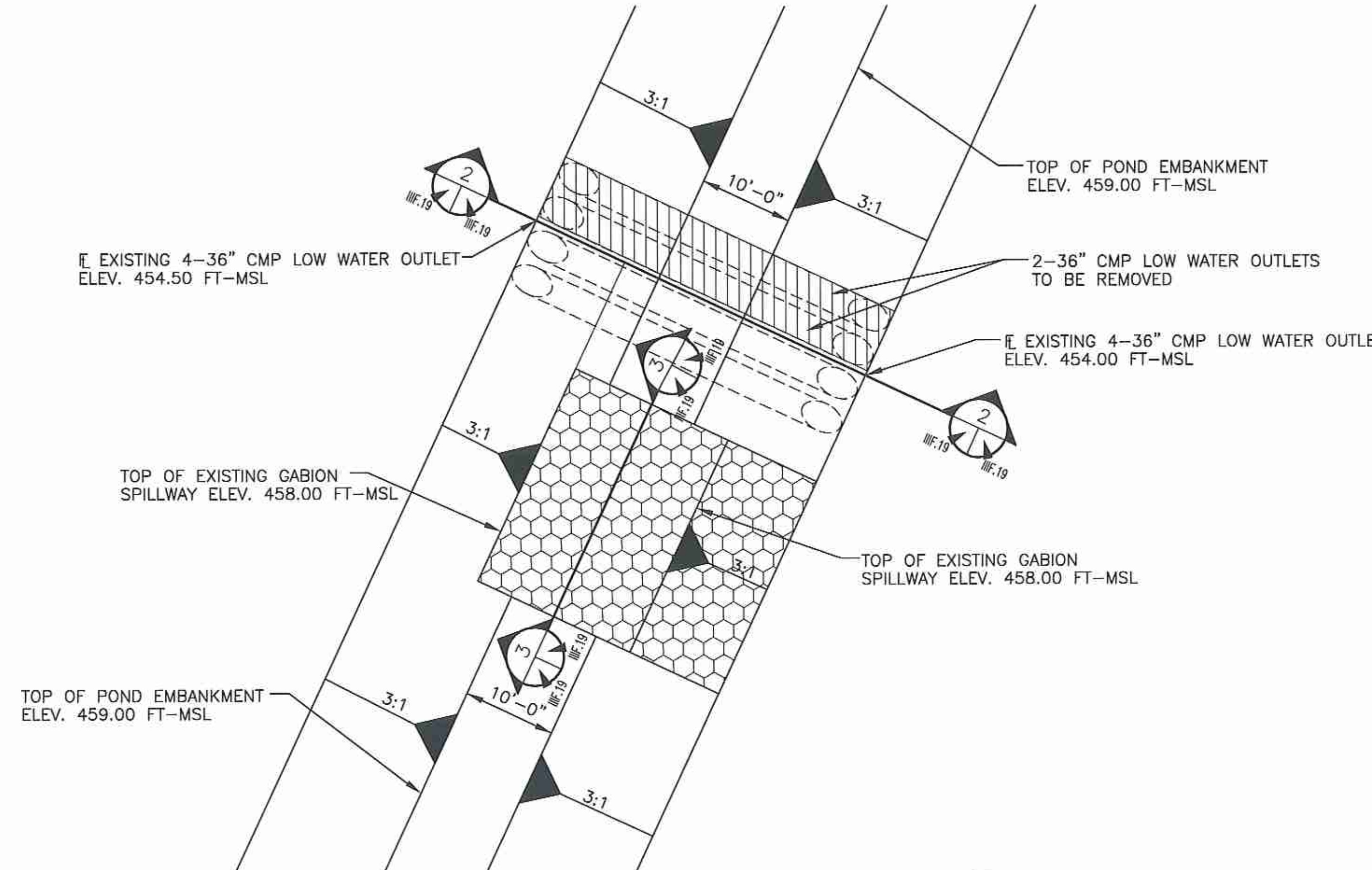
POND P1 OUTLET STRUCTURE (DP1 / IIIF.13 / IIIF.19)

0 20 40 SCALE IN FEET



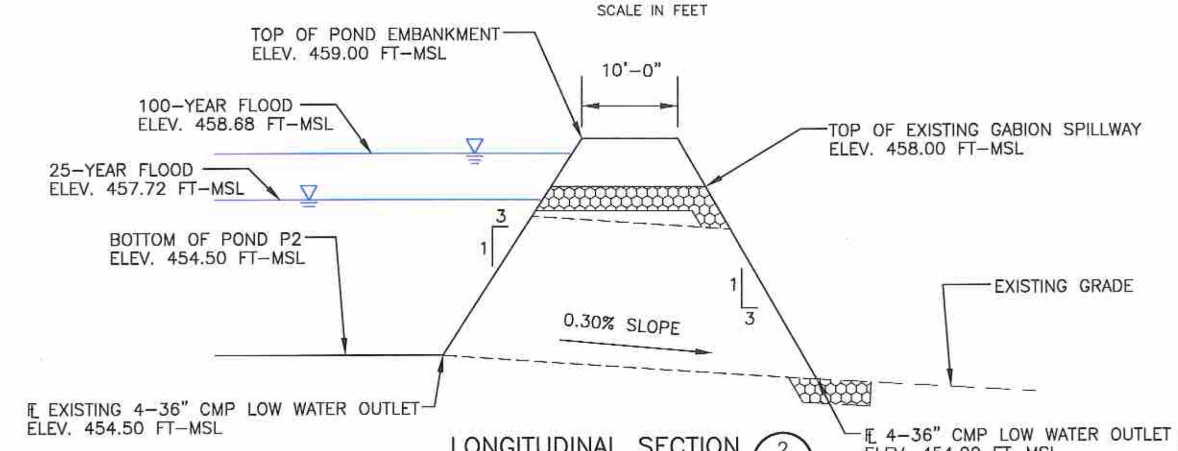
LONGITUDINAL SECTION (1 / IIIF.19 / IIIF.19)

0 20 40 SCALE IN FEET



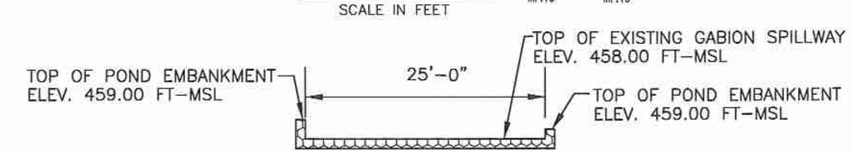
POND P2 EXISTING OUTLET STRUCTURE (DP2 / IIIF.15 / IIIF.19)

0 10 20 SCALE IN FEET



LONGITUDINAL SECTION (2 / IIIF.19 / IIIF.19)

0 10 20 SCALE IN FEET



SPILLWAY (3 / IIIF.19 / IIIF.19)

0 10 20 SCALE IN FEET

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MAJOR PERMIT AMENDMENT
POND OUTLET STRUCTURE DETAILS

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DENTON COUNTY, TEXAS

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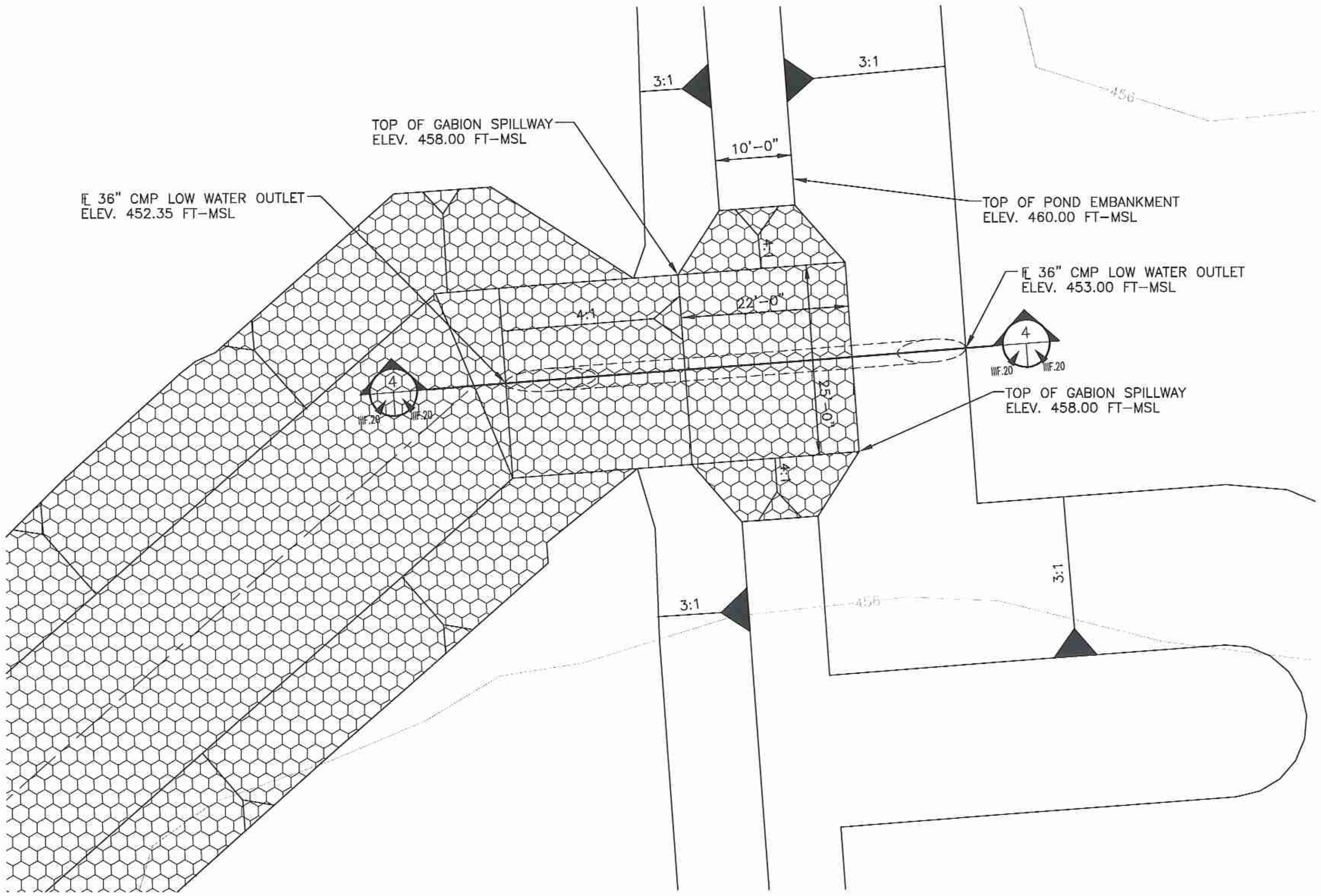
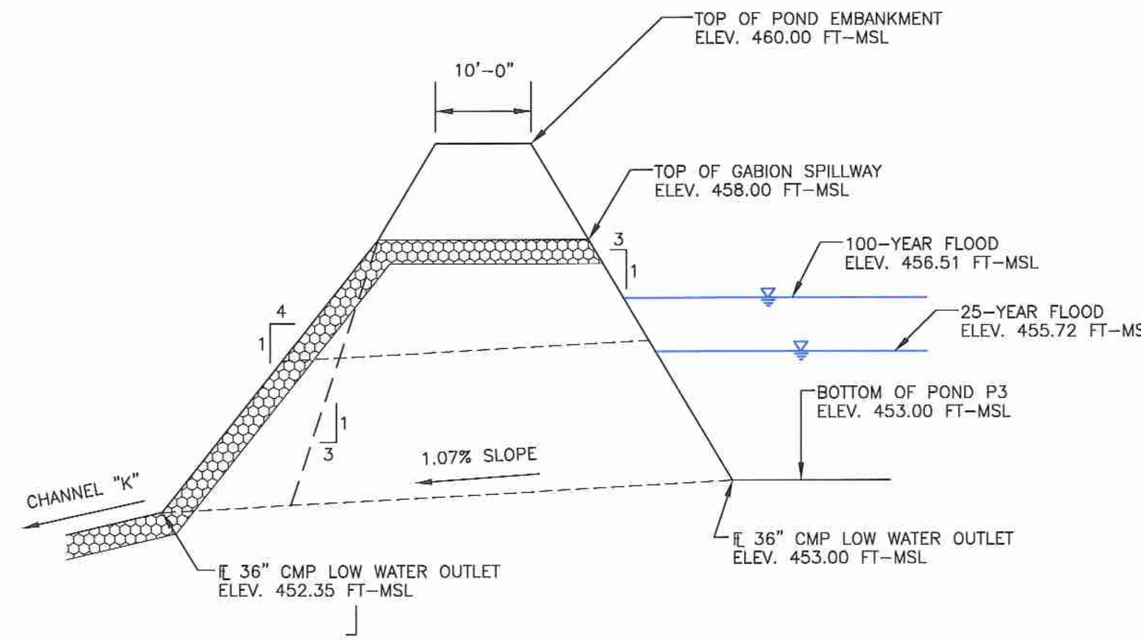


POND P3 POND OUTLET STRUCTURE (DP3 IIIF.17 IIIF.20)

0 10 20
SCALE IN FEET



LONGITUDINAL SECTION (4 IIIF.20 IIIF.20)

0 10 20
SCALE IN FEET

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
PERIMETER DRAINAGE PLAN

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants

TBPE REGISTRATION NO. F-3727

CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO
FORT WORTH, TX (817) 735-9770
GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

DRAWING IIIF.20

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF.19-20-OUTLET STRUCTURES.dwg, jwilson, 1:2

APPENDIX IIIF-A

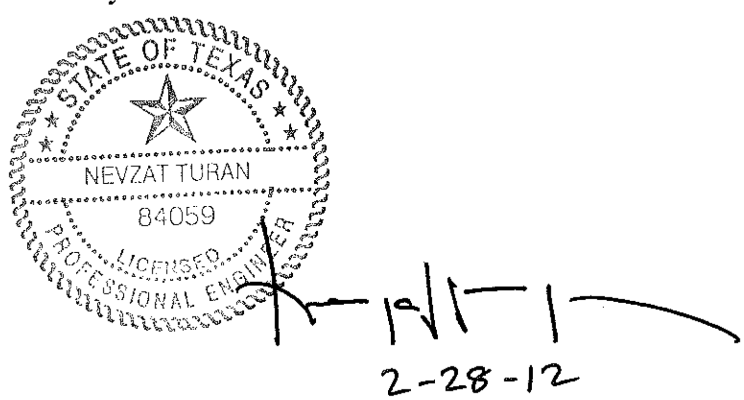
POST-DEVELOPMENT CONDITION HYDROLOGIC CALCULATIONS

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

Includes pages IIIF-A-1 through IIIF-A-116

CONTENTS



STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
2-28-12

HYPOTHETICAL STORM DATA

Hypothetical Storm Data

Precipitation data taken from TP-40 and Hydro 35 rainfall data.

Time	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr
25-Year Event	0.74	1.57	3.19	4.18	4.52	5.47	6.43	7.44
100-Year Event	0.88	1.87	4.30	5.45	5.75	6.80	8.30	9.45

TP-40 (*U.S. Department of Commerce, May 1961*) was used to identify precipitation values for storm durations ranging from 60 minutes to 24 hours.

Hydro 35 (*National Oceanic and Atmospheric Administration, June 1977*) was used to estimate precipitation for the 5 minute and 15 minute duration storm events.

PRECIPITATION LOSS DATA

Required: Determine the SCS curve numbers for both on-site and off-site drainage areas for use in the HEC-1 analysis.

References:

1. Dodson's and Associates, Inc., *ProHec-1 Plus Program Documentation*, 1995.
2. United States Department of Agriculture, National Resource Conservation Service, Web Soil Survey for Hill County, Texas (http://websoilsurvey.nrcs.usda.gov).
3. The Hydrologic Evaluation of Landfill Performance (HELP) Model - Engineering Documentation for version 3. EPA/600/R-94/168b, September 1994.

Note: Approximate non landfill areas within the permit boundary on SCS map (page IIIF-A-5).

Solution: Based on the soil survey information found in Ref. 2, hydrologic group D soils predominate the soils within the permit boundary drainage area (see pages IIIF-A-5 through IIIF-A-7).

All on-site drainage areas and off-site drainage areas near the site (O3, O4, and O5) were considered pasture land in fair conditions. A curve number was selected using the table on page IIIF-A-8.

Use:	CN = 84

Curve numbers for offsite areas O1, O1A, and O2 were calculated using an area-weighted average of rural and urban land uses, including pasture or range in fair condition, 1/4 acre average residential lots, and industrial districts. The calculated composite curve numbers are shown below.

Use:	CN = 87	for area O1
Use:	CN = 85	for area O1A
Use:	CN = 85	for area O2

The final cover system was assumed to be in place and the erosion layer will control precipitation loss. A curve number that is corrected for the surface slope of the erosion layer may be computed first using the chart on page IIIF-A-8 to select an un-adjusted curve number. Calculate the adjusted curve number using equation 34 from Ref. 3 (see page IIIF-A-8).

$$CN_{II} = 100 - (100 - CN_{IIo}) * (L^{*2} / S^{*}) \wedge (CN_{IIo}^{-0.81})$$

Use:	$CN_{IIo} = 84$, $L^* = (300/500)$, $S^* = (.04/.04)$	for top dome surfaces
Use:	$CN_{IIo} = 84$, $L^* = (120/500)$, $S^* = (.25/.04)$	for side slopes

Calculate:	CN = 84	for top dome surfaces
Calculate:	CN = 86	for side slopes

- Use curve number calculated for side slopes for the entire final cover area, inculding top dome areas, conservatively.

The pond areas are assumed to collect all precipitation for their areas:

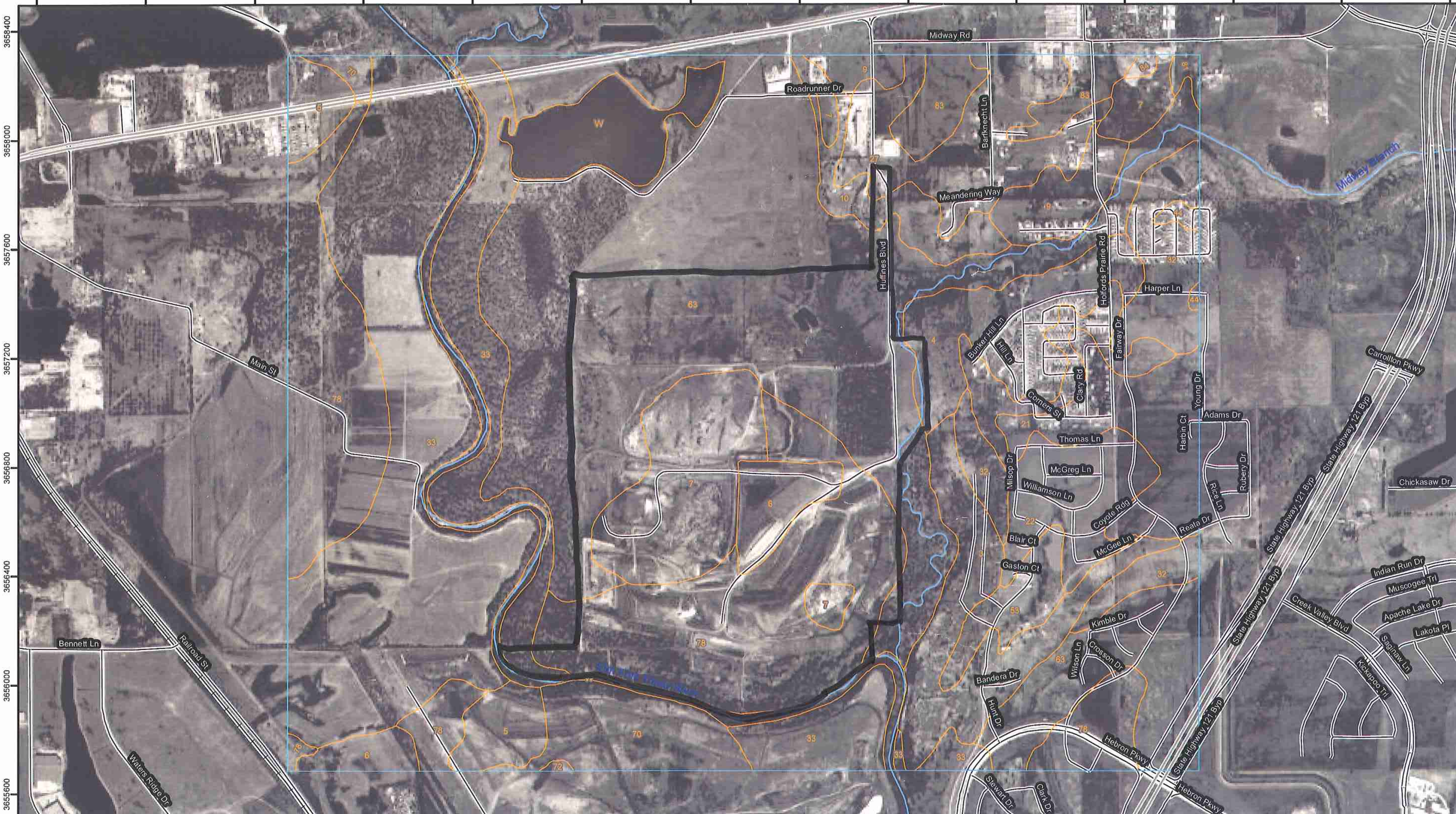
Use:	CN = 100

Soil Map—Denton County, Texas
(CAMELOT LANDFILL)

96° 58' 43"　　96° 55' 17"

33° 2' 55"　　33° 2' 51"

688800 689200 689600 690000 690400 690800 691200 691600 692000 692400 692800 693200 693600 694000



3658400 3658000 3657600 3657200 3656800 3656400 3656000 3655600

688800 689200 689600 690000 690400 690800 691200 691600 692000 692400 692800 693200 693600 694000

33° 1' 17"　　33° 1' 14"

96° 58' 45"　　96° 55' 20"

Map Scale: 1:14,700 if printed on B size (11" x 17") sheet.

N

Meters: 0　200　400　800　1,200

Feet: 0　500　1,000　2,000　3,000

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

2-28-12

IIIF-A-5

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:14,700 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 14N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Denton County, Texas
Survey Area Data: Version 7, Jan 14, 2010

Date(s) aerial images were photographed: 1995

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Denton County, Texas (TX121)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
3	Altoga silty clay, 5 to 8 percent slopes	77.8	3.6%
4	Altoga silty clay, 5 to 12 percent slopes, eroded	68.7	3.2%
5	Aquilla loamy fine sand, 2 to 5 percent slopes	37.7	1.7%
6	Arents, gently undulating	36.7	1.7%
7	Arents, hilly	102.5	4.7%
9	Bastsil fine sandy loam, 1 to 3 percent slopes	35.8	1.6%
10	Bastsil fine sandy loam, 3 to 5 percent slopes	32.7	1.5%
21	Burleson clay, 0 to 1 percent slopes	61.0	2.8%
22	Burleson clay, 1 to 3 percent slopes	80.7	3.7%
27	Crockett fine sandy loam, 1 to 3 percent slopes	79.8	3.7%
32	Ferris-Heiden clay, 5 to 15 percent slopes	66.5	3.1%
33	Frio silty clay, occasionally flooded	391.4	18.0%
44	Houston Black clay, 1 to 3 percent slopes	3.7	0.2%
53	Lewisville clay loam, 3 to 5 percent slopes	23.5	1.1%
63	Ovan clay, occasionally flooded	590.5	27.2%
70	Seagoville clay, occasionally flooded	54.2	2.5%
72	Silstid loamy fine sand, 1 to 5 percent slopes	0.8	0.0%
78	Trinity clay, occasionally flooded	307.4	14.1%
81	Vertel clay, 3 to 5 percent slopes	3.4	0.2%
83	Wilson clay loam, 0 to 1 percent slopes	33.0	1.5%
84	Wilson clay loam, 1 to 3 percent slopes	1.8	0.1%
W	Water	83.8	3.9%
Totals for Area of Interest		**2,173.6**	**100.0%**

Report—Water Features

Water Features– Denton County, Texas										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
3—Altoga silty clay, 5 to 8 percent slopes										
Altoga	B	—	Jan-Dec	—	—	—	—	None	—	—
4—Altoga silty clay, 5 to 12 percent slopes, eroded										
Altoga, eroded	B	—	Jan-Dec	—	—	—	—	None	—	—
5—Aquilla loamy fine sand, 2 to 5 percent slopes										
Aquilla	A	—	January	4.0-5.0	4.5-6.0	—	—	None	—	None
	A	—	February	4.0-5.0	4.5-6.0	—	—	None	—	None
	A	—	March	4.0-5.0	4.5-6.0	—	—	None	—	None
	A	—	December	4.0-5.0	4.5-6.0	—	—	None	—	None
6—Arents, gently undulating										
Arents	A	—	January	—	—	—	—	None	Long	Occasional
	A	—	February	—	—	—	—	None	Long	Occasional
	A	—	March	—	—	—	—	None	Long	Occasional
	A	—	April	—	—	—	—	None	Long	Occasional
	A	—	May	—	—	—	—	None	Long	Occasional
	A	—	September	—	—	—	—	None	Long	Occasional
	A	—	October	—	—	—	—	None	Long	Occasional
	A	—	November	—	—	—	—	None	Long	Occasional
	A	—	December	—	—	—	—	None	Long	Occasional

Water Features– Denton County, Texas										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
7—Arents, hilly										
Arents	A	—	January	—	—	—	—	None	Long	Occasional
	A	—	February	—	—	—	—	None	Long	Occasional
	A	—	March	—	—	—	—	None	Long	Occasional
	A	—	April	—	—	—	—	None	Long	Occasional
	A	—	May	—	—	—	—	None	Long	Occasional
	A	—	September	—	—	—	—	None	Long	Occasional
	A	—	October	—	—	—	—	None	Long	Occasional
	A	—	November	—	—	—	—	None	Long	Occasional
	A	—	December	—	—	—	—	None	Long	Occasional
9—Bastsil fine sandy loam, 1 to 3 percent slopes										
Bastsil	B	—	Jan-Dec	—	—	—	—	None	—	—
10—Bastsil fine sandy loam, 3 to 5 percent slopes										
Bastsil	B	—	Jan-Dec	—	—	—	—	None	—	—
21—Burleson clay, 0 to 1 percent slopes										
Burleson	D	—	Jan-Dec	—	—	—	—	None	—	—
22—Burleson clay, 1 to 3 percent slopes										
Burleson	D	—	Jan-Dec	—	—	—	—	None	—	—
27—Crockett fine sandy loam, 1 to 3 percent slopes										
Crockett	D	—	Jan-Dec	—	—	—	—	None	—	—

Water Features– Denton County, Texas										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
32—Ferris-Heiden clay, 5 to 15 percent slopes										
Ferris	D	—	Jan-Dec	—	—	—	—	None	—	—
Heiden	D	—	Jan-Dec	—	—	—	—	None	—	—
33—Frio silty clay, occasionally flooded										
Frio	C	—	January	—	—	—	—	None	Brief	Occasional
	C	—	February	—	—	—	—	None	Brief	Occasional
	C	—	March	—	—	—	—	None	Brief	Occasional
	C	—	April	—	—	—	—	None	Brief	Occasional
	C	—	May	—	—	—	—	None	Brief	Occasional
	C	—	October	—	—	—	—	None	Brief	Occasional
	C	—	November	—	—	—	—	None	Brief	Occasional
	C	—	December	—	—	—	—	None	Brief	Occasional
44—Houston Black clay, 1 to 3 percent slopes										
Houston black	D	—	Jan-Dec	—	—	—	—	None	—	—
53—Lewisville clay loam, 3 to 5 percent slopes										
Lewisville	B	—	Jan-Dec	—	—	—	—	None	—	—
63—Ovan clay, occasionally flooded										
Ovan	D	—	March	—	—	—	—	None	Brief	Occasional
	D	—	April	—	—	—	—	None	Brief	Occasional
	D	—	May	—	—	—	—	None	Brief	Occasional
	D	—	June	—	—	—	—	None	Brief	Occasional

Water Features– Denton County, Texas										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
70—Seagoville clay, occasionally flooded										
Seagoville	D	—	January	—	—	—	—	None	Very brief	Occasional
	D	—	February	—	—	—	—	None	Very brief	Occasional
	D	—	March	—	—	—	—	None	Very brief	Occasional
	D	—	April	—	—	—	—	None	Very brief	Occasional
	D	—	May	—	—	—	—	None	Very brief	Occasional
	D	—	June	—	—	—	—	None	Very brief	Occasional
	D	—	October	—	—	—	—	None	Very brief	Occasional
	D	—	November	—	—	—	—	None	Very brief	Occasional
	D	—	December	—	—	—	—	None	Very brief	Occasional
72—Silstid loamy fine sand, 1 to 5 percent slopes										
Silstid	A	—	Jan-Dec	—	—	—	—	None	—	—
78—Trinity clay, occasionally flooded										
Trinity	D	—	February	—	—	—	—	None	Brief	Occasional
	D	—	March	—	—	—	—	None	Brief	Occasional
	D	—	April	—	—	—	—	None	Brief	Occasional
	D	—	May	—	—	—	—	None	Brief	Occasional
81—Vertel clay, 3 to 5 percent slopes										
Vertel	D	—	Jan-Dec	—	—	—	—	None	—	—
83—Wilson clay loam, 0 to 1 percent slopes										
Wilson	D	—	Jan-Dec	—	—	—	—	None	—	—

Water Features– Denton County, Texas										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	Ft	Ft				
84—Wilson clay loam, 1 to 3 percent slopes										
Wilson	D	—	Jan-Dec	—	—	—	—	None	—	—
W—Water										
Water	—	—	Jan-Dec	—	—	—	—	None	—	—

Data Source Information

Soil Survey Area: Denton County, Texas
Survey Area Data: Version 7, Jan 14, 2010

where

CN_{II_o} = AMC-II curve number for mild slope (unadjusted for slope)

C_o = regression constant for a given level of vegetation

C_1 = regression constant for a given level of vegetation

C_2 = regression constant for a given level of vegetation

IR = infiltration correlation parameter for given soil type

The relationship between CN_{II_o}, the vegetative cover and default soil texture is shown graphically in Figure 8. Table 7 gives values of C_0, C_1 *and* C_2 for the five types of vegetative cover built into the HELP program.

4.2.3 Adjustment of Curve Number for Surface Slope

A regression equation was developed to adjust the AMC-II curve number for surface slope conditions. The regression was developed based on kinematic wave theory where

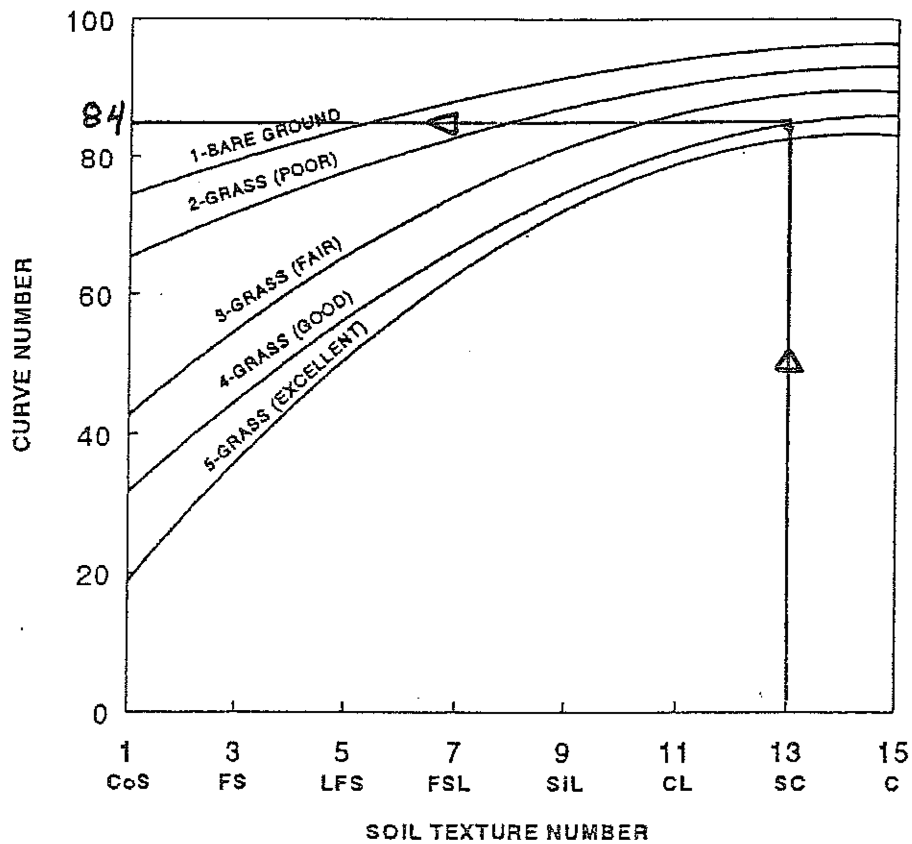


Figure 8. Relation between SCS Curve Number and Default Soil Texture Number for Various Levels of Vegetation

TABLE 5.3 Values of SCS Curve Number for Rural Areas

Source: [McCuen, 1982]

Land Use Description	Hydrologic Soil Group A	B	C	D
Fallow:				
Straight Row	77	86	91	94
Row Crops:				
Straight Row, Poor Condition	72	81	88	91
Straight Row, Good Condition	67	78	85	89
Contoured, Poor Condition	70	79	84	88
Contoured, Good Condition	65	75	82	86
Contoured and Terraced, Poor Condition	66	74	80	82
Contoured and Terraced, Good Condition	62	71	78	81
Small Grain:				
Straight Row, Poor Condition	65	76	84	88
Straight Row, Good Condition	63	75	83	87
Contoured, Poor Condition	63	74	82	85
Contoured, Good Condition	61	73	81	84
Contoured and Terraced, Poor Condition	61	72	79	82
Contoured and Terraced, Good Condition	59	70	78	81
Close-Seeded Legumes or Rotation Meadow				
Straight Row, Poor Condition	66	77	85	89
Straight Row, Good Condition	58	72	81	85
Contoured, Poor Condition	64	75	83	85
Contoured, Good Condition	55	69	78	83
Contoured and Terraced, Poor Condition	63	73	80	83
Contoured and Terraced, Good Condition	51	67	76	80
Pasture or Range:				
Poor Condition	68	79	86	89
Fair Condition	49	69	79	84
Good Condition	39	61	74	80
Contoured, Poor Condition	47	67	81	88
Contoured, Fair Condition	25	59	75	83
Contoured, Good Condition	6	35	70	79
Meadow, Good Condition	30	58	71	78
Woods or Forest Land:				
Poor Condition	45	66	77	83
Fair Condition	36	60	73	79
Good Condition	25	55	70	77
Farmsteads:	59	74	82	86

Initial and Uniform Loss Rate

An initial loss in inches (*STRTL*) and a constant loss rate (*CNSTL*) in inches per hour are specified for this method. All rainfall is lost until the volume of initial loss is satisfied. After the initial loss is satisfied, rainfall is lost at the constant rate.

This section provides guidance in selecting the values used for the initial loss and uniform loss rate in two ways:

1. By consulting previous studies of actual rainfall events for a particular watershed or region.
2. By relating the parameters to the SCS Curve Number, which can be estimated using the information presented earlier in this chapter.

Previous studies by the U.S. Army Corps of Engineers or other public agencies may provide guidance on selecting appropriate values for the initial loss and uniform loss rate for a particular location. Tables 5.4 through 5.6 list the values of initial and

HYDROGRAPH DEVELOPMENT INFORMATION

HYDROGRAPH DEVELOPMENT INFORMATION

Landfill Areas

Direct runoff methods, (i.e., kinematic wave) have been used for the majority of the landfill final cover areas. The kinematic wave method has been used to model the 4 percent topslope areas and 25 percent side slope areas before the flow is intercepted by the drainage swales. The kinematic wave method is a physically based method using slope, surface roughness, catchment lengths and areas. This method does not consider attenuation for flood wave; as a consequence, this method provides for a conservative analysis. The following typical parameters for the kinematic wave method have been developed for landfill areas.

Kinematic wave parameters for overland flow:

Slope: Varies from 0.04 to 0.25 ft/ft landfill slopes

N: 0.35 Manning's friction coefficient (based on using a value between dense grass (N = 0.24) and Bermuda grass (N = 0.41) listed in Soil Conservation Services TR-55)

L: Represents a typical distance between swales for overland flow for each drainage area. For example, as shown on Sheet IIIF-A-24, the swale spacing on 4H:1V sideslopes is 120 feet.

Percentage of drainage area represented by this element is 100 percent.

Kinematic Wave routing for channels:

- Channel length (ft): The length of the channel section.
- Channel slope (ft/ft): Varies from 0.0010 to 0.0574 (0.005 for swales).
- Channel roughness coefficient: 0.03 for grass lined channels and swales.
- Channel type: A trapezoidal channel was used with varying width and 3:1 side slopes ("V" ditch with varying side slopes for swales).

Non-Landfill Final Cover Areas

Hydrographs for the majority of non-landfill final cover areas within and near the permit boundary (e.g., pond areas) were developed using the Snyder unit hydrograph method.

Espey "10-Minute" method has been used to estimate Snyder parameters. Snyder parameter estimations are provided on pages IIIF-A-21 through IIIF-A-26.

As discussed in Section 2 of Appendix IIIF, hydrographs for the areas outside of the permit boundary (O1, O1A, O2, O3, O4, O5, O6, O7, O8, O9, OSB, and OSC), and larger areas inside the permit boundary (S7, S9, and S11) were developed using the Snyder unit hydrograph method. The percent imperviousness ranges from 2 percent to 12 percent, for the majority of the non-landfill no-site and off-site areas, which represents the majority of the watershed as undeveloped. Pond areas are assumed to be 100 percent impervious, and areas with significant channel surface or paved surfaces were assigned higher percentages of impervious area, as shown on IIIF-A-22.

Drainage Areas

The drainage areas used for this analysis are shown on Sheets IIIF-A-28 and IIIF-A-29. The routing scheme for the post-development condition is shown in the HEC-1 output file presented on pages IIIF-A-30 through IIIF-A-104.

DISTRIBUTED RUNOFF METHOD
KINEMATIC WAVE EXAMPLE

Drainage area "A7T" is used in this example (refer to Sheet IIIF-A-19 for location of drainage area).

Watershed Specific Parameters:

A =	13.58	acres	Watershed Area (acres)
A =	0.0212	sq-miles	Watershed Area (sq-miles)
CN=	84		SCS Curve Number (see sheet IIIF-A-4 for more information)

Kinematic Wave parameter for overland flow:

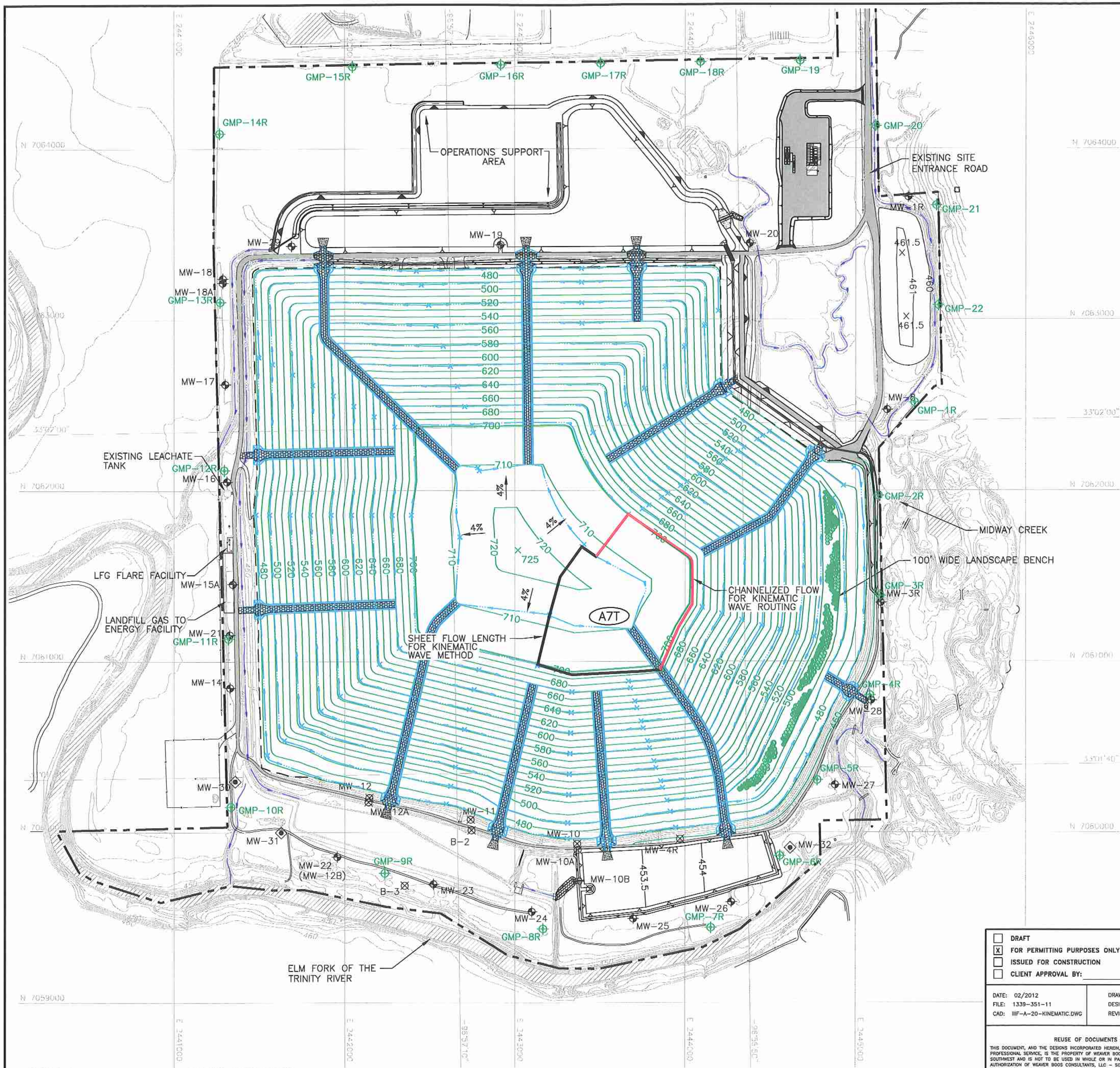
L=	312	ft	Typical overland flow (ft)
S=	0.04	ft/ft	Landfill slope (ft/ft)
N=	0.35		Manning's Coefficient

Percentage of the drainage area represented by this element is 100 percent

Kinematic Wave routing data for the swale:

L=	1133	ft	Typical swale length (ft)
S=	0.005	ft/ft	Swale bottom slope (ft/ft)
N=	0.03		Manning's Coefficient
Channel=	TRAP		Swale Type*

* A trapezoidal channel with no bottom width was used to simulate a triangular channel.



N

0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°02'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- 600 — FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- MW-8 — EXISTING GROUNDWATER MONITORING WELL
- MW-30 — PROPOSED GROUNDWATER MONITORING WELL
- GMP-20 — PROPOSED LANDFILL GAS MONITORING PROBE
- MW-12 — OBSERVATION WELL
- DRAINAGE AREA BOUNDARY
- A7T — DRAINAGE AREA DESIGNATION

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

2-28-12

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY:

DATE: 02/2012	DRAWN BY: SRF
FILE: 1339-351-11	DESIGN BY: CRM
CAD: IIIF-A-20-KINEMATIC.DWG	REVIEWED BY: JPY

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT KINEMATIC WAVE PARAMETERS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL · NAPERVILLE, IL · COLUMBUS, OH · DENVER, CO · FORT WORTH, TX (817) 735-9770 · GRIFFITH, IN · SOUTH BEND, IN · SPRINGFIELD, IL · ST. LOUIS, MO

SHEET IIIF-A-20

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-A-20-KINEMATIC WAVE.dwg, jwilson, 1:2

ESPEY 10-MINUTE METHOD PARAMETERS

Prep By: CRM
Date: 2/28/2012

Chkd By: RCE
Date: 2-28-12

CAMELOT LANDFILL
1339-351-11-02-6B.6
UNIT HYDROGRAPH DATA
PROPOSED EXPANSION CONDITION

Snyder's Hydrograph Coefficients (Espey's 10 Minute Method)

Proposed Expansion Conditions

Area No.	Area (acres)	Max. Flow Length (L) (ft)	S (ft/ft)	I (%)	Manning "n"	Φ[1]	T_r[2] (min)	T_{lag}[3] (min)	T_{lag} (hr)	Area[4] (sq mi)	q_p[5] (cfs/sq mi)	C_p[6]
O1	87.47	3,580	0.0101	23	0.04	0.80	25.7	23.2	0.39	0.1367	1059.5	0.64
O1A	23.42	2,285	0.0132	4	0.04	0.85	32.7	30.2	0.50	0.0366	864.1	0.68
O2	1008.38	14,770	0.0050	18	0.04	0.81	45.3	42.8	0.71	1.5756	524.7	0.58
O3	16.18	835	0.0611	2	0.04	0.86	20.4	17.9	0.30	0.0253	1452.4	0.68
O4	86.04	3,840	0.0180	10	0.04	0.84	28.4	25.9	0.43	0.1344	954.5	0.64
O5	116.47	2,140	0.0121	2	0.04	0.86	38.0	35.5	0.59	0.1820	690.4	0.64
S1	10.26	875	0.0020	2	0.04	0.86	48.5	46.0	0.77	0.0160	585.8	0.70
S2	30.64	2,676	0.0009	2	0.04	0.86	76.6	74.1	1.23	0.0479	344.0	0.66
S3	4.55	250	0.0120	2	0.04	0.86	23.2	20.7	0.35	0.0071	1330.2	0.72
S4	43.34	3,950	0.0058	2	0.04	0.86	52.6	50.1	0.83	0.0677	507.4	0.66
S5	7.34	1,405	0.0085	2	0.04	0.86	37.7	35.2	0.59	0.0115	778.1	0.71
S6	13.92	3,910	0.0063	2	0.04	0.86	51.4	48.9	0.81	0.0218	544.2	0.69
S7	5.39	1,015	0.0148	2	0.04	0.86	30.4	27.9	0.47	0.0084	989.9	0.72
S8	10.12	785	0.0522	2	0.04	0.86	20.9	18.4	0.31	0.0158	1440.6	0.69
S9	22.75	802	0.0279	2	0.04	0.86	24.6	22.1	0.37	0.0355	1173.3	0.68
S10	10.76	282	0.0317	2	0.04	0.86	18.7	16.2	0.27	0.0168	1617.9	0.68

[1] Conveyance efficiency coefficient from Dodson & Associates Inc., *ProHec-1 Program Documentation*, 1995, pages 6-19 and 6-20.
[2] $T_r = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\Phi^{1.57})$
[3] $T_{lag} = T_r - \Delta t/2$
[4] From area summary sheet
[5] $q_p = 31600(A^{-0.04})(T_r^{-1.07})$
[6] $C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$

T_r = surface runoff to unit hydrograph peak (min)
L = distance along main channel from study point to watershed boundary (ft)
S = main channel slope (ft/ft)
I = impervious cover within the watershed (%)
T_{lag} = watershed lag time (min)
Δt= computation interval (minutes)
q_p = unit hydrograph peak discharge (cfs/sq mi)
C_p = Snyder's peaking coefficient

Snyder Unit Hydrograph uses lag time (T_{lag}) and peaking coefficient accounting for flood wave and watershed storage conditions.

Drainage area "O1" is used in this example.

Estimated Watershed specific parameters

A =	87.47	acres	watershed area
L =	3580	feet	maximun flow length with this watershed
S =	0.0101	feet/feet	watershed slope
I =	23	percent (%)	watershed imperviousness
n =	0.04		Manning's coefficient

Calculate Tr: time beginning of surface runoff to the unit hydrograph peak in minutes

$T_r = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\Phi^{1.57})$

Estimate : conveyance efficiency coefficient
See figure 6.12 on page IIIF-A-19 for estimating
Φ = for 6 percent impervious cover and n = 0.04

$\Phi = 0.80$

$T_r = 3.1(3580^{0.23})(.010^{-0.25})(23^{-0.18})(0.8^{1.57})$

$T_r = 25.7$ min

Calculate T_{lag}: watershed lag time

$T_{lag} = Tr - (\Delta t/2)$

$T_{lag} = 23.2$ minutes

$T_{lag} = 0.39$ hours

Δt is calculation interval, and 5 minutes is used in the HEC - 1 modeling in this project

A= A/640
A= 0.1367 square miles

Calculate q_p: peak discharge of unit hydrograph per unit area (cfs/sq. mi).

$q_p = 31600(A^{-0.04})(T_r^{-1.07})$

$q_p = 31600(0.1367^{-0.04})(25.7^{-1.07})$

$q_p = 1059.5$ cfs/sq. mi

Calculate Peaking coefficient C_p:

$C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$

$C_p = 49.375(0.1367^{-0.04})(25.7^{-1.07})(0.39)$

$C_p = 0.64$

compute the value of Snyder's peaking coefficient C_p for use in HEC-1 analyses. First, the watershed lag time T_L is determined by subtracting one-half of the computation interval from the time to rise ($T_L = T_r - \Delta t/2$). Then, C_p may be computed by substituting the known values of T_L and q_p into Snyder's equation for peak unit hydrograph flow rate and solving for C_p.

$$C_p = \frac{q_p \times T_L}{640} \qquad 6.30$$

Espey "10-Minute" Method for Estimating Snyder Parameters

In another study, Espey [1977] derived the following equation for computing the time from the beginning of surface runoff to the unit hydrograph peak:

$$T_r = 3.10\, L^{0.23} S^{-0.25} I^{-0.18} \Phi^{1.57} \qquad 6.31$$

in which:

T_r = time from beginning of surface runoff to unit hydrograph peak (minutes)

L = total distance along main channel from study point to watershed boundary (feet)

S = main channel slope between the reference point and a point 0.2L downstream from the upstream watershed boundary (feet per foot)

I = impervious cover within the watershed (percent)

Φ = description of conveyance efficiency of the watershed drainage system.

The conveyance efficiency coefficient Φ is determined using the relationships illustrated on Figure 6.12.

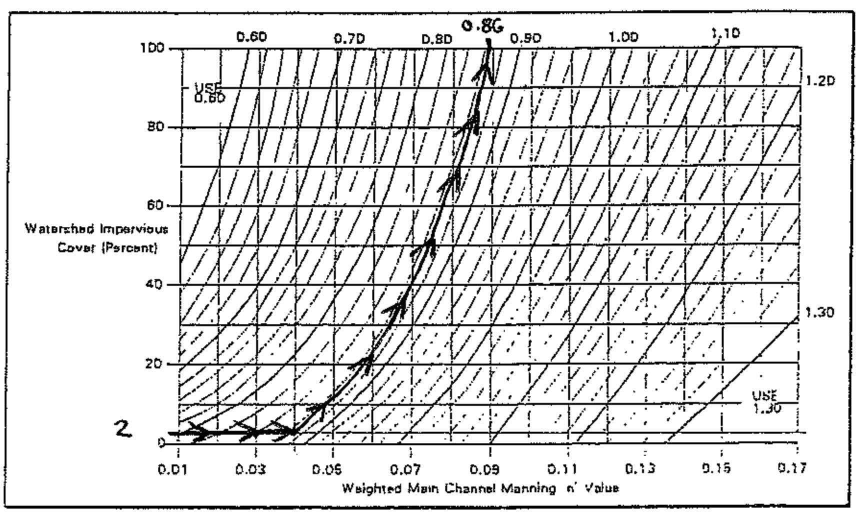


FIGURE 6.12 Determination of Conveyance Efficiency Coefficient Φ

This equation was derived from records for 41 watersheds in Texas, Tennessee, Mississippi, Pennsylvania, North Carolina, Colorado, Kentucky, and Indiana. The range in the watershed characteristics used to develop the equations for urban areas were:

Area : From 0.0128 square miles to 15.00 square miles

L : From 555 feet to 35,600 feet

S : From 0.0005 ft. per ft. to 0.0295 ft. per ft.

I : From 2% to 100%

Φ : From 0.60 to 1.30

Again, note that the time to rise T_r is not the same as the watershed lag time T_p. The difference between the two is that T_r is defined as the time from the beginning of effective rainfall to the peak of the unit hydrograph, while T_L is the time from the centroid of the effective rainfall to the peak of the unit hydrograph. For the purposes of HEC-1 analyses, however, T_L may be determined simply by subtracting one-half the computation time interval from the computed value of T_r (T_R - $\Delta t/2$).

The relationship developed by Espey to compute the peak flow rate of the unit hydrograph is as follows:

6.32 $$Q_u = 31600 \quad A^{0.96} T_r^{-1.07}$$

in which:

Q_u = unit hydrograph peak discharge (cfs)

A = drainage area (square miles)

T_r = time of rise from beginning of surface runoff to unit hydrograph peak (minutes)

Riverside County Method for Estimating Snyder Parameters

Three watershed lag equations have been derived for use in rural areas of Riverside County, California by the Riverside County Flood Control and Water Conservation District [Anonymous, 1963]. These equations differ slightly from those developed at the Tulsa District of the U.S. Army Corps of Engineers in that lag is defined as the time from the beginning of rainfall to the point on the unit hydrograph corresponding to one-half of the total runoff volume.

Each equation is applicable to a different topographic region:

6.33 $$T_L = 1.20\left(\frac{L \times L_{ca}}{\sqrt{S}}\right)^{0.38} \quad \text{(Mountain Areas)}$$

6.34 $$T_L = 0.72\left(\frac{L \times L_{ca}}{\sqrt{S}}\right)^{0.38} \quad \text{(Foothill Areas)}$$

6.35 $$T_L = 0.38\left(\frac{L \times L_{ca}}{\sqrt{S}}\right)^{0.38} \quad \text{(Valley Areas)}$$

in which:

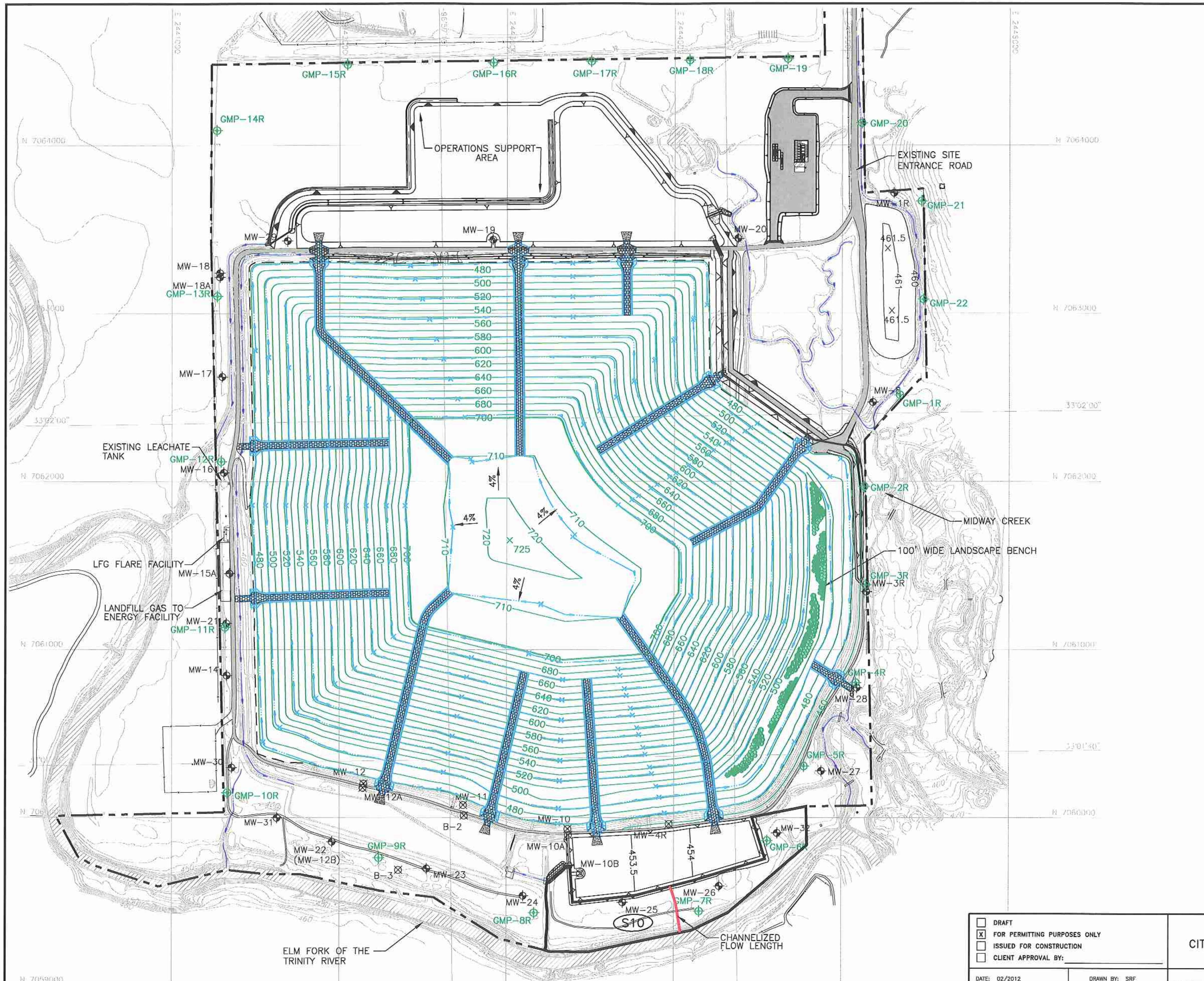
T_L = watershed lag in hours

L = watershed length in miles

L_{ca} = length to centroid in miles

S = watershed slope in feet per mile.

The sizes of the watersheds studied in developing these equations ranged from 2.3 square miles to 645 square miles.



N

0 300 600

SCALE IN FEET

LEGEND

— · — · —	PERMIT BOUNDARY
— — — —	PROPOSED LIMIT OF WASTE
N 7064000	STATE PLANE COORDINATE SYSTEM
33°02'00"	GEODETIC COORDINATE SYSTEM
500	EXISTING CONTOUR (SEE NOTE 1)
600	FINAL COVER CONTOUR
	DRAINAGE LETDOWN
	DRAINAGE SWALE
MW-8	PERMITTED GROUNDWATER MONITORING WELL
MW-12	PERMITTED GROUNDWATER OBSERVATION WELL
GMP-14R	PROPOSED GAS MONITORING PROBE
	DRAINAGE AREA BOUNDARY
S10	DRAINAGE AREA DESIGNATION

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

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☐ CLIENT APPROVAL BY:

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-A-26-ESPEY.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT ESPEY "10-MINUTE" METHOD PARAMETERS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants

TBPE REGISTRATION NO. F-3727

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SHEET IIIF-A-26

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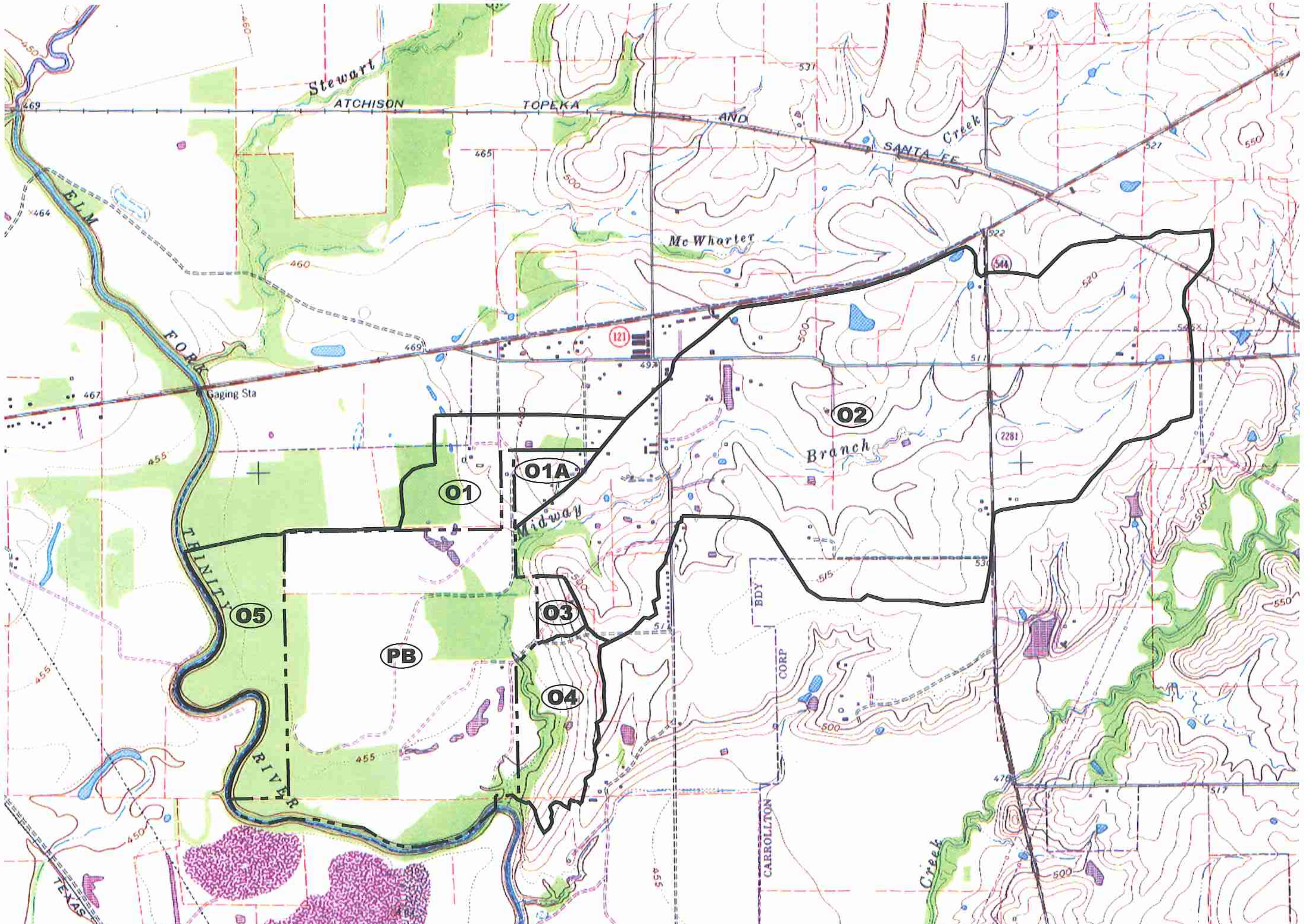
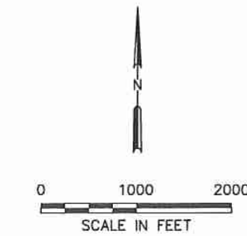
POST-DEVELOPMENT HEC-1 ANALYSIS DRAINAGE AREAS





LEGEND

- PERMIT BOUNDARY
- DRAINAGE AREA BOUNDARY
- O2 DRAINAGE AREA LABEL

DRAINAGE AREA NO.	AREA (ACRES)
O1	87.5
O1A	23.4
O2	1,008.4
O3	16.2
O4	86.0
O5	116.5
PB	462.6
TOTAL	1,807.6

ROAD CLASSIFICATION

Heavy-duty — Light-duty — Medium-duty — Unimproved dirt — Interstate Route — U.S. Route — State Route

LEWISVILLE EAST, TEX.
SW/4 FRISCO 15' QUADRANGLE
N3300—W9652.5/7.5
1960
PHOTOREVISED 1968
AMS 6650 III SW–SERIES V882

NOTES:

1. DRAINAGE AREA DELINEATION WITHIN THE PERMIT BOUNDARY IS INCLUDED ON SHEET IIIF–A–29.
2. TOPOGRAPHY REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (LEWISVILLE EAST, TX, PHOTO REVISED 1981).

STATE OF TEXAS
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84059
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2-28-12

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DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-A-28-DRAINAGE.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
OFFSITE DRAINAGE AREA MAP

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants

TBPE REGISTRATION NO. F–3727

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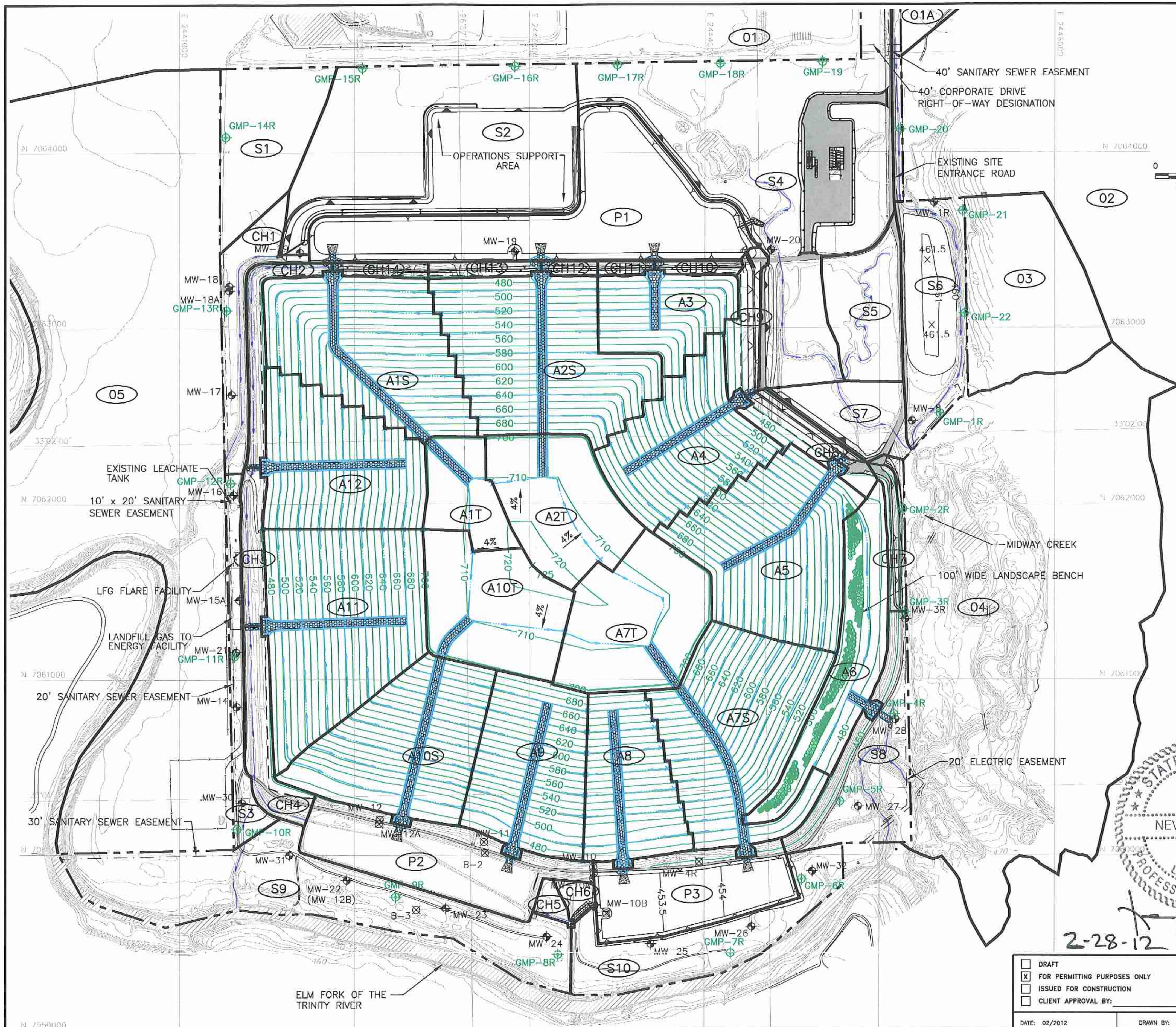
SHEET IIIF–A–28

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-A-28-OFFSITE DRAINAGE.dwg, jwilson, 1:2



LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°02'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- 600 — FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- EASEMENT BOUNDARY
- MW-8 — PERMITTED GROUNDWATER MONITORING WELL
- MW-12 — PERMITTED GROUNDWATER OBSERVATION WELL
- GMP-14R — PROPOSED GAS MONITORING PROBE
- DRAINAGE AREA BOUNDARY
- A7T — DRAINAGE AREA DESIGNATION

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.
3. MAXIMUM FINAL COVER ELEVATION IS 725 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 721.5 FT-MSL.
4. REFER TO DRAWING IIIF-A-28 FOR COMPLETE OFFSITE DRAINAGE AREA DELINEATIONS.

DRAINAGE AREA NO.	AREA (ACRES)	DRAINAGE AREA NO.	AREA (ACRES)
S1	10.26	A10T	12.37
S2	30.86	A10S	16.60
S3	4.55	A11	22.08
S4	43.34	A12	15.17
S5	7.34	CH1	5.94
S6	13.92	CH2	3.29
S7	5.39	CH3	2.71
S8	10.12	CH4	4.45
S9	22.75	CH5	0.76
S10	10.76	CH6	0.83
A1T	5.47	CH7	2.33
A1S	18.48	CH8	3.37
A2T	11.83	CH9	3.09
A2S	20.59	CH10	0.85
A3	8.07	CH11	0.56
A4	13.51	CH12	0.59
A5	19.01	CH13	1.29
A6	11.00	CH14	1.02
A7T	13.58	P1	23.10
A7S	20.36	P2	12.55
A8	10.75	P3	10.74
A9	13.99		

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DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF.2 DRAINAGE AREA.DWG

DRAWN BY: JDW
DESIGN BY: CRM
REVIEWED BY: JPY

PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
POST DEVELOPMENT DRAINAGE

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
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CHICAGO, IL; NAPERVILLE, IL; COLUMBUS, OH; DENVER, CO; FORT WORTH, TX (817) 735-9770; GRIFFITH, IN; SOUTH BEND, IN; SPRINGFIELD, IL; ST. LOUIS, MO

SHEET IIIF-A-29

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HEC-1 OUTPUT – POST-DEVELOPMENT
25-YEAR, 24-HOUR STORM EVENT

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1****************************************                                   ****************************************
 *                                      *                                   *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                   *   U.S. ARMY CORPS OF ENGINEERS       *
 *             JUN   1998               *                                   *   HYDROLOGIC ENGINEERING CENTER      *
 *          VERSION 4.1                 *                                   *        609 SECOND STREET             *
 *                                      *                                   *     DAVIS, CALIFORNIA 95616          *
 * RUN DATE   13MAY11  TIME  13:24:13   *                                   *         (916) 756-1104               *
 *                                      *                                   *                                      *
****************************************                                   ****************************************



                         X       X  XXXXXXX   XXXXX           X
                         X       X  X        X     X         XX
                         X       X  X        X                X
                         XXXXXXX    XXXX     X         XXXXX  X
                         X       X  X        X                X
                         X       X  X        X     X          X
                         X       X  XXXXXXX   XXXXX          XXX



          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                           HEC-1 INPUT                                                       PAGE  1

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                       *DIAGRAM
           1           ID        CAMELOT LANDFILL
           2           ID        PROPOSED EXPANSION CONDITION
           3           ID        25-YEAR, 24-HOUR STORM EVENT
           4           ID        FILE:\SOLID WASTE\CITY OF FARMERS BRANCH\EXPANSION\
           5           ID        PARTIII-SDP\APPENDIX IIIF\IIIFA\HEC-1\PROP25.IH1
           6           IT       5       0    2400     720       0       0
           7           IO       3       0       0
                       *

           8           KK      O1
           9           KM        OFFSITE AREA O1
          10           KO       0       0       0       7      21
          11           BA   .1367
          12           PH       4             .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44
          13           LS              87
          14           US     .39     .64
                       *

          15           KK      S4
          16           KM         SUBAREA S4
          17           KO       0       0       0       7      21
          18           BA   .0677
          19           LS       0      84
          20           US     .83     .66
                       *

          21           KK     CS4
          22           KM        COMBINE AREAS PRIOR TO POND P1 OUTLET
          23           KO       0       0       0       7      21
          24           HC       2
                       *

          25           KK     A1T
          26           KM        SUBAREA A1T
          27           KO       0       0       0       7      21
          28           BA   .0085
          29           LS       0      84
          30           UK     265     .04     .35     100
          31           RD     507    .005     .03            TRAP       0       2      NO
                       *

          32           KK     A1S
          33           KM        SUBAREA A1S
          34           KO       0       0       0       7      21
          35           BA   .0289
          36           LS       0      86
          37           UK     120     .25     .35     100
          38           RD     881    .005     .03            TRAP       0       2      NO
                       *
1                                           HEC-1 INPUT                                                       PAGE  2

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          39           KK     CA1
          40           KM        COMBINE A1 SUBAREAS
          41           KO       0       0       0       7      21
          42           HC       2
```

```
                 *

  43             KK   CH14
  44             KM        SUBAREA CH14
  45             KO      0       0       0       7      21
  46             BA   .0016
  47             LS      0      84
  48             UK     52      .1     .35     100
  49             RD    524    .005     .03            TRAP       0       3      NO
                 *

  50             KK   CCH14
  51             KM        COMBINE CH14 WITH A1 AREAS
  52             KO      0       0       0       7      21
  53             HC      2
                 *

  54             KK    A2T
  55             KM        SUBAREA A27
  56             KO      0       0       0       7      21
  57             BA   .0185
  58             LS      0      84
  59             UK    312     .04     .35     100
  60             RD    879    .005     .03            TRAP       0       2      NO
                 *

  61             KK    A2S
  62             KM        SUBAREA A2S
  63             KO      0       0       0       7      21
  64             BA   .0322
  65             LS      0      86
  66             UK    120     .25     .35     100
  67             RD    925    .005     .03            TRAP       0       2      NO
                 *

  68             KK    CA2
  69             KM        COMBINE A2 SUBAREAS
  70             KO      0       0       0       7      21
  71             HC      2
                 *

  72             KK   CH12
  73             KM        SUBAREA CH12
  74             KO      0       0       0       7      21
  75             BA   .0009
  76             LS      0      84
  77             UK     52      .1     .35     100
  78             RD    313    .005     .03            TRAP       0       3      NO
                 *
1                                            HEC-1 INPUT                                              PAGE  3

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  79             KK   CH13
  80             KM        SUBAREA CH13
  81             KO      0       0       0       7      21
  82             BA   .0020
  83             LS      0      84
  84             UK     52      .1     .35     100
  85             RD    634    .005     .03            TRAP       0       3      NO
                 *

  86             KK   CCH13
  87             KM        COMBINE CH12 AND CH13 WITH A2 AREAS
  88             KO      0       0       0       7      21
  89             HC      3
                 *

  90             KK     A3
  91             KM        SUBAREA A3
  92             KO      0       0       0       7      21
  93             BA   .0126
  94             LS      0      86
  95             UK    120     .25     .35     100
  96             RD    630    .005     .03            TRAP       0       2      NO
                 *

  97             KK   CH10
  98             KM        SUBAREA CH10
  99             KO      0       0       0       7      21
 100             BA   .0013
 101             LS      0      84
 102             UK     52      .1     .35     100
 103             RD    483    .005     .03            TRAP       0       3      NO
                 *

 104             KK   CH11
 105             KM        SUBAREA CH11
 106             KO      0       0       0       7      21
 107             BA   .0009
 108             LS      0      84
 109             UK     52      .1     .35     100
 110             RD    313    .005     .03            TRAP       0       3      NO
                 *

 111             KK   CCH11
```

```
KM        COMBINE CH10 AND CH11 WITH AREA A3
KO       0       0       0       7      21
HC       3
*

KK     CA3
KM        COMBINE AREAS FLOWING DIRECTLY INTO P1
KO       0       0       0       7      21
HC       3
*
1                                         HEC-1 INPUT                                                PAGE  4

ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

KK     CH7
KM        CHANNEL CH7
KO       0       0       0       7      21
BA   .0036
LS       0      84
UK      82     .25     .35     100
RD     830    .003     .03            TRAP       5       2      NO
*

KK      A5
KM        SUBAREA A5
KO       0       0       0       7      21
BA   .0297
LS       0      86
UK     120     .25     .35     100
RD    1007    .005     .03            TRAP       0       2      NO
*

KK     CA5
KM        COMBINE CH7 AND A5 BEFORE ROUTING THROUGH CH8
KO       0       0       0       7      21
HC       2
*

KK     CH8
KM        CHANNEL CH8
KO       0       0       0       7      21
BA   .0053
LS       0      84
UK      46   .0652     .35     100
RD     707     .03     .03            TRAP       5       2     YES
*

KK      A4
KM        SUBAREA A4
KO       0       0       0       7      21
BA   .0211
LS       0      86
UK     120     .25     .35     100
RD     403    .005     .03            TRAP       0       2      NO
*

KK     CA4
KM        COMBINE WITH A4 BEFORE ROUTING THROUGH CH9
KO       0       0       0       7      21
HC       2
*

KK     CH9
KM        CHANNEL CH9
KO       0       0       0       7      21
BA   .0048
LS       0      84
UK      75      .1     .35     100
1                                         HEC-1 INPUT                                                PAGE  5

ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

RD     670     .03     .03            TRAP       5       2     YES
*

KK      P1
KM        DETENTION POND P1
KO       0       0       0       7      21
BA   .0361
LS             100
UD       0
*

KK   P1-IN
KM        COMBINE AREAS DISCHARGING TO POND P1
KO       0       0       0       7      21
HC       3
*

KK     RP1
KM        ROUTE THROUGH POND P1
KO       0       0       0       7      21
RS       1    ELEV   454.5
SA       0 17.7532 18.1645 18.5771 18.9910 19.4062 19.8227 20.2405
SE   454.5     455     456     457     458     459     460     461
SS     458      25     2.6     1.5
```

```
179          SL   455.5  3.1416     .8      .5
             *

180          KK     CP1
181          KM        COMBINE DOWNSTREAM OF POND P1 OUTLET
182          KO      0       0       0       7       21
183          HC      2
             *

184          KK      S5
185          KM        SUBAREA S5
186          KO      0       0       0       7       21
187          BA    .0115
188          LS      0      84
189          US     .59     .71
             *

190          KK     CS5
191          KM        COMBINE AREAS UPSTREAM OF S7
192          KO      0       0       0       7       21
193          HC      2
             *

194          KK      S7
195          KM        SUBAREA S7
196          KO      0       0       0       7       21
197          BA    .0084
198          LS      0      84
199          US     .47     .72
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

200          KK     CS7
201          KM        COMBINE WITH AREA S7
202          KO      0       0       0       7       21
203          HC      2
             *

204          KK     O1A
205          KM        OFFSITE AREA O1A
206          KO      0       0       0       7       21
207          BA    .0366
208          LS      0      85
209          US      .5     .68
             *

210          KK      O2
211          KM        OFFSITE AREA O2
212          KO      0       0       0       7       21
213          BA  1.5756
214          LS      0      85
215          US     .71     .58
             *

216          KK      O3
217          KM        OFFSITE AREA O3
218          KO      0       0       0       7       21
219          BA    .0253
220          LS      0      84
221          US     .30     .68
             *

222          KK      S6
223          KM        SUBAREA S6
224          KO      0       0       0       7       21
225          BA    .0218
226          LS      0      84
227          US     .81     .69
             *

228          KK     CS6
229          KM        COMBINE AREAS DISCHARGING OFF OF P.B.
230          KO      0       0       0       7       21
231          HC      5
             *

232          KK      O4
233          KM        OFFSITE AREA O4
234          KO      0       0       0       7       21
235          BA    .1344
236          LS      0      84
237          US     .43     .64
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

238          KK     CO4
239          KM        MIDWAY BRANCH DISCHARGING BACK ONTO P.B.
240          KO      0       0       0       7       21
241          HC      2
             *
```

```
  242          KK      A6
  243          KM        SUBAREA A6
  244          KO       0       0       0       7      21
  245          BA     .0172
  246          LS       0      86
  247          UK     120     .25     .35     100
  248          RD    1314    .002     .03            TRAP       0       2      NO
               *

  249          KK      S8
  250          KM        SUBAREA S8
  251          KO       0       0       0       7      21
  252          BA     .0158
  253          LS       0      84
  254          US     .31     .69
               *

  255          KK     CS8
  256          KM        MIDWAY BRANCH DISCHARGING OFF OF P.B.
  257          KO       0       0       0       7      21
  258          HC       3
               *

  259          KK      S1
  260          KM        SUBAREA S1
  261          KO       0       0       0       7      21
  262          BA     .0160
  263          LS       0      84
  264          US     .77     .70
               *

  265          KK      S2
  266          KM        SUBAREA S2
  267          KO       0       0       0       7      21
  268          BA     .0479
  269          LS       0      84
  270          US    1.23     .66
               *

  271          KK     CH1
  272          KM        CHANNEL CH1
  273          KO       0       0       0       7      21
  274          BA     .0093
  275          LS       0      84
  276          UK     411    .005     .35     100
  277          RD    1283   .0016     .03            TRAP      15       4     YES
               *
1                                          HEC-1 INPUT                                          PAGE  8

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  278          KK      S3
  279          KM        SUBAREA S3
  280          KO       0       0       0       7      21
  281          BA     .0071
  282          LS       0      84
  283          US     .35     .72
               *

  284          KK      O5
  285          KM        OFFSITE AREA O5
  286          KO       0       0       0       7      21
  287          BA     .1820
  288          LS       0      84
  289          US     .59     .64
               *

  290          KK     CO5
  291          KM        COMBINE WEST AREAS DISCHARGING TO ELM FORK
  292          KO       0       0       0       7      21
  293          HC       4
               *

  294          KK     CH2
  295          KM        CHANNEL CH2
  296          KO       0       0       0       7      21
  297          BA     .0051
  298          LS       0      84
  299          UK      82   .0122     .35     100
  300          RD    1539   .0016     .03            TRAP       8       2      NO
               *

  301          KK     A12
  302          KM        SUBAREA A12
  303          KO       0       0       0       7      21
  304          BA     .0237
  305          LS       0      86
  306          UK     120     .25     .35     100
  307          RD     559    .005     .03            TRAP       0       2      NO
               *

  308          KK    CA12
  309          KM        COMBINE CH2 AND A12
  310          KO       0       0       0       7      21
  311          HC       2
               *
```

```
 312          KK     CH3
 313          KM        CHANNEL CH3
 314          KO      0        0        0        7       21
 315          BA   .0042
 316          LS      0       84
 317          UK     92    .0435      .35      100
 318          RD    840    .0012      .03               TRAP      10        2      YES
              *
1                                           HEC-1 INPUT                                            PAGE  9

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 319          KK     A11
 320          KM        SUBAREA A11
 321          KO      0        0        0        7       21
 322          BA   .0345
 323          LS      0       86
 324          UK    120      .25      .35      100
 325          RD    842     .005      .03               TRAP       0        2       NO
              *

 326          KK    CA11
 327          KM        COMBINE WITH CH3 AND A11
 328          KO      0        0        0        7       21
 329          HC      2
              *

 330          KK     CH4
 331          KM        CHANNEL CH4
 332          KO      0        0        0        7       21
 333          BA   .0070
 334          LS      0       84
 335          UK    101    .0792      .35      100
 336          RD   1180    .0025      .03               TRAP      10        2      YES
              *

 337          KK    A10T
 338          KM        SUBAREA A10T
 339          KO      0        0        0        7       21
 340          BA   .0193
 341          LS      0       84
 342          UK    265      .04      .35      100
 343          RD    772     .005      .03               TRAP       0        2       NO
              *

 344          KK    A10S
 345          KM        SUBAREA A10S
 346          KO      0        0        0        7       21
 347          BA   .0259
 348          LS      0       86
 349          UK    120      .25      .35      100
 350          RD    764     .005      .03               TRAP       0        2       NO
              *

 351          KK    CA10
 352          KM        COMBINE A10 SUBAREAS
 353          KO      0        0        0        7       21
 354          HC      2
              *

 355          KK      A9
 356          KM        SUBAREA A9
 357          KO      0        0        0        7       21
 358          BA   .0219
 359          LS      0       86
 360          UK    120      .25      .35      100
1                                           HEC-1 INPUT                                            PAGE 10

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 361          RD    399     .005      .03               TRAP       0        2       NO
              *

 362          KK      P2
 363          KM        DETENTION POND P2
 364          KO      0        0        0        7       21
 365          BA   .0196
 366          LS             100
 367          UD      0
              *

 368          KK   P2-IN
 369          KM        COMBINE AREAS DISCHARGING TO POND P2
 370          KO      0        0        0        7       21
 371          HC      4
              *

 372          KK     RP2
 373          KM        ROUTE THROUGH POND P2
 374          KO      0        0        0        7       21
 375          RS      1     ELEV      454
 376          SA      0   4.4466   6.7860   8.2567   8.3782   8.5005   8.6236   8.8721   9.1240
 377          SE    454    454.5      455    455.5      456    456.5      457      458      459
 378          SS    458       25      2.6      1.5
 379          SL    456   14.137       .8       .5
```

```
                *

 380            KK     CH5
 381            KM         CHANNEL CH5
 382            KO       0         0         0         7        21
 383            BA   .0012
 384            LS       0        84
 385            UK     197     .0051       .35       100
 386            RD     155      .005       .03                TRAP        20         2       YES
                *

 387            KK     A7T
 388            KM         SUBAREA A7T
 389            KO       0         0         0         7        21
 390            BA   .0212
 391            LS       0        84
 392            UK     312       .04       .35       100
 393            RD    1133      .005       .03                TRAP         0         2        NO
                *

 394            KK     A7S
 395            KM         SUBAREA A7S
 396            KO       0         0         0         7        21
 397            BA   .0318
 398            LS       0        86
 399            UK     120       .25       .35       100
 400            RD    1094      .005       .03                TRAP         0         2        NO
                *
```



```
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 401            KK     CA7
 402            KM         COMBINE A7 SUBAREAS
 403            KO       0         0         0         7        21
 404            HC       2
                *

 405            KK      A8
 406            KM         SUBAREA A8
 407            KO       0         0         0         7        21
 408            BA   .0168
 409            LS       0        86
 410            UK     120       .25       .35       100
 411            RD     399      .005       .03                TRAP         0         2        NO
                *

 412            KK      P3
 413            KM         DETENTION POND P3
 414            KO       0         0         0         7        21
 415            BA   .0168
 416            LS               100
 417            UD       0
                *

 418            KK  P3-IN
 419            KM         COMBINE AREAS DISCHARGING TO POND P3
 420            KO       0         0         0         7        21
 421            HC       3
                *

 422            KK     RP3
 423            KM         ROUTE THROUGH POND P3
 424            KO       0         0         0         7        21
 425            RS       1      ELEV       453
 426            SA       0     5.356     7.771     7.965     8.160     8.357     8.555
 427            SE     453       454       455       456       457       458       459
 428            SS     458        25       2.6       1.5
 429            SL   454.5     7.069        .8        .5
                *

 430            KK     CH6
 431            KM         CHANNEL CH6
 432            KO       0         0         0         7        21
 433            BA   .0013
 434            LS       0        84
 435            UK      50        .1       .35       100
 436            RD     155      .005       .03                TRAP        20         2       YES
                *

 437            KK    CCH6
 438            KM         COMBINE AREAS UPSTREAM OF S8
 439            KO       0         0         0         7        21
 440            HC       2
                *
```



```
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 441            KK      S9
 442            KM         SUBAREA S9
 443            KO       0         0         0         7        21
 444            BA   .0355
 445            LS       0        84
 446            US     .37       .68
```

```
                  *

        447       KK     S10
        448       KM        SUBAREA S10
        449       KO      0         0         0         7        21
        450       BA   .0168
        451       LS      0        84
        452       US    .27       .68
                  *

        453       KK     CS9
        454       KM        COMBINE AREAS DISCHARGING SOUTH OFF OF P.B.
        455       KO      0         0         0         7        21
        456       HC      3
                  *
        457       ZZ
```

1

```
            SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

   8          O1
              .
              .
  15          .          S4
              .          .
              .          .
  21         CS4..........
              .
              .
  25          .         A1T
              .          .
              .          .
  32          .          .          A1S
              .          .           .
              .          .           .
  39          .         CA1...........
              .          .
              .          .
  43          .          .          CH14
              .          .           .
              .          .           .
  50          .       CCH14...........
              .          .
              .          .
  54          .          .          A2T
              .          .           .
              .          .           .
  61          .          .           .          A2S
              .          .           .           .
              .          .           .           .
  68          .          .          CA2...........
              .          .           .
              .          .           .
  72          .          .           .          CH12
              .          .           .           .
              .          .           .           .
  79          .          .           .           .          CH13
              .          .           .           .           .
              .          .           .           .           .
  86          .          .        CCH13.......................
              .          .           .
              .          .           .
  90          .          .           .          A3
              .          .           .           .
              .          .           .           .
  97          .          .           .           .          CH10
              .          .           .           .           .
              .          .           .           .           .
 104          .          .           .           .           .          CH11
              .          .           .           .           .           .
              .          .           .           .           .           .
 111          .          .           .        CCH11.......................
              .          .           .           .
              .          .           .           .
 115          .         CA3.......................
              .          .
              .          .
 119          .          .          CH7
              .          .           .
              .          .           .
 126          .          .           .          A5
              .          .           .           .
              .          .           .           .
 133          .          .          CA5...........
              .          .           V
              .          .           V
 137          .          .          CH8 ***
              .          .           .
              .          .           .
 144          .          .           .          A4
              .          .           .           .
              .          .           .           .
 151          .          .          CA4...........
              .          .           V
```

```
                                v
155         .         .       CH9 ***
            .         .         .
            .         .         .
162         .         .         .         P1
            .         .         .          .
            .         .         .          .
168         .       P1-IN...................
            .         V
            .         V
172         .        RP1
            .         .
            .         .
180        CP1.........
            .
            .
184         .         S5
            .         .
            .         .
190        CS5.........
            .
            .
194         .         S7
            .         .
            .         .
200        CS7.........
            .
            .
204         .        O1A
            .         .
            .         .
210         .         .        O2
            .         .         .
            .         .         .
216         .         .         .         O3
            .         .         .          .
            .         .         .          .
222         .         .         .          .         S6
            .         .         .          .          .
            .         .         .          .          .
228        CS6.........................................
            .
            .
232         .         O4
            .         .
            .         .
238        CO4.........
            .
            .
242         .         A6
            .         .
            .         .
249         .         .        S8
            .         .         .
            .         .         .
255        CS8...................
            .
            .
259         .         S1
            .         .
            .         .
265         .         .        S2
            .         .         V
            .         .         V
271         .         .       CH1 ***
            .         .         .
            .         .         .
278         .         .         .         S3
            .         .         .          .
            .         .         .          .
284         .         .         .          .         O5
            .         .         .          .          .
            .         .         .          .          .
290         .        CO5.............................
            .         .
            .         .
294         .         .       CH2
            .         .         .
            .         .         .
301         .         .         .         A12
            .         .         .          .
            .         .         .          .
308         .         .       CA12.........
            .         .         V
            .         .         V
312         .         .       CH3 ***
            .         .         .
            .         .         .
319         .         .         .         A11
            .         .         .          .
            .         .         .          .
326         .         .       CA11.........
            .         .         V
            .         .         V
330         .         .       CH4 ***
            .         .         .
            .         .         .
```

```
  337         .           .           .       A10T
              .           .           .         .
              .           .           .         .
  344         .           .           .         .          A10S
              .           .           .         .            .
              .           .           .         .            .
  351         .           .           .       CA10............
              .           .           .         .
              .           .           .         .
  355         .           .           .         .           A9
              .           .           .         .            .
              .           .           .         .            .
  362         .           .           .         .            .           P2
              .           .           .         .            .            .
              .           .           .         .            .            .
  368         .           .         P2-IN..................................
              .           .           V
              .           .           V
  372         .           .          RP2
              .           .           V
              .           .           V
  380         .           .          CH5 ***
              .           .           .
              .           .           .
  387         .           .           .        A7T
              .           .           .         .
              .           .           .         .
  394         .           .           .         .          A7S
              .           .           .         .            .
              .           .           .         .            .
  401         .           .           .        CA7............
              .           .           .         .
              .           .           .         .
  405         .           .           .         .           A8
              .           .           .         .            .
              .           .           .         .            .
  412         .           .           .         .            .           P3
              .           .           .         .            .            .
              .           .           .         .            .            .
  418         .           .           .      P3-IN.......................
              .           .           .         V
              .           .           .         V
  422         .           .           .        RP3
              .           .           .         V
              .           .           .         V
  430         .           .           .        CH6 ***
              .           .           .         .
              .           .           .         .
  437         .           .         CCH6............
              .           .           .
              .           .           .
  441         .           .           .         S9
              .           .           .         .
              .           .           .         .
  447         .           .           .         .          S10
              .           .           .         .            .
              .           .           .         .            .
  453         .           .          CS9.......................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                 ****************************************
 *                                       *                 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                 *   U.S. ARMY CORPS OF ENGINEERS       *
 *            JUN   1998                 *                 *   HYDROLOGIC ENGINEERING CENTER      *
 *          VERSION 4.1                  *                 *        609 SECOND STREET             *
 *                                       *                 *      DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   13MAY11  TIME  13:24:13   *                 *         (916) 756-1104               *
 *                                       *                 *                                      *
 *****************************************                 ****************************************


                              CAMELOT LANDFILL
                              PROPOSED EXPANSION CONDITION
                              25-YEAR, 24-HOUR STORM EVENT
                              FILE:\SOLID WASTE\CITY OF FARMERS BRANCH\EXPANSION\
                              PARTIII-SDP\APPENDIX IIIF\IIIFA\HEC-1\PROP25.IH1

  7 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          5  MINUTES IN COMPUTATION INTERVAL
                      IDATE     1    0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        720  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     4    0  ENDING DATE
                     NDTIME       1155  ENDING TIME
                      ICENT         19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   59.92 HOURS
```

```
ENGLISH UNITS
    DRAINAGE AREA          SQUARE MILES
    PRECIPITATION DEPTH    INCHES
    LENGTH, ELEVATION      FEET
    FLOW                   CUBIC FEET PER SECOND
    STORAGE VOLUME         ACRE-FEET
    SURFACE AREA           ACRES
    TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  8 KK    *       O1   *
          *            *
          **************
                      OFFSITE AREA O1

 10 KO         OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 11 BA         SUBBASIN CHARACTERISTICS
                    TAREA        .14  SUBBASIN AREA

               PRECIPITATION DATA

 12 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                             STORM AREA =       .14

 13 LS         SCS LOSS RATE
                   STRTL         .30  INITIAL ABSTRACTION
                  CRVNBR       87.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

 14 US         SNYDER UNITGRAPH
                      TP         .39  LAG
                      CP         .64  PEAKING COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                         ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=    .45 HR,       R=   .34 HR
                                         SNYDER   TP=    .39 HR,      CP=   .65

                                                     UNIT HYDROGRAPH
                                                25 END-OF-PERIOD ORDINATES
            13.        46.        89.       127.       144.       135.       110.        86.        67.        53.
            41.        32.        25.        20.        15.        12.         9.         7.         6.         5.
             4.         3.         2.         2.         1.

     ***           ***           ***           ***           ***

                    HYDROGRAPH AT STATION       O1

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.53, TOTAL EXCESS =     5.90

  PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      59.92-HR
+   (CFS)       (HR)
                           (CFS)
+     298.     12.42                  70.         22.          9.          9.
                         (INCHES)   4.730       5.877       5.877       5.877
                          (AC-FT)     34.         43.         43.         43.

                     CUMULATIVE AREA =       .14 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
 15 KK    *       S4   *
          *            *
          **************
                      SUBAREA S4
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 17 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS

              SUBBASIN RUNOFF DATA

 18 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .07  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                   STORM AREA =       .07

 19 LS          SCS LOSS RATE
                     STRTL          .38  INITIAL ABSTRACTION
                    CRVNBR        84.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 20 US          SNYDER UNITGRAPH
                        TP          .83  LAG
                        CP          .66  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                   ***

                                                  UNIT HYDROGRAPH PARAMETERS
                                            CLARK   TC=   .94 HR,       R=   .69 HR
                                           SNYDER   TP=   .84 HR,      CP=   .67

                                                       UNIT HYDROGRAPH
                                                  50 END-OF-PERIOD ORDINATES
                 1.        4.        8.       13.       18.       24.       28.       32.       34.       36.
                35.       33.       29.       26.       23.       20.       18.       16.       14.       13.
                11.       10.        9.        8.        7.        6.        5.        5.        4.        4.
                 3.        3.        3.        2.        2.        2.        2.        1.        1.        1.
                 1.        1.        1.        1.        1.        1.        0.        0.        0.        0.

      ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION        S4

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                      6-HR         24-HR        72-HR       59.92-HR
+   (CFS)       (HR)
                           (CFS)
+       94.     12.92                  33.          10.           4.           4.
                         (INCHES)    4.467        5.531        5.531        5.531
                          (AC-FT)      16.          20.          20.          20.

                      CUMULATIVE AREA =      .07 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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            *            *
 21 KK      *      CS4   *
            *            *
            **************
                             COMBINE AREAS PRIOR TO POND P1 OUTLET

 23 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


 24 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                   ***

      ***            ***            ***            ***            ***
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                                   HYDROGRAPH AT STATION       CS4

  PEAK FLOW     TIME                               MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR       72-HR      59.92-HR
+   (CFS)       (HR)
                              (CFS)
+     364.      12.50                     102.          32.          13.           13.
                            (INCHES)     4.633        5.763        5.763         5.763
                             (AC-FT)       51.          63.          63.           63.

                            CUMULATIVE AREA =      .20 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  25 KK       *    A1T     *
              *            *
              **************
                                   SUBAREA A1T

  27 KO            OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

  28 BA            SUBBASIN CHARACTERISTICS
                         TAREA         .01  SUBBASIN AREA

                   PRECIPITATION DATA

  12 PH                                 DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                  STORM AREA =       .01

  29 LS            SCS LOSS RATE
                         STRTL         .38  INITIAL ABSTRACTION
                        CRVNBR       84.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
  30 UK              OVERLAND-FLOW ELEMENT NO. 1
                             L        265.  OVERLAND FLOW LENGTH
                             S       .0400  SLOPE
                             N        .350  ROUGHNESS COEFFICIENT
                            PA       100.0  PERCENT OF SUBBASIN
                         DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
  31 RD              MAIN CHANNEL
                             L        507.  CHANNEL LENGTH
                             S       .0050  SLOPE
                             N        .030  CHANNEL ROUGHNESS COEFFICIENT
                            CA         .01  CONTRIBUTING AREA
                         SHAPE        TRAP  CHANNEL SHAPE
                            WD         .00  BOTTOM WIDTH OR DIAMETER
                             Z        2.00  SIDE SLOPE
                        RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                               ***
                                       COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                              COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT         DX        PEAK     TIME TO      VOLUME     MAXIMUM
                                                                                      PEAK                  CELERITY
                                                     (MIN)       (FT)      (CFS)     (MIN)        (IN)       (FPS)

                    PLANE1        .85      1.67       2.24      53.00      28.38     727.52        5.55         .40
                    MAIN         1.63      1.33       2.26     253.50      27.96     728.16        5.50        3.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2520E+01 OUTFLOW= .2491E+01 BASIN STORAGE= .4099E-03 PERCENT ERROR=    1.1


                                             INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN         1.63      1.33       5.00                 27.39     730.00        5.49

      ***            ***            ***             ***            ***

                                   HYDROGRAPH AT STATION       A1T
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     TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
                                          6-HR         24-HR        72-HR       59.92-HR
+    (CFS)        (HR)
                              (CFS)
+      27.        12.17                    4.            1.           1.            1.
                            (INCHES)     4.488         5.487        5.492         5.492
                             (AC-FT)        2.            2.           2.            2.

                          CUMULATIVE AREA =      .01 SQ MI
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*** ***

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              **************
              *            *
   32 KK      *      A1S   *
              *            *
              **************
                                  SUBAREA A1S

   34 KO           OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

   35 BA           SUBBASIN CHARACTERISTICS
                         TAREA         .03  SUBBASIN AREA

                   PRECIPITATION DATA

   12 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                        STORM AREA =       .03

   36 LS           SCS LOSS RATE
                         STRTL         .33  INITIAL ABSTRACTION
                        CRVNBR       86.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
   37 UK             OVERLAND-FLOW ELEMENT NO. 1
                             L        120.  OVERLAND FLOW LENGTH
                             S       .2500  SLOPE
                             N        .350  ROUGHNESS COEFFICIENT
                            PA       100.0  PERCENT OF SUBBASIN
                         DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
   38 RD             MAIN CHANNEL
                             L        881.  CHANNEL LENGTH
                             S       .0050  SLOPE
                             N        .030  CHANNEL ROUGHNESS COEFFICIENT
                            CA         .03  CONTRIBUTING AREA
                         SHAPE        TRAP  CHANNEL SHAPE
                            WD         .00  BOTTOM WIDTH OR DIAMETER
                             Z        2.00  SIDE SLOPE
                        RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                                 ***
                                      COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                             COMPUTATION TIME STEP
                      ELEMENT    ALPHA        M          DT         DX        PEAK     TIME TO     VOLUME    MAXIMUM
                                                                                         PEAK                 CELERITY
                                                        (MIN)      (FT)       (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.13      1.67         .70      24.00     145.61    725.02       5.79        .61
                     MAIN          1.63      1.33        2.61     440.50     137.15    724.04       5.64       5.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .8923E+01 OUTFLOW= .8693E+01 BASIN STORAGE= .4875E-03 PERCENT ERROR=   2.6

                                                INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33        5.00                131.18    725.00       5.64

       ***             ***             ***             ***             ***

                              HYDROGRAPH AT STATION       A1S

     TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79
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```
  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                         6-HR         24-HR       72-HR      59.92-HR
+    (CFS)       (HR)
                             (CFS)
+     131.      12.08                     14.          4.          2.            2.
                           (INCHES)     4.649        5.640       5.641         5.641
                            (AC-FT)        7.           9.          9.            9.

                            CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
   39 KK       *     CA1    *
               *            *
               **************
                                     COMBINE A1 SUBAREAS

   41 KO            OUTPUT CONTROL VARIABLES
                          IPRNT            3  PRINT CONTROL
                          IPLOT            0  PLOT CONTROL
                          QSCAL           0.  HYDROGRAPH PLOT SCALE
                          IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                           IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT         .083  TIME INTERVAL IN HOURS


   42 HC            HYDROGRAPH COMBINATION
                          ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                           ***

       ***              ***               ***                ***               ***

                                HYDROGRAPH AT STATION       CA1

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                         6-HR         24-HR       72-HR      59.92-HR
+    (CFS)       (HR)
                             (CFS)
+     156.      12.08                     19.          6.          2.            2.
                           (INCHES)     4.610        5.605       5.607         5.607
                            (AC-FT)        9.          11.         11.           11.

                            CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
   43 KK       *    CH14    *
               *            *
               **************
                                     SUBAREA CH14

   45 KO            OUTPUT CONTROL VARIABLES
                          IPRNT            3  PRINT CONTROL
                          IPLOT            0  PLOT CONTROL
                          QSCAL           0.  HYDROGRAPH PLOT SCALE
                          IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                           IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT         .083  TIME INTERVAL IN HOURS


                  SUBBASIN RUNOFF DATA

   46 BA            SUBBASIN CHARACTERISTICS
                          TAREA          .00  SUBBASIN AREA

                    PRECIPITATION DATA

   12 PH                                   DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                    ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
                    5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                      .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                          STORM AREA =       .00

   47 LS            SCS LOSS RATE
                          STRTL          .38  INITIAL ABSTRACTION
                         CRVNBR        84.00  CURVE NUMBER
                          RTIMP          .00  PERCENT IMPERVIOUS AREA
```

```
               KINEMATIC WAVE
 48 UK           OVERLAND-FLOW ELEMENT NO. 1
                         L          52.  OVERLAND FLOW LENGTH
                         S        .1000  SLOPE
                         N         .350  ROUGHNESS COEFFICIENT
                        PA        100.0  PERCENT OF SUBBASIN
                     DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 49 RD           MAIN CHANNEL
                         L         524.  CHANNEL LENGTH
                         S        .0050  SLOPE
                         N         .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA          .00  CONTRIBUTING AREA
                     SHAPE         TRAP  CHANNEL SHAPE
                        WD          .00  BOTTOM WIDTH OR DIAMETER
                         Z         3.00  SIDE SLOPE
                    RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                           ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                ELEMENT    ALPHA      M        DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                            PEAK                CELERITY
                                              (MIN)      (FT)     (CFS)     (MIN)      (IN)      (FPS)

               PLANE1       1.35     1.67       .67     10.40      7.93    724.45      5.56       .33
               MAIN         1.48     1.33      3.46    262.00      7.12    725.83      5.49      2.53

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4743E+00 OUTFLOW= .4688E+00 BASIN STORAGE= .3115E-03 PERCENT ERROR=   1.1

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

               MAIN         1.48     1.33      5.00                7.05    725.00      5.48

    ***             ***            ***             ***             ***

                        HYDROGRAPH AT STATION      CH14

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR         72-HR       59.92-HR
+   (CFS)        (HR)
                          (CFS)
+       7.      12.08                    1.            0.            0.            0.
                         (INCHES)    4.503         5.483         5.483         5.483
                          (AC-FT)       0.            0.            0.            0.

                        CUMULATIVE AREA =      .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 50 KK      *    CCH14   *
            *            *
            **************
                              COMBINE CH14 WITH A1 AREAS

 52 KO         OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE
                     IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                      IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT         .083  TIME INTERVAL IN HOURS


 53 HC         HYDROGRAPH COMBINATION
                     ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                           ***

    ***             ***            ***             ***             ***

                        HYDROGRAPH AT STATION     CCH14

  PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR         72-HR       59.92-HR
+   (CFS)        (HR)
                          (CFS)
+     163.      12.08                   19.            6.            2.            2.
                         (INCHES)    4.605         5.600         5.602         5.602
                          (AC-FT)      10.           12.           12.           12.

                        CUMULATIVE AREA =      .04 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  54 KK   *      A2T   *
          *            *
          **************
                         SUBAREA A27

  56 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  57 BA        SUBBASIN CHARACTERISTICS
                     TAREA        .02  SUBBASIN AREA

               PRECIPITATION DATA

  12 PH                          DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                STORM AREA =      .02

  58 LS        SCS LOSS RATE
                     STRTL        .38  INITIAL ABSTRACTION
                    CRVNBR      84.00  CURVE NUMBER
                     RTIMP        .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  59 UK          OVERLAND-FLOW ELEMENT NO. 1
                         L       312.  OVERLAND FLOW LENGTH
                         S      .0400  SLOPE
                         N       .350  ROUGHNESS COEFFICIENT
                        PA      100.0  PERCENT OF SUBBASIN
                     DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
  60 RD          MAIN CHANNEL
                         L       879.  CHANNEL LENGTH
                         S      .0050  SLOPE
                         N       .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA        .02  CONTRIBUTING AREA
                     SHAPE       TRAP  CHANNEL SHAPE
                        WD        .00  BOTTOM WIDTH OR DIAMETER
                         Z       2.00  SIDE SLOPE
                    RUPSTQ         NO  ROUTE UPSTREAM HYDROGRAPH

                                                       ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                 ELEMENT    ALPHA       M         DT         DX       PEAK    TIME TO      VOLUME    MAXIMUM
                                                                               PEAK                 CELERITY
                                                (MIN)       (FT)      (CFS)    (MIN)        (IN)      (FPS)

                PLANE1        .85      1.67      2.54      62.40      58.76    728.32       5.55        .42
                MAIN         1.63      1.33      3.28     439.50      57.59    730.43       5.45       4.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5484E+01 OUTFLOW= .5382E+01 BASIN STORAGE= .9579E-03 PERCENT ERROR=   1.9

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                MAIN         1.63      1.33      5.00                 57.39    730.00       5.45

       ***           ***          ***           ***           ***

                          HYDROGRAPH AT STATION       A2T

     TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =      5.56

   PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      59.92-HR
+    (CFS)        (HR)
                          (CFS)
+      57.        12.17                9.           3.           1.            1.
                         (INCHES)   4.484        5.446        5.452         5.452
                          (AC-FT)      4.           5.           5.            5.

                          CUMULATIVE AREA =     .02 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
   61 KK    *      A2S   *
            *            *
            **************
                               SUBAREA A2S

   63 KO         OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

   64 BA         SUBBASIN CHARACTERISTICS
                       TAREA        .03  SUBBASIN AREA

                 PRECIPITATION DATA

   12 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN   2-HR   3-HR   6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19   4.18   4.52   5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .03

   65 LS         SCS LOSS RATE
                       STRTL        .33  INITIAL ABSTRACTION
                      CRVNBR      86.00  CURVE NUMBER
                       RTIMP        .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
   66 UK           OVERLAND-FLOW ELEMENT NO. 1
                           L       120.  OVERLAND FLOW LENGTH
                           S      .2500  SLOPE
                           N       .350  ROUGHNESS COEFFICIENT
                          PA      100.0  PERCENT OF SUBBASIN
                       DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
   67 RD           MAIN CHANNEL
                           L       925.  CHANNEL LENGTH
                           S      .0050  SLOPE
                           N       .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA        .03  CONTRIBUTING AREA
                       SHAPE       TRAP  CHANNEL SHAPE
                          WD        .00  BOTTOM WIDTH OR DIAMETER
                           Z       2.00  SIDE SLOPE
                      RUPSTQ         NO  ROUTE UPSTREAM HYDROGRAPH

                                                         ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA        M         DT        DX        PEAK     TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                 CELERITY
                                                    (MIN)      (FT)      (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.13      1.67        .70     24.00     162.24    725.02       5.79       .61
                   MAIN          1.63      1.33       2.67    462.50     150.43    723.85       5.64      5.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .9942E+01 OUTFLOW= .9680E+01 BASIN STORAGE= .5134E-03 PERCENT ERROR=   2.6


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          1.63      1.33       5.00               144.46    725.00       5.63

      ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION      A2S

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR         24-HR        72-HR       59.92-HR
+   (CFS)        (HR)
                          (CFS)
+     144.      12.08               16.           5.           2.           2.
                        (INCHES)   4.641        5.632        5.632        5.632
                        (AC-FT)       8.          10.          10.          10.

                        CUMULATIVE AREA =      .03 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  68 KK     *      CA2   *
            *            *
            **************
                           COMBINE A2 SUBAREAS

  70 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  71 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                           ***

      ***            ***            ***             ***             ***

                        HYDROGRAPH AT STATION       CA2

 PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                       6-HR          24-HR        72-HR        59.92-HR
+   (CFS)       (HR)
                            (CFS)
+      195.     12.08                   25.           8.           3.             3.
                         (INCHES)     4.580        5.564        5.567          5.567
                          (AC-FT)       12.          15.          15.            15.

                        CUMULATIVE AREA =       .05 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  72 KK     *     CH12   *
            *            *
            **************
                           SUBAREA CH12

  74 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  75 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                     STORM AREA =      .00

  76 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  77 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L          52.  OVERLAND FLOW LENGTH
                           S        .1000  SLOPE
                           N         .350  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  78 RD            MAIN CHANNEL
                           L         313.  CHANNEL LENGTH
                           S        .0050  SLOPE
                           N         .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA          .00  CONTRIBUTING AREA
                       SHAPE         TRAP  CHANNEL SHAPE
```

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                WD          .00  BOTTOM WIDTH OR DIAMETER
                 Z         3.00  SIDE SLOPE
            RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                   ***
                       COMPUTED MUSKINGUM-CUNGE PARAMETERS
                              COMPUTATION TIME STEP
       ELEMENT    ALPHA       M         DT        DX        PEAK    TIME TO    VOLUME    MAXIMUM
                                                                     PEAK                 CELERITY
                                       (MIN)     (FT)      (CFS)    (MIN)      (IN)      (FPS)

      PLANE1      1.35       1.67       .67     10.40      4.46    724.45      5.56        .33
      MAIN        1.48       1.33      2.38    156.50      4.44    724.72      5.50       2.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2668E+00 OUTFLOW= .2641E+00 BASIN STORAGE= .1752E-03 PERCENT ERROR=     .9

                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

      MAIN        1.48       1.33      5.00                4.31    725.00      5.51

   ***           ***          ***          ***             ***

                     HYDROGRAPH AT STATION     CH12

   TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR      59.92-HR
+   (CFS)       (HR)
                         (CFS)
+       4.     12.08                   0.          0.          0.           0.
                        (INCHES)     4.524       5.512       5.512        5.512
                        (AC-FT)        0.          0.          0.           0.

                        CUMULATIVE AREA =      .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
    79 KK     *     CH13   *
              *            *
              **************
                                 SUBAREA CH13

    81 KO           OUTPUT CONTROL VARIABLES
                          IPRNT            3  PRINT CONTROL
                          IPLOT            0  PLOT CONTROL
                          QSCAL           0.  HYDROGRAPH PLOT SCALE
                          IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                           IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT         .083  TIME INTERVAL IN HOURS


                  SUBBASIN RUNOFF DATA

    82 BA           SUBBASIN CHARACTERISTICS
                          TAREA          .00  SUBBASIN AREA

                    PRECIPITATION DATA

    12 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                    ..... HYDRO-35 ......    ............... TP-40 ...............   ........... TP-49 ...........
                    5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                      .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                       STORM AREA =        .00

    83 LS           SCS LOSS RATE
                          STRTL          .38  INITIAL ABSTRACTION
                         CRVNBR        84.00  CURVE NUMBER
                          RTIMP          .00  PERCENT IMPERVIOUS AREA

                    KINEMATIC WAVE
    84 UK             OVERLAND-FLOW ELEMENT NO. 1
                              L          52.  OVERLAND FLOW LENGTH
                              S        .1000  SLOPE
                              N         .350  ROUGHNESS COEFFICIENT
                             PA        100.0  PERCENT OF SUBBASIN
                          DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                    MUSKINGUM-CUNGE
    85 RD             MAIN CHANNEL
                              L         634.  CHANNEL LENGTH
                              S        .0050  SLOPE
                              N         .030  CHANNEL ROUGHNESS COEFFICIENT
                             CA          .00  CONTRIBUTING AREA
                          SHAPE         TRAP  CHANNEL SHAPE
                             WD          .00  BOTTOM WIDTH OR DIAMETER
```

```
                     Z        3.00  SIDE SLOPE
                RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                          COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                COMPUTATION TIME STEP
            ELEMENT    ALPHA     M       DT        DX      PEAK    TIME TO    VOLUME    MAXIMUM
                                                                     PEAK               CELERITY
                                        (MIN)     (FT)    (CFS)     (MIN)      (IN)      (FPS)

            PLANE1      1.35     1.67     .67     10.40     9.91    724.45     5.56       .33
            MAIN        1.48     1.33    3.96    317.00     9.58    723.77     5.48      2.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5929E+00 OUTFLOW= .5848E+00 BASIN STORAGE= .3570E-03 PERCENT ERROR=   1.3

                                INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

            MAIN        1.48     1.33    5.00               8.74    725.00     5.47

     ***         ***         ***         ***         ***

                   HYDROGRAPH AT STATION     CH13

     TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR      59.92-HR
 +   (CFS)       (HR)
                          (CFS)
 +       9.      12.08                  1.           0.          0.           0.
                        (INCHES)    4.495        5.473       5.473        5.473
                         (AC-FT)       0.           1.          1.           1.

                     CUMULATIVE AREA =      .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** 

          **************
          *            *
   86 KK  *     CCH13  *
          *            *
          **************
                              COMBINE CH12 AND CH13 WITH A2 AREAS

   88 KO       OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE
                     IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                      IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT         .083  TIME INTERVAL IN HOURS

   89 HC       HYDROGRAPH COMBINATION
                     ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***         ***         ***         ***         ***

                   HYDROGRAPH AT STATION    CCH13

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR      59.92-HR
 +   (CFS)       (HR)
                          (CFS)
 +     208.      12.08                 26.           8.          3.           3.
                        (INCHES)    4.576        5.560       5.562        5.562
                         (AC-FT)      13.          16.         16.          16.

                     CUMULATIVE AREA =      .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** 

          **************
          *            *
   90 KK  *        A3  *
          *            *
          **************
                              SUBAREA A3

   92 KO       OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
```

```
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 93 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =      .01

 94 LS        SCS LOSS RATE
                   STRTL         .33  INITIAL ABSTRACTION
                  CRVNBR       86.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
 95 UK          OVERLAND-FLOW ELEMENT NO. 1
                       L        120.  OVERLAND FLOW LENGTH
                       S       .2500  SLOPE
                       N        .350  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                   DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
 96 RD          MAIN CHANNEL
                       L        630.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                CELERITY
                                                (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

               PLANE1       2.13      1.67        .70     24.00     63.48    725.03      5.79        .61
               MAIN         1.63      1.33       2.30    315.00     61.93    724.85      5.65       4.56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3890E+01 OUTFLOW= .3800E+01 BASIN STORAGE= .3366E-03 PERCENT ERROR=   2.3

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


               MAIN         1.63      1.33       5.00               61.14    725.00      5.68

      ***            ***           ***             ***             ***

                         HYDROGRAPH AT STATION        A3

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR        72-HR       59.92-HR
+   (CFS)        (HR)
                            (CFS)
+      61.      12.08                   6.           2.           1.            1.
                          (INCHES)   4.675        5.676        5.676         5.676
                           (AC-FT)      3.           4.           4.            4.

                         CUMULATIVE AREA =      .01 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 97 KK     *      CH10  *
           *            *
           **************
                               SUBAREA CH10

 99 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
```

```
                  IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                   IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                  ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                  ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                 TIMINT       .083  TIME INTERVAL IN HOURS


          SUBBASIN RUNOFF DATA

 100 BA     SUBBASIN CHARACTERISTICS
                  TAREA        .00  SUBBASIN AREA

            PRECIPITATION DATA

  12 PH                        DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
            ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
            5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
              .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                           STORM AREA =       .00

 101 LS     SCS LOSS RATE
                 STRTL         .38  INITIAL ABSTRACTION
                CRVNBR       84.00  CURVE NUMBER
                 RTIMP         .00  PERCENT IMPERVIOUS AREA

            KINEMATIC WAVE
 102 UK       OVERLAND-FLOW ELEMENT NO. 1
                     L         52.  OVERLAND FLOW LENGTH
                     S       .1000  SLOPE
                     N        .350  ROUGHNESS COEFFICIENT
                    PA       100.0  PERCENT OF SUBBASIN
                 DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
            MUSKINGUM-CUNGE
 103 RD       MAIN CHANNEL
                     L        483.  CHANNEL LENGTH
                     S       .0050  SLOPE
                     N        .030  CHANNEL ROUGHNESS COEFFICIENT
                    CA         .00  CONTRIBUTING AREA
                 SHAPE        TRAP  CHANNEL SHAPE
                    WD         .00  BOTTOM WIDTH OR DIAMETER
                     Z        3.00  SIDE SLOPE
                RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                   ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
               ELEMENT    ALPHA      M         DT         DX        PEAK    TIME TO     VOLUME    MAXIMUM
                                                                             PEAK                 CELERITY
                                              (MIN)      (FT)      (CFS)    (MIN)        (IN)      (FPS)

              PLANE1       1.35      1.67       .67      10.40       6.44    724.45       5.56       .33
              MAIN         1.48      1.33      3.36     241.50       6.35    724.81       5.51      2.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3854E+00 OUTFLOW= .3819E+00 BASIN STORAGE= .2777E-03 PERCENT ERROR=     .8


                                    INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


              MAIN         1.48      1.33      5.00                  6.23    725.00       5.55

       ***          ***          ***          ***            ***

                        HYDROGRAPH AT STATION     CH10

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     59.92-HR
+   (CFS)       (HR)
                          (CFS)
+        6.     12.08                    1.          0.          0.           0.
                        (INCHES)     4.568       5.548       5.549        5.549
                         (AC-FT)        0.          0.          0.           0.

                        CUMULATIVE AREA =      .00 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 104 KK   *     CH11   *
          *            *
          **************
                             SUBAREA CH11

 106 KO     OUTPUT CONTROL VARIABLES
                  IPRNT          3  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE
                  IPNCH          7  PUNCH COMPUTED HYDROGRAPH
```

```
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 107 BA         SUBBASIN CHARACTERISTICS
                   TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  12 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =      .00

 108 LS         SCS LOSS RATE
                  STRTL          .38  INITIAL ABSTRACTION
                 CRVNBR        84.00  CURVE NUMBER
                  RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 109 UK           OVERLAND-FLOW ELEMENT NO. 1
                      L          52.  OVERLAND FLOW LENGTH
                      S        .1000  SLOPE
                      N         .350  ROUGHNESS COEFFICIENT
                     PA        100.0  PERCENT OF SUBBASIN
                  DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 110 RD           MAIN CHANNEL
                      L         313.  CHANNEL LENGTH
                      S        .0050  SLOPE
                      N         .030  CHANNEL ROUGHNESS COEFFICIENT
                     CA          .00  CONTRIBUTING AREA
                  SHAPE         TRAP  CHANNEL SHAPE
                     WD          .00  BOTTOM WIDTH OR DIAMETER
                      Z         3.00  SIDE SLOPE
                 RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                         ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M          DT         DX        PEAK     TIME TO     VOLUME     MAXIMUM
                                                                                    PEAK                  CELERITY
                                                   (MIN)       (FT)       (CFS)     (MIN)       (IN)       (FPS)

                  PLANE1       1.35      1.67        .67      10.40       4.46     724.45       5.56        .33
                  MAIN         1.48      1.33       2.38     156.50       4.44     724.72       5.50       2.19

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2668E+00 OUTFLOW= .2641E+00 BASIN STORAGE= .1752E-03 PERCENT ERROR=     .9

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN         1.48      1.33       5.00                  4.31     725.00       5.51

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH11

    TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR       59.92-HR
 +   (CFS)      (HR)
                           (CFS)
 +       4.     12.08                 0.           0.          0.           0.
                         (INCHES)   4.524       5.512       5.512        5.512
                          (AC-FT)      0.          0.          0.           0.

                          CUMULATIVE AREA =      .00 SQ MI



 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 111 KK      *    CCH11   *
             *            *
             **************
                                  COMBINE CH10 AND CH11 WITH AREA A3

 113 KO         OUTPUT CONTROL VARIABLES
                   IPRNT           3  PRINT CONTROL
                   IPLOT           0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE
                   IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
```

```
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


 114 HC        HYDROGRAPH COMBINATION
                    ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                             ***

      ***            ***            ***             ***            ***

                      HYDROGRAPH AT STATION    CCH11

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR      59.92-HR
+   (CFS)      (HR)
                         (CFS)
+      72.    12.08                  7.          2.          1.           1.
                       (INCHES)   4.656       5.655       5.655        5.655
                        (AC-FT)      4.          4.          4.           4.

                      CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 115 KK     *       CA3  *
            *            *
            **************
                             COMBINE AREAS FLOWING DIRECTLY INTO P1

 117 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


 118 HC        HYDROGRAPH COMBINATION
                    ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                             ***

      ***            ***            ***             ***            ***

                      HYDROGRAPH AT STATION      CA3

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR      59.92-HR
+   (CFS)      (HR)
                         (CFS)
+     443.    12.08                 53.         16.          6.           6.
                       (INCHES)   4.597       5.587       5.589        5.589
                        (AC-FT)     26.         32.         32.          32.

                      CUMULATIVE AREA =      .11 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 119 KK     *       CH7  *
            *            *
            **************
                             CHANNEL CH7

 121 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS

            SUBBASIN RUNOFF DATA

 122 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .00  SUBBASIN AREA

               PRECIPITATION DATA
```

```
  12 PH                                      DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                       STORM AREA =      .00

 123 LS           SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 124 UK             OVERLAND-FLOW ELEMENT NO. 1
                           L          82.  OVERLAND FLOW LENGTH
                           S        .2500  SLOPE
                           N         .350  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
 125 RD             MAIN CHANNEL
                           L         830.  CHANNEL LENGTH
                           S        .0030  SLOPE
                           N         .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA          .00  CONTRIBUTING AREA
                       SHAPE         TRAP  CHANNEL SHAPE
                          WD         5.00  BOTTOM WIDTH OR DIAMETER
                           Z         2.00  SIDE SLOPE
                      RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                                ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT         DX        PEAK     TIME TO      VOLUME     MAXIMUM
                                                                                     PEAK                   CELERITY
                                                    (MIN)       (FT)      (CFS)     (MIN)        (IN)       (FPS)

                    PLANE1        2.13      1.67        .69     16.40     17.84     724.42       5.56        .53
                    MAIN           .98      1.39       5.00    415.00     16.54     725.00       5.35       2.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1067E+01 OUTFLOW= .1026E+01 BASIN STORAGE= .7822E-03 PERCENT ERROR=   3.7

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN           .98      1.39       5.00               16.54     725.00       5.35

      ***            ***            ***             ***             ***

                         HYDROGRAPH AT STATION        CH7

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                     6-HR          24-HR        72-HR       59.92-HR
+   (CFS)       (HR)
                          (CFS)
+       17.     12.08                  2.            1.           0.            0.
                        (INCHES)     4.438         5.346        5.347         5.347
                         (AC-FT)        1.            1.           1.            1.

                         CUMULATIVE AREA =       .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 126 KK     *       A5   *
            *            *
            **************
                              SUBAREA A5

 128 KO           OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                        IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT         .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 129 BA           SUBBASIN CHARACTERISTICS
                       TAREA          .03  SUBBASIN AREA

                  PRECIPITATION DATA
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```
 12 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......    ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .03

 130 LS          SCS LOSS RATE
                       STRTL          .33  INITIAL ABSTRACTION
                      CRVNBR        86.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 131 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         120.  OVERLAND FLOW LENGTH
                           S        .2500  SLOPE
                           N         .350  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 132 RD            MAIN CHANNEL
                           L        1007.  CHANNEL LENGTH
                           S        .0050  SLOPE
                           N         .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA          .03  CONTRIBUTING AREA
                       SHAPE         TRAP  CHANNEL SHAPE
                          WD          .00  BOTTOM WIDTH OR DIAMETER
                           Z         2.00  SIDE SLOPE
                      RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                                ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME     MAXIMUM
                                                                                 PEAK                  CELERITY
                                                    (MIN)      (FT)     (CFS)    (MIN)       (IN)       (FPS)

                   PLANE1       2.13      1.67        .70     24.00    149.64    725.02       5.79         .61
                   MAIN         1.63      1.33       2.97    503.50    140.34    724.03       5.63        5.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .9170E+01 OUTFLOW= .8918E+01 BASIN STORAGE= .5553E-03 PERCENT ERROR=    2.7

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN         1.63      1.33       5.00              133.57    725.00       5.62

      ***              ***             ***             ***             ***

                        HYDROGRAPH AT STATION        A5

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      59.92-HR
+   (CFS)       (HR)
                           (CFS)
+      134.     12.08                  15.          4.           2.            2.
                          (INCHES)    4.629        5.616        5.617         5.617
                           (AC-FT)       7.           9.           9.            9.

                        CUMULATIVE AREA =      .03 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 133 KK      *      CA5   *
             *            *
             **************
                                  COMBINE CH7 AND A5 BEFORE ROUTING THROUGH CH8

 135 KO          OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                        IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT         .083  TIME INTERVAL IN HOURS


 136 HC          HYDROGRAPH COMBINATION
                       ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                ***

      ***              ***             ***             ***             ***

                        HYDROGRAPH AT STATION       CA5
```

```
 PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR        72-HR      59.92-HR
+   (CFS)       (HR)
                          (CFS)
+     150.     12.08                    17.          5.           2.            2.
                        (INCHES)      4.609        5.587        5.588         5.588
                         (AC-FT)         8.          10.          10.           10.

                        CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

           **************
           *            *
 137 KK    *      CH8   *
           *            *
           **************
                           CHANNEL CH8

 139 KO         OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 140 BA         SUBBASIN CHARACTERISTICS
                      TAREA        .01  SUBBASIN AREA

                PRECIPITATION DATA

  12 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......  ............... TP-40 ..............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                   STORM AREA =       .01

 141 LS         SCS LOSS RATE
                     STRTL         .38  INITIAL ABSTRACTION
                    CRVNBR       84.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 142 UK           OVERLAND-FLOW ELEMENT NO. 1
                         L          46.  OVERLAND FLOW LENGTH
                         S        .0652  SLOPE
                         N         .350  ROUGHNESS COEFFICIENT
                        PA        100.0  PERCENT OF SUBBASIN
                     DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 143 RD           MAIN CHANNEL
                         L         707.  CHANNEL LENGTH
                         S        .0300  SLOPE
                         N         .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA          .01  CONTRIBUTING AREA
                     SHAPE         TRAP  CHANNEL SHAPE
                        WD         5.00  BOTTOM WIDTH OR DIAMETER
                         Z         2.00  SIDE SLOPE
                    RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                       ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                  ELEMENT     ALPHA       M         DT         DX         PEAK     TIME TO      VOLUME     MAXIMUM
                                                                                     PEAK                   CELERITY
                                                  (MIN)       (FT)       (CFS)     (MIN)         (IN)       (FPS)

                 PLANE1        1.09      1.67        .57       9.20       26.40    724.95        5.56         .28
                 MAIN          3.11      1.39       1.07     353.50      168.61    725.84        5.57       11.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9924E+01  EXCESS= .1571E+01 OUTFLOW= .1146E+02 BASIN STORAGE= .2671E-03 PERCENT ERROR=     .3

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN          3.11      1.39       5.00                  166.32    725.00        5.57

      ***            ***            ***            ***            ***

                           HYDROGRAPH AT STATION      CH8

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56
```

```
  PEAK FLOW      TIME                                 MAXIMUM AVERAGE FLOW
                                            6-HR          24-HR         72-HR        59.92-HR
+   (CFS)        (HR)
                            (CFS)
+     166.      12.08                       19.            6.            2.            2.
                            (INCHES)       4.601         5.574         5.575         5.575
                             (AC-FT)          9.           11.           11.           11.

                            CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  144 KK     *      A4    *
             *            *
             **************
                                   SUBAREA A4

  146 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  147 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .02  SUBBASIN AREA

                  PRECIPITATION DATA

   12 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......    ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN     2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19     4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                   STORM AREA =       .02

  148 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  149 UK            OVERLAND-FLOW ELEMENT NO. 1
                            L        120.  OVERLAND FLOW LENGTH
                            S       .2500  SLOPE
                            N        .350  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  150 RD            MAIN CHANNEL
                            L        403.  CHANNEL LENGTH
                            S       .0050  SLOPE
                            N        .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .02  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD         .00  BOTTOM WIDTH OR DIAMETER
                            Z        2.00  SIDE SLOPE
                       RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                                 ***
                                      COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                             COMPUTATION TIME STEP
                    ELEMENT    ALPHA        M          DT         DX        PEAK    TIME TO      VOLUME    MAXIMUM
                                                                                      PEAK                 CELERITY
                                                      (MIN)      (FT)       (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1       2.13      1.67         .70      24.00      106.31    725.02       5.79        .61
                   MAIN         1.63      1.33        1.29     403.00      102.51    724.49       5.08       5.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .6515E+01 OUTFLOW= .5714E+01 BASIN STORAGE= .2350E-03 PERCENT ERROR=  12.3

                                            INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN         1.63      1.33        5.00                 100.30    725.00       5.09

      ***          ***          ***          ***          ***

                         HYDROGRAPH AT STATION         A4

    TOTAL RAINFALL =      7.44, TOTAL LOSS =      1.65, TOTAL EXCESS =      5.79

  PEAK FLOW      TIME                                 MAXIMUM AVERAGE FLOW
```

```
                                              6-HR        24-HR       72-HR     59.92-HR
+   (CFS)       (HR)
                              (CFS)
+      100.     12.08                          10.          3.          1.          1.
                            (INCHES)        4.353       5.087       5.088       5.088
                             (AC-FT)           5.          6.          6.          6.

                             CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

           **************
           *            *
   151 KK  *      CA4   *
           *            *
           **************
                                     COMBINE WITH A4 BEFORE ROUTING THROUGH CH9

   153 KO        OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   154 HC        HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                ***

       ***            ***            ***            ***            ***

                              HYDROGRAPH AT STATION       CA4

   PEAK FLOW     TIME                               MAXIMUM AVERAGE FLOW
                                              6-HR        24-HR       72-HR     59.92-HR
+   (CFS)       (HR)
                              (CFS)
+      267.     12.08                          29.          9.          3.          3.
                            (INCHES)        4.513       5.402       5.403       5.403
                             (AC-FT)          14.         17.         17.         17.

                             CUMULATIVE AREA =      .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

           **************
           *            *
   155 KK  *      CH9   *
           *            *
           **************
                                     CHANNEL CH9

   157 KO        OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

   158 BA        SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

    12 PH                                     DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                         STORM AREA =      .00

   159 LS        SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
   160 UK          OVERLAND-FLOW ELEMENT NO. 1
```

```
                  L          75.  OVERLAND FLOW LENGTH
                  S       .1000  SLOPE
                  N        .350  ROUGHNESS COEFFICIENT
                 PA       100.0  PERCENT OF SUBBASIN
              DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
         MUSKINGUM-CUNGE
161 RD     MAIN CHANNEL
                  L        670.  CHANNEL LENGTH
                  S       .0300  SLOPE
                  N        .030  CHANNEL ROUGHNESS COEFFICIENT
                 CA         .00  CONTRIBUTING AREA
              SHAPE        TRAP  CHANNEL SHAPE
                 WD        5.00  BOTTOM WIDTH OR DIAMETER
                  Z        2.00  SIDE SLOPE
             RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                           COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                  COMPUTATION TIME STEP
           ELEMENT    ALPHA       M        DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                       PEAK                CELERITY
                                         (MIN)      (FT)     (CFS)    (MIN)      (IN)      (FPS)

          PLANE1      1.35      1.67       .74     15.00     23.33    724.59     5.56       .38
          MAIN        3.11      1.39       .88    335.00    280.65    725.43     5.41     12.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1720E+02  EXCESS= .1423E+01 OUTFLOW= .1860E+02 BASIN STORAGE= .2560E-03 PERCENT ERROR=     .2

                                INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

          MAIN        3.11      1.39      5.00              274.91    725.00     5.41

    ***          ***          ***          ***          ***

                      HYDROGRAPH AT STATION        CH9

   TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR      59.92-HR
+    (CFS)      (HR)
                              (CFS)
+     275.     12.08                  31.          9.          4.          4.
                          (INCHES)  4.518       5.411       5.411       5.411
                           (AC-FT)    16.         19.         19.         19.

                       CUMULATIVE AREA =    .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
162 KK      *       P1   *
            *            *
            **************
                             DETENTION POND P1

164 KO           OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS

              SUBBASIN RUNOFF DATA

165 BA           SUBBASIN CHARACTERISTICS
                      TAREA        .04  SUBBASIN AREA

                 PRECIPITATION DATA

 12 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............    ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =      .04

166 LS           SCS LOSS RATE
                      STRTL        .00  INITIAL ABSTRACTION
                     CRVNBR     100.00  CURVE NUMBER
                      RTIMP        .00  PERCENT IMPERVIOUS AREA

167 UD           SCS DIMENSIONLESS UNITGRAPH
                       TLAG        .00  LAG
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                                                                 ***

                                                          UNIT HYDROGRAPH
                                                       5 END-OF-PERIOD ORDINATES
             208.        58.        11.         2.        0.

      ***           ***            ***            ***            ***

                            HYDROGRAPH AT STATION       P1

        TOTAL RAINFALL =    7.44, TOTAL LOSS =     .00, TOTAL EXCESS =    7.44

     PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR      59.92-HR
 +   (CFS)        (HR)
                              (CFS)
 +     186.      12.08                     21.          7.          3.           3.
                            (INCHES)      5.468       7.437       7.440        7.440
                             (AC-FT)       11.         14.         14.          14.

                            CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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               *            *
     168 KK    *    P1-IN   *
               *            *
               **************
                                  COMBINE AREAS DISCHARGING TO POND P1

     170 KO         OUTPUT CONTROL VARIABLES
                          IPRNT            3  PRINT CONTROL
                          IPLOT            0  PLOT CONTROL
                          QSCAL           0.  HYDROGRAPH PLOT SCALE
                          IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                           IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT         .083  TIME INTERVAL IN HOURS


     171 HC         HYDROGRAPH COMBINATION
                          ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                 ***

      ***           ***            ***            ***            ***

                            HYDROGRAPH AT STATION    P1-IN

     PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR      59.92-HR
 +   (CFS)        (HR)
                              (CFS)
 +     904.      12.08                    105.         33.         13.          13.
                            (INCHES)      4.711       5.839       5.855        5.855
                             (AC-FT)       52.         65.         65.          65.

                            CUMULATIVE AREA =      .21 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

               **************
               *            *
     172 KK    *      RP1   *
               *            *
               **************
                                  ROUTE THROUGH POND P1

     174 KO         OUTPUT CONTROL VARIABLES
                          IPRNT            3  PRINT CONTROL
                          IPLOT            0  PLOT CONTROL
                          QSCAL           0.  HYDROGRAPH PLOT SCALE
                          IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                           IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT         .083  TIME INTERVAL IN HOURS


                  HYDROGRAPH ROUTING DATA

     175 RS         STORAGE ROUTING
                          NSTPS            1  NUMBER OF SUBREACHES
                           ITYP         ELEV  TYPE OF INITIAL CONDITION
                         RSVRIC       454.50  INITIAL CONDITION
                              X          .00 WORKING R AND D COEFFICIENT
```

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176 SA            AREA         .0      17.8      18.2      18.6      19.0      19.4      19.8      20.2

177 SE       ELEVATION     454.50    455.00    456.00    457.00    458.00    459.00    460.00    461.00

179 SL       LOW-LEVEL OUTLET
                   ELEVL     455.50  ELEVATION AT CENTER OF OUTLET
                   CAREA       3.14  CROSS-SECTIONAL AREA
                    COQL        .80  COEFFICIENT
                    EXPL        .50  EXPONENT OF HEAD

178 SS       SPILLWAY
                    CREL     458.00  SPILLWAY CREST ELEVATION
                   SPWID      25.00  SPILLWAY WIDTH
                    COQW       2.60  WEIR COEFFICIENT
                    EXPW       1.50  EXPONENT OF HEAD

                                                       ***

                                       COMPUTED STORAGE-ELEVATION DATA

          STORAGE       .00      2.96     20.92     39.29     58.07     77.27     96.88    116.91
        ELEVATION    454.50    455.00    456.00    457.00    458.00    459.00    460.00    461.00

                                       COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW       .00       .00     19.56     20.70     21.98     23.44     25.10     27.01     29.24     31.87
        ELEVATION    454.50    455.50    456.44    456.55    456.69    456.85    457.05    457.30    457.60    458.00

          OUTFLOW     33.02     36.99     45.59     60.62     83.84    117.03    161.97    220.42    294.18    385.02
        ELEVATION    458.05    458.16    458.32    458.54    458.81    459.14    459.52    459.96    460.45    461.00


                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00      2.96     11.89     20.92     28.97     31.05     33.54     36.54     39.29     40.22
          OUTFLOW       .00       .00       .00     14.25     19.56     20.70     21.98     23.44     24.69     25.10
        ELEVATION    454.50    455.00    455.50    456.00    456.44    456.55    456.69    456.85    457.00    457.05

          STORAGE     44.80     50.59     58.07     59.09     61.10     64.16     68.31     73.55     77.27     79.89
          OUTFLOW     27.01     29.24     31.87     33.02     36.99     45.59     60.62     83.84    102.71    117.03
        ELEVATION    457.30    457.60    458.00    458.05    458.16    458.32    458.54    458.81    459.00    459.14

          STORAGE     87.38     96.02     96.88    105.85    116.91
          OUTFLOW    161.97    220.42    226.61    294.18    385.02
        ELEVATION    459.52    459.96    460.00    460.45    461.00

     ***          ***          ***          ***          ***

                HYDROGRAPH AT STATION      RP1

 PEAK FLOW    TIME                           MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      59.92-HR
+   (CFS)     (HR)
                          (CFS)
+      28.    15.17                  28.          23.         11.          11.
                       (INCHES)   1.242        4.051       4.752        4.752
                        (AC-FT)     14.          45.         53.          53.

 PEAK STORAGE  TIME                         MAXIMUM AVERAGE STORAGE
                                   6-HR        24-HR       72-HR      59.92-HR
+  (AC-FT)    (HR)
      48.     15.17                  47.          36.         21.          21.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                   6-HR        24-HR       72-HR      59.92-HR
+   (FEET)    (HR)
    457.46    15.17               457.40       456.82      455.94       455.94

                     CUMULATIVE AREA =      .21 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
180 KK        *      CP1   *
              *            *
              **************
                               COMBINE DOWNSTREAM OF POND P1 OUTLET

182 KO       OUTPUT CONTROL VARIABLES
                   IPRNT           3  PRINT CONTROL
                   IPLOT           0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE
                   IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


183 HC       HYDROGRAPH COMBINATION
                   ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
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                                                                                ***

         ***             ***              ***              ***              ***

                                   HYDROGRAPH AT STATION        CP1

     PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                              6-HR          24-HR         72-HR        59.92-HR
 +     (CFS)        (HR)
                                    (CFS)
 +       389.      12.50                      125.            52.           23.            23.
                                  (INCHES)   2.826          4.684         5.253          5.253
                                   (AC-FT)     62.           103.          116.           116.

                                 CUMULATIVE AREA =      .41 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

                  **************
                  *            *
    184 KK        *       S5   *
                  *            *
                  **************
                                         SUBAREA S5

    186 KO             OUTPUT CONTROL VARIABLES
                             IPRNT           3  PRINT CONTROL
                             IPLOT           0  PLOT CONTROL
                             QSCAL          0.  HYDROGRAPH PLOT SCALE
                             IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                              IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                             ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                             ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                            TIMINT        .083  TIME INTERVAL IN HOURS


                     SUBBASIN RUNOFF DATA

    187 BA             SUBBASIN CHARACTERISTICS
                             TAREA         .01  SUBBASIN AREA

                       PRECIPITATION DATA

     12 PH                                     DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                       ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                       5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                         .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                          STORM AREA =       .01

    188 LS             SCS LOSS RATE
                            STRTL          .38  INITIAL ABSTRACTION
                           CRVNBR        84.00  CURVE NUMBER
                            RTIMP          .00  PERCENT IMPERVIOUS AREA

    189 US             SNYDER UNITGRAPH
                               TP          .59  LAG
                               CP          .71  PEAKING COEFFICIENT

                       SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                                ***

                                                              UNIT HYDROGRAPH PARAMETERS
                                                        CLARK   TC=    .69 HR,        R=    .42 HR
                                                       SNYDER   TP=    .58 HR,       CP=    .70

                                                                   UNIT HYDROGRAPH
                                                              32 END-OF-PERIOD ORDINATES
                         0.         2.         3.         5.         7.         8.         9.         9.         8.         7.
                         5.         4.         4.         3.         2.         2.         2.         1.         1.         1.
                         1.         1.         0.         0.         0.         0.         0.         0.         0.         0.
                         0.         0.

         ***             ***              ***              ***              ***

                                   HYDROGRAPH AT STATION         S5

         TOTAL RAINFALL =      7.44, TOTAL LOSS =      1.88, TOTAL EXCESS =      5.56

     PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                              6-HR          24-HR         72-HR        59.92-HR
 +     (CFS)        (HR)
                                    (CFS)
 +        21.      12.58                        6.             2.            1.             1.
                                  (INCHES)   4.489          5.535         5.535          5.535
                                   (AC-FT)      3.             3.            3.             3.

                                 CUMULATIVE AREA =      .01 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 190 KK   *      CS5   *
          *            *
          **************
                         COMBINE AREAS UPSTREAM OF S7

 192 KO        OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


 193 HC        HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       CS5

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     59.92-HR
+  (CFS)       (HR)
                        (CFS)
+    408.     12.50               131.         54.         24.         24.
                      (INCHES)   2.870       4.704       5.260       5.260
                       (AC-FT)     65.        106.        119.        119.

                      CUMULATIVE AREA =     .42 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 194 KK   *       S7   *
          *            *
          **************
                         SUBAREA S7

 196 KO        OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 197 BA        SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

  12 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......    .............. TP-40 ..............    ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =      .01

 198 LS        SCS LOSS RATE
                    STRTL          .38  INITIAL ABSTRACTION
                   CRVNBR        84.00  CURVE NUMBER
                    RTIMP          .00  PERCENT IMPERVIOUS AREA

 199 US        SNYDER UNITGRAPH
                       TP          .47  LAG
                       CP          .72  PEAKING COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                             UNIT HYDROGRAPH PARAMETERS
                                       CLARK    TC=    .57 HR,         R=    .32 HR
                                      SNYDER    TP=    .47 HR,        CP=    .71

                                                  UNIT HYDROGRAPH
                                             25 END-OF-PERIOD ORDINATES
```

```
              1.        2.        4.        6.        8.        8.        8.        6.        5.        4.
              3.        2.        2.        1.        1.        1.        1.        0.        0.        0.
              0.        0.        0.        0.        0.

    ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION       S7

     TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR        72-HR      59.92-HR
+   (CFS)       (HR)
                         (CFS)
+      17.     12.50                     4.           1.           1.           1.
                        (INCHES)      4.494        5.536        5.536        5.536
                         (AC-FT)         2.           2.           2.           2.

                         CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  200 KK    *      CS7   *
            *            *
            **************
                                COMBINE WITH AREA S7

  202 KO        OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  203 HC        HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                      ***

    ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION      CS7

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR        72-HR      59.92-HR
+   (CFS)       (HR)
                         (CFS)
+     426.     12.50                   135.          55.          25.          25.
                        (INCHES)      2.900        4.717        5.266        5.266
                         (AC-FT)        67.         109.         121.         121.

                         CUMULATIVE AREA =      .43 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  204 KK    *      O1A   *
            *            *
            **************
                                OFFSITE AREA O1A

  206 KO        OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS

              SUBBASIN RUNOFF DATA

  207 BA        SUBBASIN CHARACTERISTICS
                      TAREA         .04  SUBBASIN AREA

                PRECIPITATION DATA

   12 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
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                  .74     1.57     3.19     4.18     4.52     5.47     6.43     7.44      .00      .00      .00      .00

                                                 STORM AREA =       .04

 208 LS            SCS LOSS RATE
                       STRTL          .35  INITIAL ABSTRACTION
                      CRVNBR        85.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

 209 US            SNYDER UNITGRAPH
                          TP          .50  LAG
                          CP          .68  PEAKING COEFFICIENT

                   SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                              ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                             CLARK    TC=    .58 HR,        R=    .39 HR
                                            SNYDER    TP=    .50 HR,       CP=    .67

                                                        UNIT HYDROGRAPH
                                                   29 END-OF-PERIOD ORDINATES
                   2.        8.       15.       23.       29.       32.       32.       28.       22.       18.
                  15.       12.        9.        8.        6.        5.        4.        3.        3.        2.
                   2.        1.        1.        1.        1.        1.        0.        0.        0.

      ***           ***            ***            ***            ***

                             HYDROGRAPH AT STATION      O1A

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.77, TOTAL EXCESS =    5.67

  PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR         72-HR        59.92-HR
 +   (CFS)       (HR)
                             (CFS)
 +      70.     12.58                  18.           6.            2.             2.
                          (INCHES)    4.570        5.648         5.648          5.648
                           (AC-FT)       9.          11.           11.            11.

                          CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 210 KK     *       O2   *
            *            *
            **************
                               OFFSITE AREA O2

 212 KO            OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                        IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT         .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

 213 BA            SUBBASIN CHARACTERISTICS
                       TAREA         1.58  SUBBASIN AREA

                   PRECIPITATION DATA

  12 PH                                    DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR     3-HR     6-HR    12-HR    24-HR    2-DAY    4-DAY    7-DAY  10-DAY
                    .74     1.57     3.19     4.18     4.52     5.47     6.43     7.44      .00      .00      .00      .00

                                                 STORM AREA =      1.58

 214 LS            SCS LOSS RATE
                       STRTL          .35  INITIAL ABSTRACTION
                      CRVNBR        85.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

 215 US            SNYDER UNITGRAPH
                          TP          .71  LAG
                          CP          .58  PEAKING COEFFICIENT

                   SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                              ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                             CLARK    TC=    .79 HR,        R=    .76 HR
                                            SNYDER    TP=    .71 HR,       CP=    .58
```

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                                        UNIT HYDROGRAPH
                                  54 END-OF-PERIOD ORDINATES
       31.      115.      232.      367.      512.      648.      752.      817.      841.      808.
      733.      657.      589.      528.      473.      424.      380.      341.      306.      274.
      246.      220.      197.      177.      159.      142.      127.      114.      102.       92.
       82.       74.       66.       59.       53.       48.       43.       38.       34.       31.
       28.       25.       22.       20.       18.       16.       14.       13.       11.       10.
        9.        8.        7.        7.

  ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION       O2

  TOTAL RAINFALL =    7.42, TOTAL LOSS =    1.77, TOTAL EXCESS =    5.66

 PEAK FLOW    TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR      59.92-HR
+   (CFS)     (HR)
                         (CFS)
+    2171.    12.75                  767.        239.          96.          96.
                      (INCHES)      4.524       5.632        5.632        5.632
                       (AC-FT)       380.        473.         473.         473.

                    CUMULATIVE AREA =    1.58 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
 216 KK   *       O3   *
          *            *
          **************
                          OFFSITE AREA O3

 218 KO       OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 219 BA       SUBBASIN CHARACTERISTICS
                    TAREA         .03  SUBBASIN AREA

              PRECIPITATION DATA

  12 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =       .03

 220 LS       SCS LOSS RATE
                   STRTL          .38  INITIAL ABSTRACTION
                  CRVNBR        84.00  CURVE NUMBER
                   RTIMP          .00  PERCENT IMPERVIOUS AREA

 221 US       SNYDER UNITGRAPH
                      TP          .30  LAG
                      CP          .68  PEAKING COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                         ***

                                             UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=    .35 HR,         R=   .23 HR
                                       SNYDER   TP=    .30 HR,        CP=   .68

                                                  UNIT HYDROGRAPH
                                            18 END-OF-PERIOD ORDINATES
         5.       17.       30.       36.       32.       23.       16.       11.        8.        5.
         4.        3.        2.        1.        1.        1.        0.        0.

  ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION       O3

  TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

 PEAK FLOW    TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR      59.92-HR
+   (CFS)     (HR)
                         (CFS)
+      62.    12.33                   12.          4.           2.           2.
```

```
                   (INCHES)    4.500       5.539       5.539        5.539
                    (AC-FT)       6.          7.          7.           7.

                    CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
 222 KK   *      S6    *
          *            *
          **************
                          SUBAREA S6

 224 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS

             SUBBASIN RUNOFF DATA

 225 BA        SUBBASIN CHARACTERISTICS
                     TAREA        .02  SUBBASIN AREA

               PRECIPITATION DATA

  12 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ..............    ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =      .02

 226 LS        SCS LOSS RATE
                    STRTL         .38  INITIAL ABSTRACTION
                   CRVNBR       84.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

 227 US        SNYDER UNITGRAPH
                       TP         .81  LAG
                       CP         .69  PEAKING COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                                     UNIT HYDROGRAPH PARAMETERS
                                                CLARK    TC=    .94 HR,       R=   .62 HR
                                               SNYDER    TP=    .81 HR,      CP=   .69

                                                          UNIT HYDROGRAPH
                                                     46 END-OF-PERIOD ORDINATES
               0.         1.         3.         5.         6.         8.        10.        11.        12.        12.
              12.        11.        10.         8.         7.         6.         6.         5.         4.         4.
               3.         3.         2.         2.         2.         2.         1.         1.         1.         1.
               1.         1.         1.         1.         0.         0.         0.         0.         0.         0.
               0.         0.         0.         0.         0.         0.

      ***          ***           ***            ***            ***

                     HYDROGRAPH AT STATION         S6

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR        72-HR      59.92-HR
+   (CFS)       (HR)
                          (CFS)
+      32.     12.83                   10.           3.           1.           1.
                       (INCHES)     4.475        5.534        5.534        5.534
                        (AC-FT)        5.           6.           6.           6.

                    CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
 228 KK   *     CS6    *
          *            *
          **************
                          COMBINE AREAS DISCHARGING OFF OF P.B.
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230 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS

231 HC          HYDROGRAPH COMBINATION
                      ICOMP           5  NUMBER OF HYDROGRAPHS TO COMBINE

                                                         ***

    ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION       CS6

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR       59.92-HR
+   (CFS)      (HR)
                            (CFS)
+    2664.     12.75                   941.        305.        125.          125.
                          (INCHES)   4.185       5.416       5.555         5.555
                           (AC-FT)    467.        604.        620.          620.

                         CUMULATIVE AREA =     2.09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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             *            *
232 KK       *       O4   *
             *            *
             **************
                                 OFFSITE AREA O4

234 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS

              SUBBASIN RUNOFF DATA

235 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .13  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ..........
                5-MIN  15-MIN  60-MIN   2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19   4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =      .13

236 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

237 US          SNYDER UNITGRAPH
                         TP         .43  LAG
                         CP         .64  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                         ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .51 HR,        R=   .36 HR
                                       SNYDER   TP=   .43 HR,       CP=   .64

                                                   UNIT HYDROGRAPH
                                              27 END-OF-PERIOD ORDINATES
               10.       36.       71.      105.      126.      131.      115.       92.       73.       58.
               46.       37.       29.       23.       18.       15.       12.        9.        7.        6.
                5.        4.        3.        2.        2.        1.        1.

    ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION       O4

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =      5.56
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  PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR       59.92-HR
+   (CFS)        (HR)
                               (CFS)
+      269.     12.50                     65.          20.           8.            8.
                             (INCHES)   4.491        5.534        5.534         5.534
                              (AC-FT)     32.          40.          40.           40.

                              CUMULATIVE AREA =      .13 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
  238 KK      *       CO4  *
              *            *
              **************
                                      MIDWAY BRANCH DISCHARGING BACK ONTO P.B.

  240 KO           OUTPUT CONTROL VARIABLES
                         IPRNT            3  PRINT CONTROL
                         IPLOT            0  PLOT CONTROL
                         QSCAL           0.  HYDROGRAPH PLOT SCALE
                         IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                          IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT         .083  TIME INTERVAL IN HOURS


  241 HC           HYDROGRAPH COMBINATION
                         ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                   ***

       ***             ***             ***              ***              ***

                               HYDROGRAPH AT STATION      CO4

  PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR       59.92-HR
+   (CFS)        (HR)
                               (CFS)
+     2881.     12.67                   1006.         325.         133.          133.
                             (INCHES)   4.202        5.422        5.554         5.554
                              (AC-FT)    499.         644.         659.          659.

                              CUMULATIVE AREA =     2.23 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
  242 KK      *        A6  *
              *            *
              **************
                                      SUBAREA A6

  244 KO           OUTPUT CONTROL VARIABLES
                         IPRNT            3  PRINT CONTROL
                         IPLOT            0  PLOT CONTROL
                         QSCAL           0.  HYDROGRAPH PLOT SCALE
                         IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                          IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT         .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

  245 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .02  SUBBASIN AREA

                   PRECIPITATION DATA

   12 PH                                   DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                      STORM AREA =       .02

  246 LS           SCS LOSS RATE
                         STRTL          .33  INITIAL ABSTRACTION
                        CRVNBR        86.00  CURVE NUMBER
                         RTIMP          .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
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247 UK          OVERLAND-FLOW ELEMENT NO. 1
                        L       120.  OVERLAND FLOW LENGTH
                        S     .2500  SLOPE
                        N      .350  ROUGHNESS COEFFICIENT
                       PA     100.0  PERCENT OF SUBBASIN
                    DXMIN         5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
248 RD          MAIN CHANNEL
                        L      1314.  CHANNEL LENGTH
                        S     .0020  SLOPE
                        N      .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA       .02  CONTRIBUTING AREA
                    SHAPE      TRAP  CHANNEL SHAPE
                       WD       .00  BOTTOM WIDTH OR DIAMETER
                        Z      2.00  SIDE SLOPE
                   RUPSTQ        NO  ROUTE UPSTREAM HYDROGRAPH

                                         ***
                           COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                  COMPUTATION TIME STEP
               ELEMENT    ALPHA      M        DT       DX      PEAK    TIME TO     VOLUME    MAXIMUM
                                                                         PEAK                 CELERITY
                                             (MIN)     (FT)    (CFS)    (MIN)       (IN)      (FPS)

               PLANE1      2.13     1.67       .70    24.00    86.66   725.02       5.79        .61
               MAIN        1.03     1.33      5.00   657.00    72.90   725.00       5.57       3.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5311E+01 OUTFLOW= .5112E+01 BASIN STORAGE= .9760E-03 PERCENT ERROR=   3.7

                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

               MAIN        1.03     1.33      5.00             72.90   725.00       5.57

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION        A6

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR      59.92-HR
+   (CFS)      (HR)
                          (CFS)
+     73.     12.08                 9.          3.          1.           1.
                       (INCHES)   4.638       5.573       5.573        5.573
                        (AC-FT)      4.          5.          5.           5.

                    CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
249 KK      *      S8    *
            *            *
            **************
                          SUBAREA S8

251 KO          OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS

             SUBBASIN RUNOFF DATA

252 BA          SUBBASIN CHARACTERISTICS
                    TAREA        .02  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN     2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19     4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                            STORM AREA =      .02

253 LS          SCS LOSS RATE
                   STRTL         .38  INITIAL ABSTRACTION
                  CRVNBR       84.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

254 US          SNYDER UNITGRAPH
                      TP         .31  LAG
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                    CP          .69  PEAKING COEFFICIENT

          SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                ***

                                     UNIT HYDROGRAPH PARAMETERS
                               CLARK   TC=    .37 HR,        R=   .24 HR
                              SNYDER   TP=    .31 HR,       CP=   .68

                                          UNIT HYDROGRAPH
                                     18 END-OF-PERIOD ORDINATES
          3.        10.        18.        22.        20.        15.        10.        7.        5.        4.
          2.         2.         1.         1.         1.         0.         0.        0.

    ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION         S8

  TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR        72-HR       59.92-HR
+   (CFS)       (HR)
                         (CFS)
+      39.     12.33                 8.          2.           1.           1.
                       (INCHES)  4.499       5.538        5.538        5.538
                        (AC-FT)     4.          5.           5.           5.

                    CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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             *            *
 255 KK      *       CS8  *
             *            *
             **************
                              MIDWAY BRANCH DISCHARGING OFF OF P.B.

 257 KO         OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


 258 HC         HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                ***

    ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION        CS8

 PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR        72-HR       59.92-HR
+   (CFS)       (HR)
                         (CFS)
+    2919.     12.67              1022.        329.         135.         135.
                       (INCHES)  4.207       5.424        5.554        5.554
                        (AC-FT)   507.        653.         669.         669.

                    CUMULATIVE AREA =     2.26 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
 259 KK      *        S1  *
             *            *
             **************
                              SUBAREA S1

 261 KO         OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS
```

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               SUBBASIN RUNOFF DATA

 262 BA          SUBBASIN CHARACTERISTICS
                       TAREA          .02  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .02

 263 LS          SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                      CRVNBR        84.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

 264 US          SNYDER UNITGRAPH
                          TP          .77  LAG
                          CP          .70  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                ***

                                                     UNIT HYDROGRAPH PARAMETERS
                                              CLARK   TC=   .89 HR,        R=   .57 HR
                                             SNYDER   TP=   .77 HR,       CP=   .69

                                                          UNIT HYDROGRAPH
                                                     42 END-OF-PERIOD ORDINATES
                    0.         1.         3.         4.         5.         7.         8.         9.        10.        10.
                    9.         8.         7.         6.         5.         4.         4.         3.         3.         2.
                    2.         2.         2.         1.         1.         1.         1.         1.         1.         1.
                    0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
                    0.         0.

      ***            ***            ***             ***             ***

                         HYDROGRAPH AT STATION        S1

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR       59.92-HR
 +  (CFS)      (HR)
                         (CFS)
 +     24.     12.83                    8.          2.          1.            1.
                       (INCHES)     4.477       5.532       5.532         5.532
                        (AC-FT)        4.          5.          5.            5.

                         CUMULATIVE AREA =      .02 SQ MI


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 265 KK       *      S2    *
              *            *
              **************
                                SUBAREA S2

 267 KO          OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                        IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT         .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 268 BA          SUBBASIN CHARACTERISTICS
                       TAREA          .05  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .05

 269 LS          SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                      CRVNBR        84.00  CURVE NUMBER
```

```
                RTIMP          .00  PERCENT IMPERVIOUS AREA

 270 US         SNYDER UNITGRAPH
                     TP        1.23  LAG
                     CP         .66  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                   ***

                                                 UNIT HYDROGRAPH PARAMETERS
                                           CLARK   TC=  1.38 HR,        R=  1.03 HR
                                          SNYDER   TP=  1.23 HR,       CP=   .66

                                                      UNIT HYDROGRAPH
                                                 75 END-OF-PERIOD ORDINATES
                0.         1.         2.         4.         5.         7.         9.        10.        12.        14.
               15.        16.        17.        17.        17.        17.        16.        15.        14.        13.
               12.        11.        10.         9.         9.         8.         7.         7.         6.         6.
                5.         5.         4.         4.         4.         3.         3.         3.         3.         3.
                2.         2.         2.         2.         2.         2.         1.         1.         1.         1.
                1.         1.         1.         1.         1.         1.         1.         1.         1.         0.
                0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
                0.         0.         0.         0.         0.

      ***              ***             ***              ***              ***

                  HYDROGRAPH AT STATION        S2

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR        72-HR       59.92-HR
+    (CFS)       (HR)
                            (CFS)
+      52.      13.25                   23.            7.           3.            3.
                          (INCHES)    4.418         5.533        5.533         5.533
                           (AC-FT)      11.           14.          14.           14.

                  CUMULATIVE AREA =     .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 271 KK      *      CH1   *
             *            *
             **************
                               CHANNEL CH1

 273 KO         OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 274 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  12 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .01

 275 LS         SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 276 UK           OVERLAND-FLOW ELEMENT NO. 1
                          L        411.  OVERLAND FLOW LENGTH
                          S       .0050  SLOPE
                          N        .350  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 277 RD           MAIN CHANNEL
                          L       1283.  CHANNEL LENGTH
                          S       .0016  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
```

```
                    SHAPE         TRAP  CHANNEL SHAPE
                       WD        15.00  BOTTOM WIDTH OR DIAMETER
                        Z         4.00  SIDE SLOPE
                   RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                                  ***

                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                  ELEMENT    ALPHA        M          DT        DX        PEAK     TIME TO     VOLUME     MAXIMUM
                                                                                    PEAK                 CELERITY
                                                   (MIN)      (FT)      (CFS)      (MIN)       (IN)       (FPS)

                 PLANE1        .30      1.67        3.98     45.67      17.56     741.79       5.55         .20
                 MAIN          .46      1.43        5.00    641.50      57.14     800.00       5.51        2.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1413E+02  EXCESS= .2757E+01 OUTFLOW= .1682E+02 BASIN STORAGE= .3597E-02 PERCENT ERROR=     .4

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN          .46      1.43        5.00                57.14     800.00       5.51

       ***           ***           ***             ***             ***

                       HYDROGRAPH AT STATION      CH1

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

   PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
                                        6-HR          24-HR        72-HR        59.92-HR
+    (CFS)        (HR)
                               (CFS)
+       57.      13.33                   27.            8.           3.            3.
                             (INCHES)   4.415        5.509        5.512         5.512
                              (AC-FT)     13.          17.          17.           17.

                            CUMULATIVE AREA =      .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
   278 KK     *      S3    *
              *            *
              **************
                               SUBAREA S3

   280 KO           OUTPUT CONTROL VARIABLES
                          IPRNT           3  PRINT CONTROL
                          IPLOT           0  PLOT CONTROL
                          QSCAL          0.  HYDROGRAPH PLOT SCALE
                          IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                           IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT        .083  TIME INTERVAL IN HOURS

                  SUBBASIN RUNOFF DATA

   281 BA           SUBBASIN CHARACTERISTICS
                          TAREA         .01  SUBBASIN AREA

                    PRECIPITATION DATA

    12 PH                                  DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                    ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
                    5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                      .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                    STORM AREA =       .01

   282 LS           SCS LOSS RATE
                         STRTL          .38  INITIAL ABSTRACTION
                        CRVNBR        84.00  CURVE NUMBER
                         RTIMP          .00  PERCENT IMPERVIOUS AREA

   283 US           SNYDER UNITGRAPH
                            TP          .35  LAG
                            CP          .72  PEAKING COEFFICIENT

                    SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                  ***

                                                  UNIT HYDROGRAPH PARAMETERS
                                            CLARK    TC=    .45 HR,        R=    .23 HR
                                           SNYDER    TP=    .35 HR,       CP=    .72

                                                       UNIT HYDROGRAPH
                                                  18 END-OF-PERIOD ORDINATES
```

```
               1.        3.        6.        9.        9.        8.        6.        4.        3.        2.
               1.        1.        1.        0.        0.        0.        0.        0.

    ***           ***           ***           ***           ***

                    HYDROGRAPH AT STATION       S3

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

 PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR       59.92-HR
+  (CFS)       (HR)
                         (CFS)
+     17.     12.42                  3.          1.          0.           0.
                        (INCHES)   4.500       5.538       5.538        5.538
                         (AC-FT)      2.          2.          2.           2.

                    CUMULATIVE AREA =     .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 284 KK     *      O5    *
            *            *
            **************
                           OFFSITE AREA O5

 286 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 287 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .18  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =      .18

 288 LS          SCS LOSS RATE
                       STRTL        .38  INITIAL ABSTRACTION
                      CRVNBR      84.00  CURVE NUMBER
                       RTIMP        .00  PERCENT IMPERVIOUS AREA

 289 US          SNYDER UNITGRAPH
                          TP        .59  LAG
                          CP        .64  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                               ***

                                                     UNIT HYDROGRAPH PARAMETERS
                                               CLARK   TC=   .67 HR,        R=   .52 HR
                                              SNYDER   TP=   .59 HR,       CP=   .64

                                                          UNIT HYDROGRAPH
                                                     38 END-OF-PERIOD ORDINATES
               7.       24.       48.       74.      100.      119.      129.      129.      116.       99.
              84.       72.       61.       52.       44.       38.       32.       27.       23.       20.
              17.       14.       12.       10.        9.        7.        6.        5.        5.        4.
               3.        3.        2.        2.        2.        1.        1.        1.

    ***           ***           ***           ***           ***

                    HYDROGRAPH AT STATION       O5

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

 PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR       59.92-HR
+  (CFS)       (HR)
                         (CFS)
+    302.     12.67                 88.         27.         11.          11.
                        (INCHES)   4.481       5.533       5.533        5.533
                         (AC-FT)     43.         54.         54.          54.

                    CUMULATIVE AREA =     .18 SQ MI
```

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  290 KK    *     CO5    *
            *            *
            **************
                              COMBINE WEST AREAS DISCHARGING TO ELM FORK

  292 KO        OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


  293 HC        HYDROGRAPH COMBINATION
                      ICOMP          4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                ***

      ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION       CO5

  PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR       72-HR      59.92-HR
+    (CFS)       (HR)
                             (CFS)
+     381.      12.67                  126.          39.         16.          16.
                           (INCHES)   4.453        5.528       5.529        5.529
                            (AC-FT)     62.          77.         77.          77.

                          CUMULATIVE AREA =      .26 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  294 KK    *     CH2    *
            *            *
            **************
                              CHANNEL CH2

  296 KO        OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  297 BA        SUBBASIN CHARACTERISTICS
                      TAREA        .01  SUBBASIN AREA

                PRECIPITATION DATA

   12 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                     STORM AREA =       .01

  298 LS        SCS LOSS RATE
                     STRTL         .38  INITIAL ABSTRACTION
                    CRVNBR       84.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  299 UK          OVERLAND-FLOW ELEMENT NO. 1
                          L         82.  OVERLAND FLOW LENGTH
                          S       .0122  SLOPE
                          N        .350  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  300 RD          MAIN CHANNEL
                          L       1539.  CHANNEL LENGTH
                          S       .0016  SLOPE
```

```
                    N         .030  CHANNEL ROUGHNESS COEFFICIENT
                   CA          .01  CONTRIBUTING AREA
                SHAPE         TRAP  CHANNEL SHAPE
                   WD         8.00  BOTTOM WIDTH OR DIAMETER
                    Z         2.00  SIDE SLOPE
               RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                       ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
              ELEMENT     ALPHA        M          DT         DX        PEAK    TIME TO      VOLUME     MAXIMUM
                                                                                PEAK                  CELERITY
                                                 (MIN)      (FT)      (CFS)    (MIN)         (IN)       (FPS)

              PLANE1        .47       1.67        1.55      16.40     20.08    724.70        5.56         .19
              MAIN          .61       1.42        5.00     513.00     15.36    730.00        4.85        1.99


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1512E+01 OUTFLOW= .1320E+01 BASIN STORAGE= .2050E-02 PERCENT ERROR=  12.5


                                     INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


              MAIN          .61       1.42        5.00                15.36    730.00        4.85

      ***           ***           ***           ***           ***

                         HYDROGRAPH AT STATION       CH2

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                         6-HR        24-HR       72-HR      59.92-HR
+    (CFS)       (HR)
                             (CFS)
+      15.      12.17                      2.          1.          0.          0.
                          (INCHES)     4.118       4.852       4.854       4.854
                           (AC-FT)        1.          1.          1.          1.

                        CUMULATIVE AREA =      .01 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   301 KK   *      A12   *
            *            *
            **************
                                SUBAREA A12

   303 KO          OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

   304 BA          SUBBASIN CHARACTERISTICS
                         TAREA         .02  SUBBASIN AREA

                   PRECIPITATION DATA

    12 PH                                   DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                       ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                     STORM AREA =       .02

   305 LS          SCS LOSS RATE
                         STRTL         .33  INITIAL ABSTRACTION
                        CRVNBR       86.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
   306 UK            OVERLAND-FLOW ELEMENT NO. 1
                             L        120.  OVERLAND FLOW LENGTH
                             S       .2500  SLOPE
                             N        .350  ROUGHNESS COEFFICIENT
                            PA       100.0  PERCENT OF SUBBASIN
                         DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
   307 RD            MAIN CHANNEL
                             L        559.  CHANNEL LENGTH
                             S       .0050  SLOPE
                             N        .030  CHANNEL ROUGHNESS COEFFICIENT
```

```
           CA          .02  CONTRIBUTING AREA
        SHAPE         TRAP  CHANNEL SHAPE
           WD          .00  BOTTOM WIDTH OR DIAMETER
            Z         2.00  SIDE SLOPE
       RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                         COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                COMPUTATION TIME STEP
        ELEMENT    ALPHA      M         DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                     PEAK                CELERITY
                                      (MIN)      (FT)     (CFS)     (MIN)      (IN)      (FPS)

       PLANE1       2.13     1.67       .70     24.00    119.41    725.02      5.79        .61
       MAIN         1.63     1.33      1.74    559.00    114.14    725.10      5.02       5.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7317E+01 OUTFLOW= .6340E+01 BASIN STORAGE= .3260E-03 PERCENT ERROR=  13.4


                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


       MAIN         1.63     1.33      5.00              113.71    725.00      5.03

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION       A12

   TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.65, TOTAL EXCESS =     5.79

  PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      59.92-HR
+   (CFS)        (HR)
                         (CFS)
+     114.      12.08                 11.          3.          1.           1.
                       (INCHES)     4.308       5.032       5.033        5.033
                        (AC-FT)        5.          6.          6.           6.

                    CUMULATIVE AREA =      .02 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 308 KK   *     CA12   *
          *            *
          **************
                        COMBINE CH2 AND A12

 310 KO        OUTPUT CONTROL VARIABLES
                  IPRNT           3  PRINT CONTROL
                  IPLOT           0  PLOT CONTROL
                  QSCAL          0.  HYDROGRAPH PLOT SCALE
                  IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                   IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                  ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                  ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                 TIMINT        .083  TIME INTERVAL IN HOURS


 311 HC        HYDROGRAPH COMBINATION
                  ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION      CA12

  PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      59.92-HR
+   (CFS)        (HR)
                         (CFS)
+     126.      12.08                 13.          4.          2.           2.
                       (INCHES)     4.273       5.000       5.001        5.001
                        (AC-FT)        7.          8.          8.           8.

                    CUMULATIVE AREA =      .03 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 312 KK   *      CH3   *
          *            *
          **************
                        CHANNEL CH3
```

```
 314 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 315 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .00  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......  ............... TP-40 ..............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                            STORM AREA =       .00

 316 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 317 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         92.  OVERLAND FLOW LENGTH
                          S       .0435  SLOPE
                          N        .350  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 318 RD            MAIN CHANNEL
                          L        840.  CHANNEL LENGTH
                          S       .0012  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD       10.00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                           ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M          DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                 CELERITY
                                                    (MIN)      (FT)     (CFS)    (MIN)       (IN)       (FPS)

                   PLANE1        .89     1.67       1.14     18.40     18.94    725.03       5.56        .31
                   MAIN          .47     1.44       4.39    840.00    111.02    728.70       4.99       3.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7682E+01  EXCESS= .1245E+01 OUTFLOW= .8789E+01 BASIN STORAGE= .1382E-02 PERCENT ERROR=    1.5

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          .47     1.44       5.00              106.75    730.00       4.99

      ***           ***           ***          ***           ***

                            HYDROGRAPH AT STATION       CH3

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =      5.56

  PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                         6-HR        24-HR        72-HR       59.92-HR
+   (CFS)        (HR)
                             (CFS)
+     107.      12.17                     15.           4.           2.           2.
                           (INCHES)      4.266        4.989        4.990        4.990
                            (AC-FT)         8.           9.           9.           9.

                          CUMULATIVE AREA =      .03 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 319 KK      *      A11   *
             *            *
             **************
                               SUBAREA A11

 321 KO          OUTPUT CONTROL VARIABLES
```

```
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS

              SUBBASIN RUNOFF DATA

 322 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .03  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =       .03

 323 LS         SCS LOSS RATE
                   STRTL          .33  INITIAL ABSTRACTION
                  CRVNBR        86.00  CURVE NUMBER
                   RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 324 UK           OVERLAND-FLOW ELEMENT NO. 1
                       L         120.  OVERLAND FLOW LENGTH
                       S        .2500  SLOPE
                       N         .350  ROUGHNESS COEFFICIENT
                      PA        100.0  PERCENT OF SUBBASIN
                   DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 325 RD           MAIN CHANNEL
                       L         842.  CHANNEL LENGTH
                       S        .0050  SLOPE
                       N         .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA          .03  CONTRIBUTING AREA
                   SHAPE         TRAP  CHANNEL SHAPE
                      WD          .00  BOTTOM WIDTH OR DIAMETER
                       Z         2.00  SIDE SLOPE
                  RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                 ELEMENT     ALPHA       M          DT          DX        PEAK     TIME TO    VOLUME     MAXIMUM
                                                                                    PEAK                 CELERITY
                                                   (MIN)       (FT)      (CFS)     (MIN)       (IN)       (FPS)

                 PLANE1       2.13      1.67         .70      24.00     173.83    725.02       5.79        .61
                 MAIN         1.63      1.33        2.39     421.00     164.16    724.07       5.64       5.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1065E+02 OUTFLOW= .1038E+02 BASIN STORAGE= .4782E-03 PERCENT ERROR=   2.5

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN         1.63      1.33        5.00                157.65    725.00       5.64

      ***            ***           ***            ***            ***

                        HYDROGRAPH AT STATION      A11

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      59.92-HR
+   (CFS)        (HR)
                            (CFS)
+     158.      12.08                 17.           5.           2.           2.
                          (INCHES)  4.643        5.637        5.638        5.638
                           (AC-FT)     9.          10.          10.          10.

                         CUMULATIVE AREA =      .03 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 326 KK     *    CA11    *
            *            *
            **************
                              COMBINE WITH CH3 AND A11

 328 KO         OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
```

```
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


 329 HC         HYDROGRAPH COMBINATION
                    ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***             ***             ***             ***

                       HYDROGRAPH AT STATION     CA11

 PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR      59.92-HR
+   (CFS)      (HR)
                         (CFS)
+     261.     12.08               32.         10.          4.            4.
                       (INCHES)   4.458       5.320       5.321         5.321
                        (AC-FT)     16.         19.         19.           19.

                        CUMULATIVE AREA =      .07 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 330 KK    *      CH4   *
           *            *
           **************
                              CHANNEL CH4

 332 KO         OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 333 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  12 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   .............. TP-40 ..............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .01

 334 LS         SCS LOSS RATE
                   STRTL          .38  INITIAL ABSTRACTION
                  CRVNBR        84.00  CURVE NUMBER
                   RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 335 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L        101.  OVERLAND FLOW LENGTH
                        S       .0792  SLOPE
                        N        .350  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 336 RD           MAIN CHANNEL
                        L       1180.  CHANNEL LENGTH
                        S       .0025  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD       10.00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                  ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                               PEAK                CELERITY
                                                  (MIN)     (FT)     (CFS)    (MIN)       (IN)      (FPS)

                 PLANE1       1.20      1.67        .99     20.20     31.93    724.55      5.56        .38
```

```
              MAIN          .68      1.44       3.86   1180.00    260.55    728.77      5.29      5.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1916E+02  EXCESS= .2075E+01 OUTFLOW= .2103E+02 BASIN STORAGE= .1474E-02 PERCENT ERROR=    .9

                                   INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

              MAIN          .68      1.44       5.00              250.54    730.00      5.30

      ***            ***           ***           ***           ***

                   HYDROGRAPH AT STATION      CH4

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR      72-HR     59.92-HR
+   (CFS)       (HR)
                         (CFS)
+     251.     12.17              36.         11.         4.          4.
                       (INCHES)  4.452       5.300      5.301       5.301
                        (AC-FT)    18.         21.        21.         21.

                      CUMULATIVE AREA =      .07 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

           **************
           *            *
 337 KK    *     A10T   *
           *            *
           **************
                         SUBAREA A10T

 339 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 340 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .02  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                STORM AREA =      .02

 341 LS          SCS LOSS RATE
                       STRTL        .38  INITIAL ABSTRACTION
                      CRVNBR      84.00  CURVE NUMBER
                       RTIMP        .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 342 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L       265.  OVERLAND FLOW LENGTH
                           S      .0400  SLOPE
                           N       .350  ROUGHNESS COEFFICIENT
                          PA      100.0  PERCENT OF SUBBASIN
                       DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 343 RD            MAIN CHANNEL
                           L       772.  CHANNEL LENGTH
                           S      .0050  SLOPE
                           N       .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA        .02  CONTRIBUTING AREA
                       SHAPE       TRAP  CHANNEL SHAPE
                          WD        .00  BOTTOM WIDTH OR DIAMETER
                           Z       2.00  SIDE SLOPE
                      RUPSTQ         NO  ROUTE UPSTREAM HYDROGRAPH

                                                       ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
               ELEMENT    ALPHA       M          DT         DX        PEAK    TIME TO     VOLUME    MAXIMUM
                                                                               PEAK                CELERITY
                                               (MIN)       (FT)       (CFS)    (MIN)       (IN)      (FPS)

              PLANE1        .85      1.67       2.24      53.00      64.44    727.52      5.55       .40
              MAIN         1.63      1.33       2.81     386.00      62.64    729.38      5.46      4.59
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5722E+01 OUTFLOW= .5617E+01 BASIN STORAGE= .7387E-03 PERCENT ERROR=   1.8

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          1.63       1.33       5.00              61.97    730.00       5.45

      ***             ***            ***            ***            ***

                            HYDROGRAPH AT STATION     A10T

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR        72-HR       59.92-HR
+    (CFS)       (HR)
                           (CFS)
+       62.      12.17                  9.          3.          1.            1.
                          (INCHES)    4.488       5.450       5.455         5.455
                           (AC-FT)       5.          6.          6.            6.

                           CUMULATIVE AREA =       .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
 344 KK      *    A10S    *
             *            *
             **************
                                 SUBAREA A10S

 346 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 347 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .03  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                                DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                   STORM AREA =       .03

 348 LS          SCS LOSS RATE
                      STRTL          .33  INITIAL ABSTRACTION
                     CRVNBR        86.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 349 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         120.  OVERLAND FLOW LENGTH
                          S        .2500  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 350 RD            MAIN CHANNEL
                          L         764.  CHANNEL LENGTH
                          S        .0050  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .03  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         2.00  SIDE SLOPE
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                       ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT     ALPHA        M         DT         DX        PEAK     TIME TO      VOLUME     MAXIMUM
                                                                                      PEAK                  CELERITY
                                                      (MIN)      (FT)      (CFS)     (MIN)        (IN)       (FPS)

                   PLANE1        2.13       1.67        .70      24.00     130.50    725.02        5.79         .61
                   MAIN          1.63       1.33       2.33     382.00     126.55    724.58        5.65        5.47
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7997E+01 OUTFLOW= .7801E+01 BASIN STORAGE= .4245E-03 PERCENT ERROR=   2.4

                                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00              122.75    725.00       5.65

      ***           ***           ***            ***           ***

                         HYDROGRAPH AT STATION     A10S

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.65, TOTAL EXCESS =    5.79

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     59.92-HR
+   (CFS)       (HR)
                             (CFS)
+     123.     12.08                     13.          4.          2.          2.
                           (INCHES)    4.659       5.654       5.655       5.655
                            (AC-FT)       6.          8.          8.          8.

                          CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  351 KK      *     CA10   *
              *            *
              **************
                                 COMBINE A10 SUBAREAS

  353 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


  354 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                           ***

      ***           ***           ***            ***           ***

                         HYDROGRAPH AT STATION     CA10

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     59.92-HR
+   (CFS)       (HR)
                             (CFS)
+     180.     12.08                     22.          7.          3.          3.
                           (INCHES)    4.582       5.567       5.569       5.569
                            (AC-FT)      11.         13.         13.         13.

                          CUMULATIVE AREA =      .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  355 KK      *       A9   *
              *            *
              **************
                                 SUBAREA A9

  357 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  358 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .02  SUBBASIN AREA
```

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              PRECIPITATION DATA

 12 PH                           DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                          STORM AREA =      .02

359 LS        SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
360 UK          OVERLAND-FLOW ELEMENT NO. 1
                        L        120.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
                        N        .350  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
361 RD          MAIN CHANNEL
                        L        399.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .02  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                ELEMENT    ALPHA       M          DT        DX        PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                  CELERITY
                                                (MIN)      (FT)      (CFS)    (MIN)       (IN)       (FPS)

                PLANE1      2.13      1.67        .70     24.00     110.33    725.02       5.79        .61
                MAIN        1.63      1.33       1.27    399.00     106.95    724.60       5.08       5.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .6762E+01 OUTFLOW= .5937E+01 BASIN STORAGE= .2341E-03 PERCENT ERROR=  12.2

                                      INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                MAIN        1.63      1.33       5.00               104.68    725.00       5.10

     ***           ***          ***          ***          ***

                      HYDROGRAPH AT STATION       A9

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      59.92-HR
+   (CFS)       (HR)
                           (CFS)
+     105.     12.08                  10.          3.          1.          1.
                         (INCHES)   4.361       5.095       5.096       5.096
                          (AC-FT)      5.          6.          6.          6.

                      CUMULATIVE AREA =      .02 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 362 KK     *      P2    *
            *            *
            **************
                              DETENTION POND P2

 364 KO       OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS

            SUBBASIN RUNOFF DATA

 365 BA       SUBBASIN CHARACTERISTICS
                    TAREA         .02  SUBBASIN AREA

              PRECIPITATION DATA
```

```
  12 PH                                    DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                      STORM AREA =       .02

 366 LS           SCS LOSS RATE
                      STRTL          .00  INITIAL ABSTRACTION
                      CRVNBR      100.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 367 UD           SCS DIMENSIONLESS UNITGRAPH
                      TLAG           .00  LAG

                                                                ***

                                                          UNIT HYDROGRAPH
                                                      5 END-OF-PERIOD ORDINATES
               113.       32.        6.        1.        0.

     ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION        P2

   TOTAL RAINFALL =     7.44, TOTAL LOSS =      .00, TOTAL EXCESS =     7.44

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR       59.92-HR
+   (CFS)       (HR)
                          (CFS)
+      101.    12.08                   12.           4.           2.             2.
                        (INCHES)     5.468        7.437        7.440          7.440
                         (AC-FT)        6.           8.           8.             8.

                          CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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            *            *
 368 KK     *    P2-IN   *
            *            *
            **************
                                  COMBINE AREAS DISCHARGING TO POND P2

 370 KO           OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS


 371 HC           HYDROGRAPH COMBINATION
                      ICOMP            4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                ***

     ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION     P2-IN

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR       59.92-HR
+   (CFS)       (HR)
                          (CFS)
+      616.    12.08                   80.          24.          10.            10.
                        (INCHES)     4.590        5.594        5.608          5.608
                         (AC-FT)       39.          48.          48.            48.

                          CUMULATIVE AREA =      .16 SQ MI


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 372 KK     *      RP2   *
            *            *
            **************
                                  ROUTE THROUGH POND P2

 374 KO           OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
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                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

375 RS         STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       ELEV  TYPE OF INITIAL CONDITION
                   RSVRIC     454.00  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

376 SA               AREA         .0        4.4        6.8        8.3        8.4        8.5        8.6        8.9        9.1

377 SE          ELEVATION     454.00     454.50     455.00     455.50     456.00     456.50     457.00     458.00     459.00

379 SL         LOW-LEVEL OUTLET
                    ELEVL     456.00  ELEVATION AT CENTER OF OUTLET
                    CAREA      14.14  CROSS-SECTIONAL AREA
                     COQL        .80  COEFFICIENT
                     EXPL        .50  EXPONENT OF HEAD

378 SS         SPILLWAY
                     CREL     458.00  SPILLWAY CREST ELEVATION
                    SPWID      25.00  SPILLWAY WIDTH
                     COQW       2.60  WEIR COEFFICIENT
                     EXPW       1.50  EXPONENT OF HEAD

                                                           ***

                                                  COMPUTED STORAGE-ELEVATION DATA

           STORAGE       .00       .74      3.53      7.28     11.44     15.66     19.94     28.69     37.69
         ELEVATION    454.00    454.50    455.00    455.50    456.00    456.50    457.00    458.00    459.00

                                                  COMPUTED OUTFLOW-ELEVATION DATA

           OUTFLOW       .00       .00    122.28    123.10    123.94    124.78    125.64    126.50    127.38    128.27
         ELEVATION    454.00    456.00    457.82    457.84    457.87    457.89    457.92    457.95    457.97    458.00

           OUTFLOW    137.24    141.43    146.68    153.10    160.79    169.87    180.43    192.58    206.44    222.10
         ELEVATION    458.16    458.21    458.28    458.36    458.44    458.54    458.64    458.75    458.87    459.00


                                              COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

           STORAGE       .00       .74      3.53      7.28     11.44     15.66     19.94     27.08     27.29     27.51
           OUTFLOW       .00       .00       .00       .00       .00     64.14     90.70    122.28    123.10    123.94
         ELEVATION    454.00    454.50    455.00    455.50    456.00    456.50    457.00    457.82    457.84    457.87

           STORAGE     27.74     27.97     28.20     28.44     28.69     30.08     30.60     31.19     31.87     32.63
           OUTFLOW    124.78    125.64    126.50    127.38    128.27    137.24    141.43    146.68    153.10    160.79
         ELEVATION    457.89    457.92    457.95    457.97    458.00    458.16    458.21    458.28    458.36    458.44

           STORAGE     33.47     34.40     35.41     36.51     37.69
           OUTFLOW    169.87    180.43    192.58    206.44    222.10
         ELEVATION    458.54    458.64    458.75    458.87    459.00

    ***             ***             ***             ***             ***

                  HYDROGRAPH AT STATION       RP2

 PEAK FLOW       TIME                            MAXIMUM AVERAGE FLOW
                                    6-HR          24-HR         72-HR       59.92-HR
+   (CFS)        (HR)
                           (CFS)
+     118.      12.75                 64.           19.            7.            7.
                         (INCHES)    3.717         4.277         4.277         4.277
                          (AC-FT)     32.           37.           37.           37.

PEAK STORAGE     TIME                          MAXIMUM AVERAGE STORAGE
                                    6-HR          24-HR         72-HR       59.92-HR
+  (AC-FT)       (HR)
       26.      12.75                 18.           13.           10.           10.

 PEAK STAGE      TIME                            MAXIMUM AVERAGE STAGE
                                    6-HR          24-HR         72-HR       59.92-HR
+   (FEET)       (HR)
    457.72      12.75               456.73        456.20        455.78        455.78

                         CUMULATIVE AREA =      .16 SQ MI


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             *            *
380 KK       *      CH5   *
             *            *
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                          CHANNEL CH5

 382 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 383 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .00  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =      .00

 384 LS          SCS LOSS RATE
                       STRTL        .38  INITIAL ABSTRACTION
                      CRVNBR      84.00  CURVE NUMBER
                       RTIMP        .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 385 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L       197.  OVERLAND FLOW LENGTH
                           S      .0051  SLOPE
                           N       .350  ROUGHNESS COEFFICIENT
                          PA      100.0  PERCENT OF SUBBASIN
                       DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 386 RD            MAIN CHANNEL
                           L       155.  CHANNEL LENGTH
                           S      .0050  SLOPE
                           N       .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA        .00  CONTRIBUTING AREA
                       SHAPE       TRAP  CHANNEL SHAPE
                          WD      20.00  BOTTOM WIDTH OR DIAMETER
                           Z       2.00  SIDE SLOPE
                      RUPSTQ        YES  ROUTE UPSTREAM HYDROGRAPH

                                                                 ***
                             COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                    COMPUTATION TIME STEP
                   ELEMENT     ALPHA       M        DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                PEAK                CELERITY
                                                  (MIN)      (FT)     (CFS)    (MIN)       (IN)       (FPS)

                  PLANE1         .30     1.67      3.83     39.40      3.15    735.42      5.55        .17
                  MAIN           .65     1.51       .58    155.00    119.57    765.36      4.28       4.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3677E+02  EXCESS= .3558E+00 OUTFLOW= .3709E+02 BASIN STORAGE= .2947E-03 PERCENT ERROR=     .1

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN           .65     1.51      5.00               119.56    765.00      4.28

       ***           ***          ***           ***            ***

                         HYDROGRAPH AT STATION      CH5

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      59.92-HR
+   (CFS)        (HR)
                           (CFS)
+     120.      12.75                 65.         19.          7.           7.
                         (INCHES)   3.719       4.282       4.283        4.283
                          (AC-FT)     32.         37.         37.          37.

                         CUMULATIVE AREA =      .16 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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             *            *
 387 KK      *      A7T   *
             *            *
             **************
                          SUBAREA A7T
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389 KO         OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

390 BA         SUBBASIN CHARACTERISTICS
                     TAREA        .02  SUBBASIN AREA

               PRECIPITATION DATA

 12 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =       .02

391 LS         SCS LOSS RATE
                     STRTL        .38  INITIAL ABSTRACTION
                    CRVNBR      84.00  CURVE NUMBER
                     RTIMP        .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
392 UK           OVERLAND-FLOW ELEMENT NO. 1
                         L       312.  OVERLAND FLOW LENGTH
                         S      .0400  SLOPE
                         N       .350  ROUGHNESS COEFFICIENT
                        PA      100.0  PERCENT OF SUBBASIN
                     DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
393 RD           MAIN CHANNEL
                         L      1133.  CHANNEL LENGTH
                         S      .0050  SLOPE
                         N       .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA        .02  CONTRIBUTING AREA
                     SHAPE       TRAP  CHANNEL SHAPE
                        WD        .00  BOTTOM WIDTH OR DIAMETER
                         Z       2.00  SIDE SLOPE
                    RUPSTQ         NO  ROUTE UPSTREAM HYDROGRAPH

                                                           ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                  ELEMENT    ALPHA       M         DT        DX       PEAK     TIME TO    VOLUME    MAXIMUM
                                                                                PEAK                 CELERITY
                                                 (MIN)      (FT)     (CFS)     (MIN)      (IN)       (FPS)

                 PLANE1         .85     1.67      2.54     62.40     67.33    728.32      5.55        .42
                 MAIN          1.63     1.33      4.08    566.50     66.56    730.43      5.45       4.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .6285E+01 OUTFLOW= .6162E+01 BASIN STORAGE= .1163E-02 PERCENT ERROR=   1.9

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN          1.63     1.33      5.00               66.14    730.00      5.45

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       A7T

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =      5.56

  PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
                                         6-HR          24-HR          72-HR        59.92-HR
+    (CFS)       (HR)
                            (CFS)
+      66.      12.17                     10.             3.             1.             1.
                           (INCHES)     4.491          5.448          5.454          5.454
                            (AC-FT)        5.             6.             6.             6.

                          CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
394 KK    *      A7S   *
          *            *
          **************
                         SUBAREA A7S
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 396 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS

             SUBBASIN RUNOFF DATA

 397 BA        SUBBASIN CHARACTERISTICS
                     TAREA        .03  SUBBASIN AREA

               PRECIPITATION DATA

  12 PH                             DEPTHS FOR  4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
               5-MIN 15-MIN 60-MIN   2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74   1.57   3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                               STORM AREA =      .03

 398 LS        SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 399 UK          OVERLAND-FLOW ELEMENT NO. 1
                        L        120.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
                        N        .350  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 400 RD          MAIN CHANNEL
                        L       1094.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .03  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                           ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                  ELEMENT    ALPHA      M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                 CELERITY
                                                 (MIN)     (FT)     (CFS)    (MIN)        (IN)      (FPS)

                 PLANE1       2.13     1.67       .70     24.00    160.22    725.02       5.79        .61
                 MAIN         1.63     1.33      3.17    547.00    147.31    725.68       5.63       5.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .9818E+01 OUTFLOW= .9550E+01 BASIN STORAGE= .6044E-03 PERCENT ERROR=   2.7

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN         1.63     1.33      5.00              143.97    725.00       5.64

     ***             ***            ***             ***             ***

                         HYDROGRAPH AT STATION       A7S

   TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.65, TOTAL EXCESS =     5.79

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR       59.92-HR
+   (CFS)        (HR)
                           (CFS)
+      144.     12.08                 16.           5.           2.            2.
                         (INCHES)   4.654        5.639        5.639         5.639
                          (AC-FT)      8.          10.          10.           10.

                          CUMULATIVE AREA =      .03 SQ MI


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            *            *
 401 KK     *      CA7   *
            *            *
            **************
                              COMBINE A7 SUBAREAS

 403 KO        OUTPUT CONTROL VARIABLES
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                IPRNT          3  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE
                IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                 IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
               TIMINT       .083  TIME INTERVAL IN HOURS


404 HC        HYDROGRAPH COMBINATION
                ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***            ***            ***             ***             ***

                   HYDROGRAPH AT STATION      CA7

PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      59.92-HR
+   (CFS)      (HR)
                  (CFS)
+     201.    12.08                  26.          8.          3.           3.
                (INCHES)           4.584       5.562       5.565       5.565
                 (AC-FT)             13.         16.         16.         16.

                  CUMULATIVE AREA =      .05 SQ MI


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           *            *
405 KK     *       A8   *
           *            *
           **************
                             SUBAREA A8

407 KO        OUTPUT CONTROL VARIABLES
                IPRNT          3  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE
                IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                 IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
               TIMINT       .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

408 BA        SUBBASIN CHARACTERISTICS
                TAREA        .02  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                              STORM AREA =       .02

409 LS        SCS LOSS RATE
                STRTL        .33  INITIAL ABSTRACTION
               CRVNBR      86.00  CURVE NUMBER
                RTIMP        .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
410 UK          OVERLAND-FLOW ELEMENT NO. 1
                    L       120.  OVERLAND FLOW LENGTH
                    S      .2500  SLOPE
                    N       .350  ROUGHNESS COEFFICIENT
                   PA      100.0  PERCENT OF SUBBASIN
                DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
411 RD          MAIN CHANNEL
                    L       399.  CHANNEL LENGTH
                    S      .0050  SLOPE
                    N       .030  CHANNEL ROUGHNESS COEFFICIENT
                   CA        .02  CONTRIBUTING AREA
                SHAPE       TRAP  CHANNEL SHAPE
                   WD        .00  BOTTOM WIDTH OR DIAMETER
                    Z       2.00  SIDE SLOPE
               RUPSTQ         NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                             COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                    COMPUTATION TIME STEP
            ELEMENT     ALPHA       M         DT         DX        PEAK     TIME TO     VOLUME     MAXIMUM
                                                                              PEAK                CELERITY
                                             (MIN)       (FT)      (CFS)     (MIN)        (IN)      (FPS)
```

```
                PLANE1        2.13       1.67        .70     24.00      84.63    725.03      5.79       .61
                MAIN          1.63       1.33       1.36    399.00      80.42    724.17      5.06      4.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5187E+01 OUTFLOW= .4535E+01 BASIN STORAGE= .2273E-03 PERCENT ERROR=  12.6

                                      INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN          1.63       1.33       5.00                79.62    725.00      5.07

      ***            ***            ***            ***            ***

                           HYDROGRAPH AT STATION       A8

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR      59.92-HR
 +   (CFS)      (HR)
                           (CFS)
 +      80.     12.08                   8.          2.          1.          1.
                         (INCHES)     4.333       5.066       5.067       5.067
                          (AC-FT)       4.          5.          5.          5.

                         CUMULATIVE AREA =      .02 SQ MI


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            *            *
  412 KK    *      P3    *
            *            *
            **************
                                DETENTION POND P3

  414 KO         OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  415 BA         SUBBASIN CHARACTERISTICS
                       TAREA        .02  SUBBASIN AREA

                 PRECIPITATION DATA

   12 PH                          DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                               STORM AREA =       .02

  416 LS         SCS LOSS RATE
                       STRTL        .00  INITIAL ABSTRACTION
                      CRVNBR     100.00  CURVE NUMBER
                       RTIMP        .00  PERCENT IMPERVIOUS AREA

  417 UD         SCS DIMENSIONLESS UNITGRAPH
                        TLAG        .00  LAG

                                                              ***

                                                        UNIT HYDROGRAPH
                                                    5 END-OF-PERIOD ORDINATES
              97.        27.        5.        1.         0.

      ***            ***            ***            ***            ***

                           HYDROGRAPH AT STATION       P3

   TOTAL RAINFALL =     7.44, TOTAL LOSS =      .00, TOTAL EXCESS =     7.44

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR      59.92-HR
 +   (CFS)      (HR)
                           (CFS)
 +      87.     12.08                  10.          3.          1.          1.
                         (INCHES)     5.468       7.437       7.440       7.440
                          (AC-FT)       5.          7.          7.          7.

                         CUMULATIVE AREA =      .02 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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            *            *
 418 KK     *    P3-IN   *
            *            *
            **************
                            COMBINE AREAS DISCHARGING TO POND P3

 420 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


 421 HC          HYDROGRAPH COMBINATION
                      ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                   ***

      ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION    P3-IN

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     59.92-HR
+   (CFS)      (HR)
                           (CFS)
+     368.    12.08                   44.         14.         5.          5.
                        (INCHES)    4.691       5.811      5.832       5.832
                         (AC-FT)      22.         27.        27.         27.

                      CUMULATIVE AREA =      .09 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 422 KK     *      RP3   *
            *            *
            **************
                            ROUTE THROUGH POND P3

 424 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


                HYDROGRAPH ROUTING DATA

 425 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     453.00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

 426 SA               AREA          .0        5.4        7.8        8.0        8.2        8.4        8.6

 427 SE          ELEVATION      453.00     454.00     455.00     456.00     457.00     458.00     459.00

 429 SL          LOW-LEVEL OUTLET
                      ELEVL     454.50  ELEVATION AT CENTER OF OUTLET
                      CAREA       7.07  CROSS-SECTIONAL AREA
                       COQL        .80  COEFFICIENT
                       EXPL        .50  EXPONENT OF HEAD

 428 SS          SPILLWAY
                       CREL     458.00  SPILLWAY CREST ELEVATION
                      SPWID      25.00  SPILLWAY WIDTH
                       COQW       2.60  WEIR COEFFICIENT
                       EXPW       1.50  EXPONENT OF HEAD

                                                                   ***

                                                    COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00       1.79       8.31      16.18      24.24      32.50      40.96
          ELEVATION     453.00     454.00     455.00     456.00     457.00     458.00     459.00
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                                    COMPUTED OUTFLOW-ELEVATION DATA

  OUTFLOW       .00       .00     53.75     56.72     60.04     63.77     67.99     72.81     78.37     84.85
ELEVATION    453.00    454.50    455.90    456.06    456.25    456.48    456.75    457.08    457.49    458.00

  OUTFLOW     86.01     87.68     90.42     94.49    100.15    107.65    117.25    129.21    143.78    161.21
ELEVATION    458.04    458.09    458.15    458.23    458.32    458.42    458.54    458.68    458.83    459.00


                                COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

  STORAGE       .00      1.79      4.75      8.31     15.42     16.18     16.69     18.20     20.00     22.19
  OUTFLOW       .00       .00       .00     32.07     53.75     55.55     56.72     60.04     63.77     67.99
ELEVATION    453.00    454.00    454.50    455.00    455.90    456.00    456.06    456.25    456.48    456.75

  STORAGE     24.24     24.87     28.23     32.50     32.88     33.25     33.75     34.39     35.15     36.05
  OUTFLOW     71.71     72.81     78.37     84.85     86.01     87.68     90.42     94.49    100.15    107.65
ELEVATION    457.00    457.08    457.49    458.00    458.04    458.09    458.15    458.23    458.32    458.42

  STORAGE     37.07     38.23     39.53     40.96
  OUTFLOW    117.25    129.21    143.78    161.21
ELEVATION    458.54    458.68    458.83    459.00

      ***            ***           ***           ***           ***

                       HYDROGRAPH AT STATION       RP3

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR          72-HR       59.92-HR
+    (CFS)        (HR)
                             (CFS)
+       53.      12.92                   37.          11.            4.            4.
                          (INCHES)     3.954        4.804          4.805         4.805
                           (AC-FT)       18.          22.            22.           22.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                       6-HR         24-HR          72-HR       59.92-HR
+   (AC-FT)       (HR)
        15.      12.92                   11.           6.             5.            5.

  PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                       6-HR         24-HR          72-HR       59.92-HR
+    (FEET)       (HR)
     455.87      12.92               455.29       454.73         454.38        454.38

                         CUMULATIVE AREA =       .09 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 430 KK       *      CH6   *
              *            *
              **************
                               CHANNEL CH6

 432 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 433 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

  12 PH                                   DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ................ TP-40 ................   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =        .00

 434 LS           SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                      CRVNBR        84.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 435 UK             OVERLAND-FLOW ELEMENT NO. 1
                           L          50.  OVERLAND FLOW LENGTH
                           S        .1000  SLOPE
                           N         .350  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
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                 MUSKINGUM-CUNGE
 436 RD            MAIN CHANNEL
                         L          155.  CHANNEL LENGTH
                         S         .0050  SLOPE
                         N          .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA           .00  CONTRIBUTING AREA
                     SHAPE          TRAP  CHANNEL SHAPE
                        WD         20.00  BOTTOM WIDTH OR DIAMETER
                         Z          2.00  SIDE SLOPE
                    RUPSTQ           YES  ROUTE UPSTREAM HYDROGRAPH

                                                          ***

                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
                  ELEMENT    ALPHA      M          DT        DX        PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                  CELERITY
                                                  (MIN)      (FT)      (CFS)     (MIN)      (IN)      (FPS)

                 PLANE1       1.35     1.67        .60     10.00       6.48    724.83      5.56        .33
                 MAIN          .65     1.51        .76    155.00      53.61    770.47      4.81       3.41

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2219E+02  EXCESS= .3854E+00 OUTFLOW= .2253E+02 BASIN STORAGE= .2239E-03 PERCENT ERROR=     .2

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN           .65      1.51       5.00                  53.61    770.00       4.81

      ***             ***          ***             ***             ***

                          HYDROGRAPH AT STATION       CH6

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =      5.56

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR        72-HR      59.92-HR
 +   (CFS)       (HR)
                            (CFS)
 +       54.     12.83                 37.          11.           5.            5.
                          (INCHES)   3.950        4.806        4.808         4.808
                           (AC-FT)     19.          23.          23.           23.

                          CUMULATIVE AREA =      .09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 437 KK     *     CCH6   *
            *            *
            **************
                              COMBINE AREAS UPSTREAM OF S8

 439 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


 440 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***          ***             ***             ***

                          HYDROGRAPH AT STATION      CCH6

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR        72-HR      59.92-HR
 +   (CFS)       (HR)
                            (CFS)
 +      173.     12.75                102.          30.          12.           12.
                          (INCHES)   3.799        4.466        4.467         4.467
                           (AC-FT)     51.          60.          60.           60.

                          CUMULATIVE AREA =      .25 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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441 KK      *       S9  *
            *           *
            *************
                                  SUBAREA S9

443 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

444 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .04  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                     STORM AREA =       .04

445 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

446 US          SNYDER UNITGRAPH
                         TP         .37  LAG
                         CP         .68  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                   ***

                                                        UNIT HYDROGRAPH PARAMETERS
                                                  CLARK   TC=   .45 HR,       R=   .28 HR
                                                 SNYDER   TP=   .37 HR,      CP=   .68

                                                              UNIT HYDROGRAPH
                                                        21 END-OF-PERIOD ORDINATES
                4.        14.        28.        38.        42.        38.        29.        21.        16.        12.
                9.         6.         5.         4.         3.         2.         1.         1.         1.         1.
                0.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION        S9

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR         24-HR        72-HR       59.92-HR
+   (CFS)       (HR)
                          (CFS)
+      80.     12.42                17.            5.           2.           2.
                          (INCHES)  4.495        5.534        5.534        5.534
                          (AC-FT)      9.          10.          10.          10.

                         CUMULATIVE AREA =      .04 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            *************
            *           *
447 KK      *      S10  *
            *           *
            *************
                                  SUBAREA S10

449 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

450 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .02  SUBBASIN AREA
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               PRECIPITATION DATA

   12 PH                                       DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......    ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN     2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19     4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                    STORM AREA =       .02

  451 LS       SCS LOSS RATE
                     STRTL        .38  INITIAL ABSTRACTION
                    CRVNBR      84.00  CURVE NUMBER
                     RTIMP        .00  PERCENT IMPERVIOUS AREA

  452 US       SNYDER UNITGRAPH
                        TP        .27  LAG
                        CP        .68  PEAKING COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                 ***

                                                      UNIT HYDROGRAPH PARAMETERS
                                                CLARK    TC=    .34 HR,        R=   .20 HR
                                               SNYDER    TP=    .27 HR,       CP=   .68

                                                           UNIT HYDROGRAPH
                                                      15 END-OF-PERIOD ORDINATES
               4.         13.        23.        26.        22.        14.         9.         6.         4.         3.
               2.          1.         1.         1.         0.

      ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION       S10

    TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR        72-HR      59.92-HR
+   (CFS)       (HR)
                          (CFS)
+      44.     12.33                 8.           2.           1.           1.
                        (INCHES)  4.495        5.532        5.532        5.532
                         (AC-FT)     4.           5.           5.           5.

                     CUMULATIVE AREA =      .02 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  453 KK  *       CS9  *
          *            *
          **************
                             COMBINE AREAS DISCHARGING SOUTH OFF OF P.B.

  455 KO        OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        720  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


  456 HC        HYDROGRAPH COMBINATION
                      ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                 ***

      ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION       CS9

  PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR        72-HR      59.92-HR
+   (CFS)       (HR)
                          (CFS)
+     286.     12.42               126.          38.          15.          15.
                        (INCHES)  3.865        4.649        4.651        4.651
                         (AC-FT)    62.          75.          75.          75.

                     CUMULATIVE AREA =      .30 SQ MI

1
                                                           RUNOFF SUMMARY
                                                     FLOW IN CUBIC FEET PER SECOND
                                                  TIME IN HOURS,  AREA IN SQUARE MILES

                                        PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
```

+	OPERATION	STATION	FLOW	PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	STAGE	MAX STAGE
+	HYDROGRAPH AT	O1	298.	12.42	70.	22.	9.	.14		
+	HYDROGRAPH AT	S4	94.	12.92	33.	10.	4.	.07		
+	2 COMBINED AT	CS4	364.	12.50	102.	32.	13.	.20		
+	HYDROGRAPH AT	A1T	27.	12.17	4.	1.	1.	.01		
+	HYDROGRAPH AT	A1S	131.	12.08	14.	4.	2.	.03		
+	2 COMBINED AT	CA1	156.	12.08	19.	6.	2.	.04		
+	HYDROGRAPH AT	CH14	7.	12.08	1.	0.	0.	.00		
+	2 COMBINED AT	CCH14	163.	12.08	19.	6.	2.	.04		
+	HYDROGRAPH AT	A2T	57.	12.17	9.	3.	1.	.02		
+	HYDROGRAPH AT	A2S	144.	12.08	16.	5.	2.	.03		
+	2 COMBINED AT	CA2	195.	12.08	25.	8.	3.	.05		
+	HYDROGRAPH AT	CH12	4.	12.08	0.	0.	0.	.00		
+	HYDROGRAPH AT	CH13	9.	12.08	1.	0.	0.	.00		
+	3 COMBINED AT	CCH13	208.	12.08	26.	8.	3.	.05		
+	HYDROGRAPH AT	A3	61.	12.08	6.	2.	1.	.01		
+	HYDROGRAPH AT	CH10	6.	12.08	1.	0.	0.	.00		
+	HYDROGRAPH AT	CH11	4.	12.08	0.	0.	0.	.00		
+	3 COMBINED AT	CCH11	72.	12.08	7.	2.	1.	.01		
+	3 COMBINED AT	CA3	443.	12.08	53.	16.	6.	.11		
+	HYDROGRAPH AT	CH7	17.	12.08	2.	1.	0.	.00		
+	HYDROGRAPH AT	A5	134.	12.08	15.	4.	2.	.03		
+	2 COMBINED AT	CA5	150.	12.08	17.	5.	2.	.03		
+	HYDROGRAPH AT	CH8	166.	12.08	19.	6.	2.	.04		
+	HYDROGRAPH AT	A4	100.	12.08	10.	3.	1.	.02		
+	2 COMBINED AT	CA4	267.	12.08	29.	9.	3.	.06		
+	HYDROGRAPH AT	CH9	275.	12.08	31.	9.	4.	.06		
+	HYDROGRAPH AT	P1	186.	12.08	21.	7.	3.	.04		
+	3 COMBINED AT	P1-IN	904.	12.08	105.	33.	13.	.21		
+	ROUTED TO	RP1	28.	15.17	28.	23.	11.	.21		
+									457.46	15.17
+	2 COMBINED AT	CP1	389.	12.50	125.	52.	23.	.41		
+	HYDROGRAPH AT	S5	21.	12.58	6.	2.	1.	.01		

+	2 COMBINED AT	CS5	408.	12.50	131.	54.	24.	.42
+	HYDROGRAPH AT	S7	17.	12.50	4.	1.	1.	.01
+	2 COMBINED AT	CS7	426.	12.50	135.	55.	25.	.43
+	HYDROGRAPH AT	O1A	70.	12.58	18.	6.	2.	.04
+	HYDROGRAPH AT	O2	2171.	12.75	767.	239.	96.	1.58
+	HYDROGRAPH AT	O3	62.	12.33	12.	4.	2.	.03
+	HYDROGRAPH AT	S6	32.	12.83	10.	3.	1.	.02
+	5 COMBINED AT	CS6	2664.	12.75	941.	305.	125.	2.09
+	HYDROGRAPH AT	O4	269.	12.50	65.	20.	8.	.13
+	2 COMBINED AT	CO4	2881.	12.67	1006.	325.	133.	2.23
+	HYDROGRAPH AT	A6	73.	12.08	9.	3.	1.	.02
+	HYDROGRAPH AT	S8	39.	12.33	8.	2.	1.	.02
+	3 COMBINED AT	CS8	2919.	12.67	1022.	329.	135.	2.26
+	HYDROGRAPH AT	S1	24.	12.83	8.	2.	1.	.02
+	HYDROGRAPH AT	S2	52.	13.25	23.	7.	3.	.05
+	HYDROGRAPH AT	CH1	57.	13.33	27.	8.	3.	.06
+	HYDROGRAPH AT	S3	17.	12.42	3.	1.	0.	.01
+	HYDROGRAPH AT	O5	302.	12.67	88.	27.	11.	.18
+	4 COMBINED AT	CO5	381.	12.67	126.	39.	16.	.26
+	HYDROGRAPH AT	CH2	15.	12.17	2.	1.	0.	.01
+	HYDROGRAPH AT	A12	114.	12.08	11.	3.	1.	.02
+	2 COMBINED AT	CA12	126.	12.08	13.	4.	2.	.03
+	HYDROGRAPH AT	CH3	107.	12.17	15.	4.	2.	.03
+	HYDROGRAPH AT	A11	158.	12.08	17.	5.	2.	.03
+	2 COMBINED AT	CA11	261.	12.08	32.	10.	4.	.07
+	HYDROGRAPH AT	CH4	251.	12.17	36.	11.	4.	.07
+	HYDROGRAPH AT	A10T	62.	12.17	9.	3.	1.	.02
+	HYDROGRAPH AT	A10S	123.	12.08	13.	4.	2.	.03
+	2 COMBINED AT	CA10	180.	12.08	22.	7.	3.	.05
+	HYDROGRAPH AT	A9	105.	12.08	10.	3.	1.	.02
+	HYDROGRAPH AT	P2	101.	12.08	12.	4.	2.	.02
+	4 COMBINED AT	P2-IN	616.	12.08	80.	24.	10.	.16
	ROUTED TO							

+		RP2	118.	12.75	64.	19.	7.	.16		
+									457.72	12.75
+	HYDROGRAPH AT	CH5	120.	12.75	65.	19.	7.	.16		
+	HYDROGRAPH AT	A7T	66.	12.17	10.	3.	1.	.02		
+	HYDROGRAPH AT	A7S	144.	12.08	16.	5.	2.	.03		
+	2 COMBINED AT	CA7	201.	12.08	26.	8.	3.	.05		
+	HYDROGRAPH AT	A8	80.	12.08	8.	2.	1.	.02		
+	HYDROGRAPH AT	P3	87.	12.08	10.	3.	1.	.02		
+	3 COMBINED AT	P3-IN	368.	12.08	44.	14.	5.	.09		
+	ROUTED TO	RP3	53.	12.92	37.	11.	4.	.09		
+									455.87	12.92
+	HYDROGRAPH AT	CH6	54.	12.83	37.	11.	5.	.09		
+	2 COMBINED AT	CCH6	173.	12.75	102.	30.	12.	.25		
+	HYDROGRAPH AT	S9	80.	12.42	17.	5.	2.	.04		
+	HYDROGRAPH AT	S10	44.	12.33	8.	2.	1.	.02		
+	3 COMBINED AT	CS9	286.	12.42	126.	38.	15.	.30		

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
A1T	MANE	2.26	27.96	728.16	5.50	5.00	27.39	730.00	5.49
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2520E+01 OUTFLOW= .2491E+01 BASIN STORAGE= .4099E-03 PERCENT ERROR= 1.1									
A1S	MANE	2.61	137.15	724.04	5.64	5.00	131.18	725.00	5.64
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .8923E+01 OUTFLOW= .8693E+01 BASIN STORAGE= .4875E-03 PERCENT ERROR= 2.6									
CH14	MANE	3.46	7.12	725.83	5.49	5.00	7.05	725.00	5.48
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4743E+00 OUTFLOW= .4688E+00 BASIN STORAGE= .3115E-03 PERCENT ERROR= 1.1									
A2T	MANE	3.28	57.59	730.43	5.45	5.00	57.39	730.00	5.45
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5484E+01 OUTFLOW= .5382E+01 BASIN STORAGE= .9579E-03 PERCENT ERROR= 1.9									
A2S	MANE	2.67	150.43	723.85	5.64	5.00	144.46	725.00	5.63
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9942E+01 OUTFLOW= .9680E+01 BASIN STORAGE= .5134E-03 PERCENT ERROR= 2.6									
CH12	MANE	2.38	4.44	724.72	5.50	5.00	4.31	725.00	5.51
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2668E+00 OUTFLOW= .2641E+00 BASIN STORAGE= .1752E-03 PERCENT ERROR= .9									
CH13	MANE	3.96	9.58	723.77	5.48	5.00	8.74	725.00	5.47
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5929E+00 OUTFLOW= .5848E+00 BASIN STORAGE= .3570E-03 PERCENT ERROR= 1.3									
A3	MANE	2.30	61.93	724.85	5.65	5.00	61.14	725.00	5.68

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CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3890E+01 OUTFLOW= .3800E+01 BASIN STORAGE= .3366E-03 PERCENT ERROR=   2.3

           CH10  MANE        3.36      6.35    724.81      5.51      5.00      6.23    725.00        5.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3854E+00 OUTFLOW= .3819E+00 BASIN STORAGE= .2777E-03 PERCENT ERROR=    .8

           CH11  MANE        2.38      4.44    724.72      5.50      5.00      4.31    725.00        5.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2668E+00 OUTFLOW= .2641E+00 BASIN STORAGE= .1752E-03 PERCENT ERROR=    .9

            CH7  MANE        5.00     16.54    725.00      5.35      5.00     16.54    725.00        5.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1067E+01 OUTFLOW= .1026E+01 BASIN STORAGE= .7822E-03 PERCENT ERROR=   3.7

             A5  MANE        2.97    140.34    724.03      5.63      5.00    133.57    725.00        5.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9170E+01 OUTFLOW= .8918E+01 BASIN STORAGE= .5553E-03 PERCENT ERROR=   2.7

            CH8  MANE        1.07    168.61    725.84      5.57      5.00    166.32    725.00        5.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9924E+01 EXCESS= .1571E+01 OUTFLOW= .1146E+02 BASIN STORAGE= .2671E-03 PERCENT ERROR=    .3

             A4  MANE        1.29    102.51    724.49      5.08      5.00    100.30    725.00        5.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .6515E+01 OUTFLOW= .5714E+01 BASIN STORAGE= .2350E-03 PERCENT ERROR=  12.3

            CH9  MANE         .88    280.65    725.43      5.41      5.00    274.91    725.00        5.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1720E+02 EXCESS= .1423E+01 OUTFLOW= .1860E+02 BASIN STORAGE= .2560E-03 PERCENT ERROR=    .2

             A6  MANE        5.00     72.90    725.00      5.57      5.00     72.90    725.00        5.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5311E+01 OUTFLOW= .5112E+01 BASIN STORAGE= .9760E-03 PERCENT ERROR=   3.7

            CH1  MANE        5.00     57.14    800.00      5.51      5.00     57.14    800.00        5.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1413E+02 EXCESS= .2757E+01 OUTFLOW= .1682E+02 BASIN STORAGE= .3597E-02 PERCENT ERROR=    .4

            CH2  MANE        5.00     15.36    730.00      4.85      5.00     15.36    730.00        4.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1512E+01 OUTFLOW= .1320E+01 BASIN STORAGE= .2050E-02 PERCENT ERROR=  12.5

            A12  MANE        1.74    114.14    725.10      5.02      5.00    113.71    725.00        5.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7317E+01 OUTFLOW= .6340E+01 BASIN STORAGE= .3260E-03 PERCENT ERROR=  13.4

            CH3  MANE        4.39    111.02    728.70      4.99      5.00    106.75    730.00        4.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7682E+01 EXCESS= .1245E+01 OUTFLOW= .8789E+01 BASIN STORAGE= .1382E-02 PERCENT ERROR=   1.5

            A11  MANE        2.39    164.16    724.07      5.64      5.00    157.65    725.00        5.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1065E+02 OUTFLOW= .1038E+02 BASIN STORAGE= .4782E-03 PERCENT ERROR=   2.5

            CH4  MANE        3.86    260.55    728.77      5.29      5.00    250.54    730.00        5.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1916E+02 EXCESS= .2075E+01 OUTFLOW= .2103E+02 BASIN STORAGE= .1474E-02 PERCENT ERROR=    .9

           A10T  MANE        2.81     62.64    729.38      5.46      5.00     61.97    730.00        5.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5722E+01 OUTFLOW= .5617E+01 BASIN STORAGE= .7387E-03 PERCENT ERROR=   1.8

           A10S  MANE        2.33    126.55    724.58      5.65      5.00    122.75    725.00        5.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7997E+01 OUTFLOW= .7801E+01 BASIN STORAGE= .4245E-03 PERCENT ERROR=   2.4
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           A9  MANE        1.27   106.95   724.60     5.08      5.00   104.68   725.00        5.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .6762E+01 OUTFLOW= .5937E+01 BASIN STORAGE= .2341E-03 PERCENT ERROR=  12.2

          CH5  MANE         .58   119.57   765.36     4.28      5.00   119.56   765.00        4.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3677E+02 EXCESS= .3558E+00 OUTFLOW= .3709E+02 BASIN STORAGE= .2947E-03 PERCENT ERROR=    .1

          A7T  MANE        4.08    66.56   730.43     5.45      5.00    66.14   730.00        5.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .6285E+01 OUTFLOW= .6162E+01 BASIN STORAGE= .1163E-02 PERCENT ERROR=   1.9

          A7S  MANE        3.17   147.31   725.68     5.63      5.00   143.97   725.00        5.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9818E+01 OUTFLOW= .9550E+01 BASIN STORAGE= .6044E-03 PERCENT ERROR=   2.7

           A8  MANE        1.36    80.42   724.17     5.06      5.00    79.62   725.00        5.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5187E+01 OUTFLOW= .4535E+01 BASIN STORAGE= .2273E-03 PERCENT ERROR=  12.6

          CH6  MANE         .76    53.61   770.47     4.81      5.00    53.61   770.00        4.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2219E+02 EXCESS= .3854E+00 OUTFLOW= .2253E+02 BASIN STORAGE= .2239E-03 PERCENT ERROR=    .2


*** NORMAL END OF HEC-1 ***
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VOLUME CALCULATIONS

EXCESS RAINFALL VOLUME CALCULATION

The volume generated by the site and the surrounding properties is calculated for the 25-year storm event. A summary of the design information that is included in this Appendix and related appendices are listed below.

- Excess rainfall and drainage areas used in the volume calculations were taken from the HEC-1 analysis located on pages IIIF-A-31 through IIIF-A-104.
- Post-development condition volume information is summarized on pages IIIF-A-107 through IIIF-A-110.

CAMELOT LANDFILL
1339-351-11-02-01
25-YEAR EXCESS RAINFALL
VOLUME CALCULATIONS

Required: Determine the 25-year 24-hour storm volume generated by the site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.

Method: 1. Use the excessive rainfall data generated by the HEC-1 analysis (pages IIIF-A-31 through IIIF-A-104) to determine the volume produced by the site for the proposed expansion conditions.

Proposed Expansion Conditions

1. Volume Discharging Southeast Downstream of Entrance Road

1a. Landfill Areas Discharging into Pond P1 and Flowing under Entrance Road

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
A1T	**0.0085**	**5.56**	**5.47**	**3**
A1S	**0.0289**	**5.79**	**18.48**	**9**
A2T	**0.0185**	**5.56**	**11.83**	**5**
A2S	**0.0322**	**5.79**	**20.59**	**10**
A3	**0.0126**	**5.79**	**8.07**	**4**
CH7	**0.0036**	**5.56**	**2.33**	**1**
A5	**0.0297**	**5.79**	**19.01**	**9**
CH8	**0.0053**	**5.56**	**3.37**	**2**
A4	**0.0211**	**5.79**	**13.51**	**7**
CH9	**0.0048**	**5.56**	**3.09**	**1**
CH10	**0.0013**	**5.56**	**0.85**	**0**
CH11	**0.0009**	**5.56**	**0.56**	**0**
CH12	**0.0009**	**5.56**	**0.59**	**0**
CH13	**0.0020**	**5.56**	**1.29**	**1**
CH14	**0.0016**	**5.56**	**1.02**	**0**
P1	**0.0361**	**7.44**	**23.10**	**14**
Total Volume Flowing under Entrance Road				**67**

1b. Volume Upstream of Entrance Road

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
O1	**0.1367**	**5.90**	**87.47**	**43**
O1A	**0.0366**	**5.67**	**23.42**	**11**
O2	**1.5754**	**5.66**	**1,008.23**	**476**
S4	**0.0677**	**5.56**	**43.34**	**20**
S5	**0.0115**	**5.56**	**7.34**	**3**
S7	**0.0084**	**5.56**	**5.39**	**2**
Total Volume Upstream of Entrance Road				**556**

1c. Non-Landfill Areas Downstream of Entrance Road

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S6	**0.0218**	**5.56**	**13.92**	**6**
O3	**0.0253**	**5.56**	**16.18**	**7**
Total Volume of Non-Landfill Areas D.S. of Entrance Road				**14**

Total Volume Discharging Southeast Downstream of Entrance Road = **636** **ac-ft**

2. Volume in Midway Branch Exiting Permit Boundary

2a. Volume in Midway Branch Entering Permit Boundary

Offsite Area Entering Midway Branch	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
O4	**0.1344**	**5.56**	**86.04**	**40**
Total Volume in Midway Branch Entering Permit Boundary				**40**

2b. Landfill Areas Flowing East into Midway Branch

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
A6	**0.0172**	**5.79**	**11.00**	**5**
S8	**0.0158**	**5.56**	**10.12**	**5**
Total Volume Flowing East into Midway Branch				**10**

Total Volume in Midway Branch Excluding Section 1 Discharge Volume = **50** **ac-ft**

Total Volume in Midway Branch Exiting Permit Boundary = **686** **ac-ft**

3. Volume Discharging South into Elm Fork

3a. Areas Discharging into Pond P2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
CH2	**0.0051**	**5.56**	**3.29**	**2**
A12	**0.0237**	**5.79**	**15.17**	**7**
CH3	**0.0042**	**5.56**	**2.71**	**1**
A11	**0.0345**	**5.79**	**22.08**	**11**
CH4	**0.0070**	**5.56**	**4.45**	**2**
A10T	**0.0193**	**5.56**	**12.37**	**6**
A10S	**0.0259**	**5.79**	**16.60**	**8**
A9	**0.0219**	**5.79**	**13.99**	**7**
P2	**0.0196**	**7.44**	**12.55**	**8**
Total Volume Discharging into Pond P2				**51**

3b. Areas Discharging into Pond P3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
A7T	**0.0212**	**5.56**	**13.58**	**6**
A7S	**0.0318**	**5.79**	**20.36**	**10**
A8	**0.0168**	**5.79**	**10.75**	**5**
P3	**0.0168**	**7.44**	**10.74**	**7**
Total Volume Discharging into Pond P3				**28**

3c. Flow Downstream of Ponds P2 and P3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
CH5	**0.0012**	**5.56**	**0.76**	**0**
CH6	**0.0013**	**5.56**	**0.83**	**0**
Total Volume Downstream of Ponds P2 and P3				**1**

Total Volume Discharged South to Elm Fork = **80** **ac-ft**

4. Volume Discharging Southeast into Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S10	**0.0168**	**5.56**	**10.76**	**5**
Total Volume Discharging Southeast into Elm Fork				**5**

5. Volume Discharging Southwest into Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S9	**0.0355**	**5.56**	**22.75**	**11**
Total Volume Discharging Southwest into Elm Fork				**11**

6. Southern Volume Discharging Southwest Towards Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S3	**0.0071**	**5.56**	**4.55**	**2**
Total Southern Volume Discharging Southwest Towards Elm Fork				**2**

7. Northern Volume Discharging West Towards Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S2	**0.0482**	**5.56**	**30.86**	**14**
CH1	**0.0093**	**5.56**	**5.94**	**3**
Total Northern Volume Discharging West Towards Elm Fork				**17**

8. Volume Discharging from Northwest Corner Towards Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S1	**0.0160**	**5.56**	**10.26**	**5**
Total Volume Discharging from NW Corner Towards Elm Fork				**5**

Total Volume Exiting Permit Boundary = 805 ac-ft

VELOCITY CALCULATIONS

Required: Determine the flow velocities entering and exiting the permit boundary using HYDROCALC HYDRAULICS (Version 1.2a, 1996) for the flows calculated for the 25-year storm event in the HEC-1 analysis. HEC-RAS is used to determine the velocity in Elm Fork.

Method:

1. Use the flow data generated by the HEC-1 analysis to determine velocity of runoff entering the landfill permit boundary.
2. Use the flow data generated by the HEC-1 analysis to determine velocity of runoff exiting the landfill permit boundary.

1. Flow Velocity entering the landfill permit boundary

DP1

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2171 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2171	0.010	0.03	4.00	20.00	60.00	2.85	8.08

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP2

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 62 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	62	0.090	0.03	4.00	6.00	87.00	0.16	4.38

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP4

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2881 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2881	0.005	0.03	10.00	2.00	22.00	6.00	8.28

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP12

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 298 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	298	0.001	0.03	77.00	83.00	0.00	1.65	1.38

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP13

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 70 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	70	0.019	0.03	50.00	48.00	0.00	0.66	3.27

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

2. Flow Velocity exiting the landfill permit boundary

DP3

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2664 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2664	0.008	0.03	16.00	17.00	27.00	3.85	7.63

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP5

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2919 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2919	0.008	0.03	2.00	2.00	9.00	8.73	12.63

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP6

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 173 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	173	0.030	0.03	1.00	2.00	1.00	2.98	10.60

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP7

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 44 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	44	0.010	0.03	24.00	29.00	0.00	0.79	2.67

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP8

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 80 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	80	0.083	0.03	4.50	5.00	0.00	1.27	10.39

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP9

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 17 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	17	0.089	0.03	99.00	100.00	0.00	0.22	3.44

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP10

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 57 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	57	0.001	0.03	3.00	3.00	20.00	1.37	1.72

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

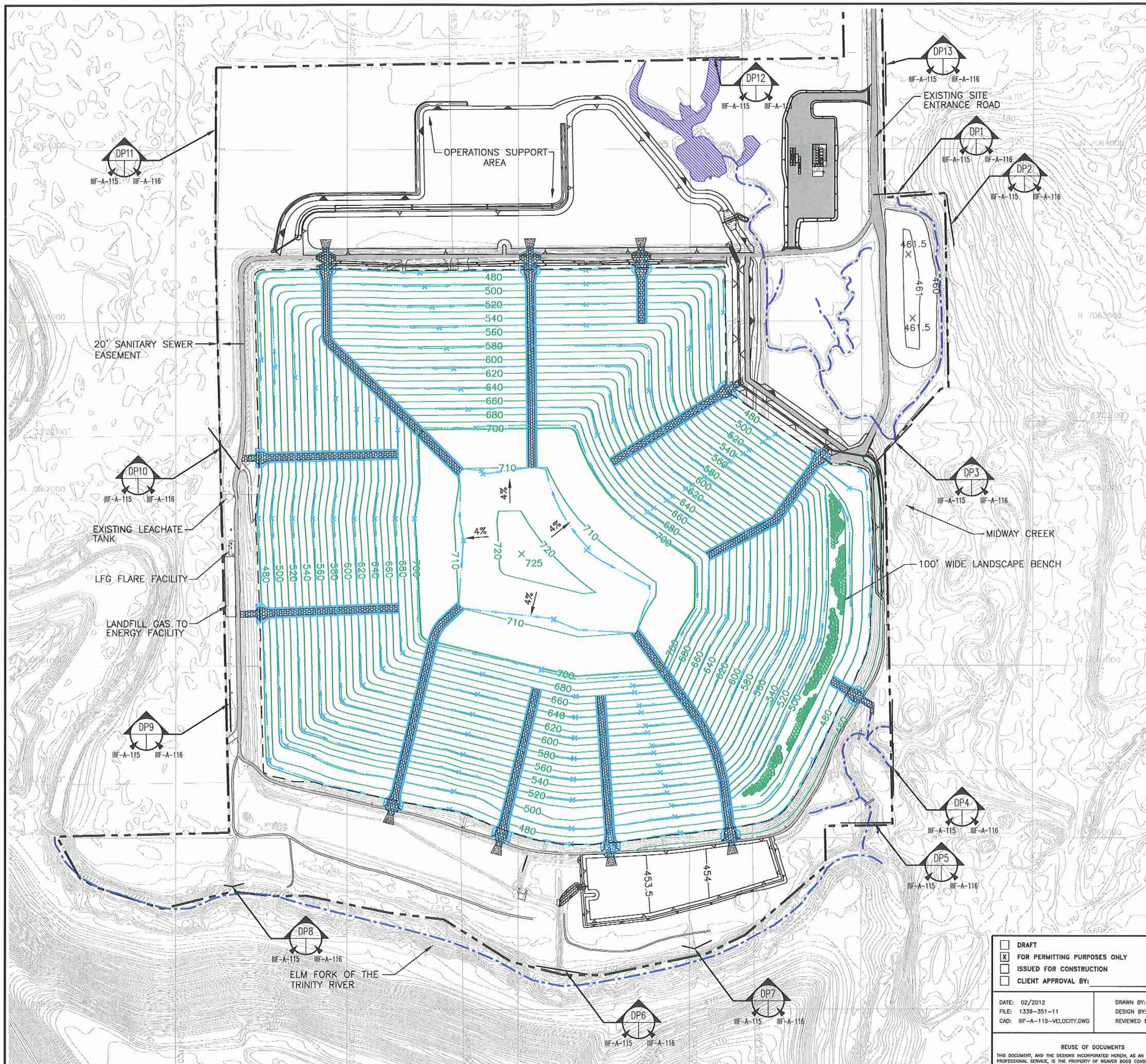
DP11

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 24 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	24	0.001	0.03	100.00	100.00	0.00	0.59	0.69

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).



LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°02'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- 600 — FINAL COVER CONTOUR
- PERMITTED DRAINAGE LETDOWN
- PERMITTED DRAINAGE SWALE
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 5)
- USACE JURISDICTIONAL WETLANDS

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988. OFF-SITE CONTOURS AND ELEVATIONS PROVIDED BY DFWMAPS.COM FROM AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN JANUARY TO MARCH 2007.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN DECEMBER 2010.
3. MAXIMUM FINAL COVER ELEVATION IS 725 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 721.5 FT-MSL.
4. REFER TO SHEET IIIF-A-28 FOR COMPLETE OFFSITE DRAINAGE AREA DELINEATIONS.
5. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

2-28-12

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY:

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-A-115-VELOCITY.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
UPDATED PERMITTED DISCHARGE POINT VELOCITY CALCULATIONS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

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COLUMBUS, OH
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ST. LOUIS, MO

SHEET IIIF-A-115

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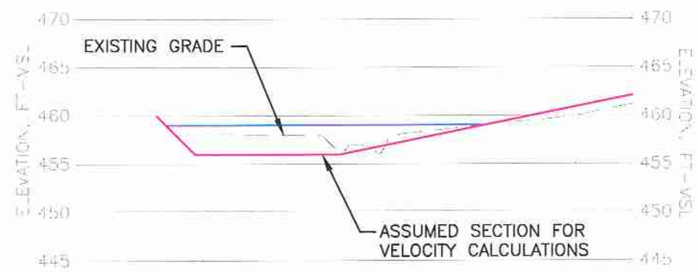
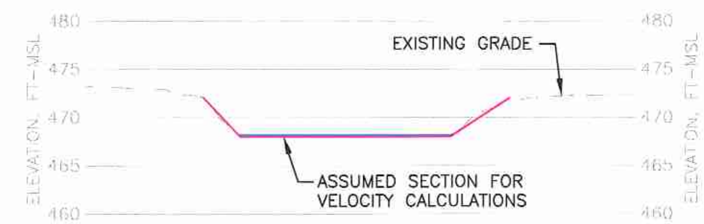


DISCHARGE POINT 1

DP1 IIF-A-115 IIF-A-116

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 2

DP2 IIF-A-115 IIF-A-116

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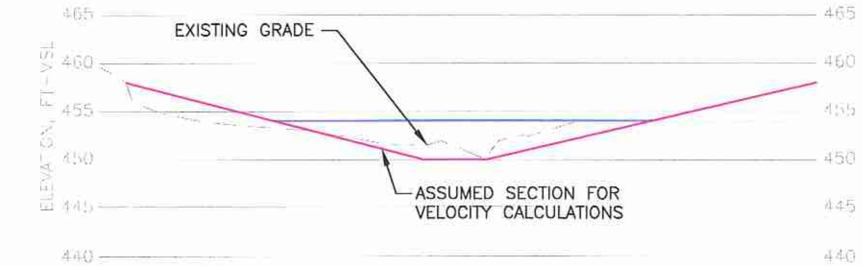
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 3

DP3 IIF-A-115 IIF-A-116

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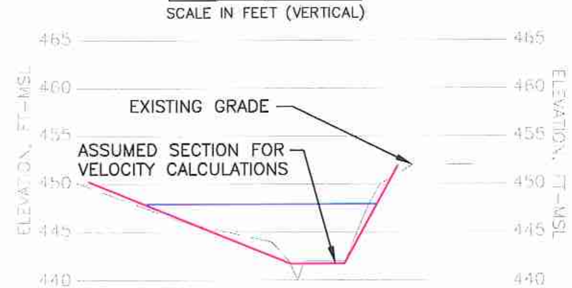
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 4

DP4 IIF-A-115 IIF-A-116

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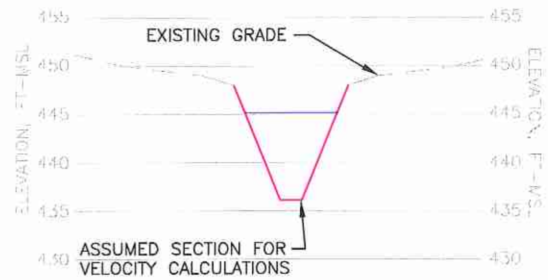
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 5

DP5 IIF-A-115 IIF-A-116

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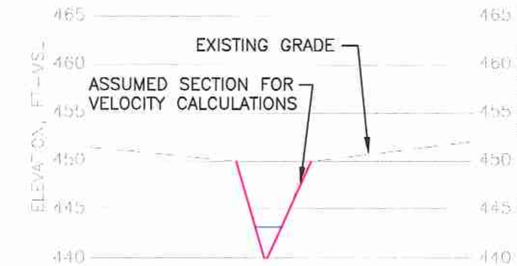
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 6

DP6 IIF-A-115 IIF-A-116

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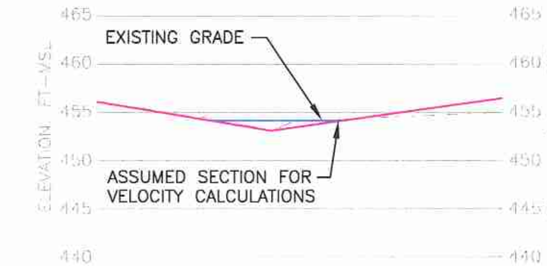
0 10 20 SCALE IN FEET (VERTICAL)

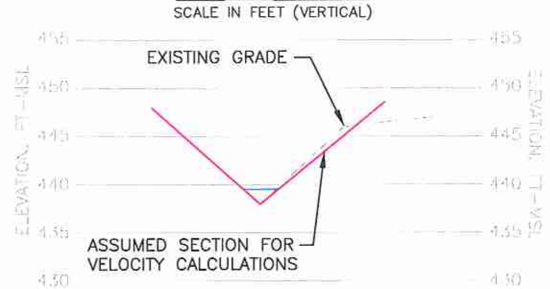


DISCHARGE POINT 7

DP7 IIF-A-115 IIF-A-116

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 8

DP8 IIF-A-115 IIF-A-116

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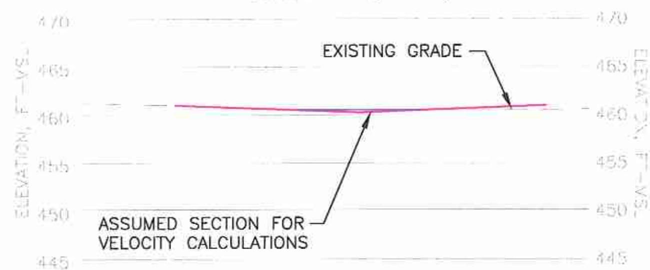
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 9

DP9 IIF-A-115 IIF-A-116

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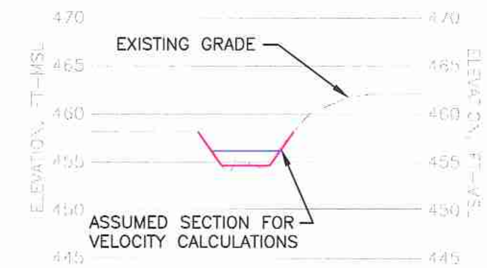
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 10

DP10 IIF-A-115 IIF-A-116

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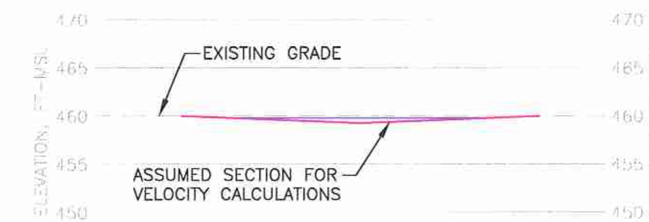
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 11

DP11 IIF-A-115 IIF-A-116

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

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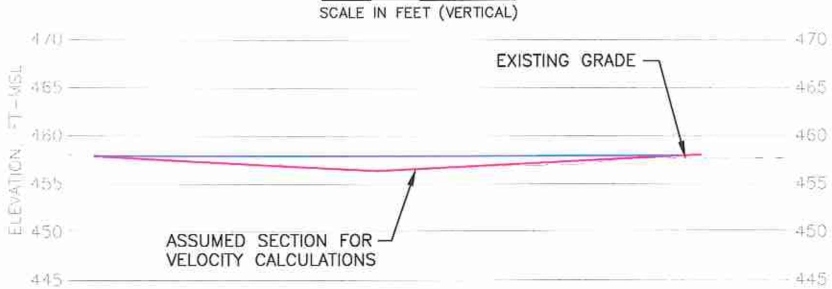
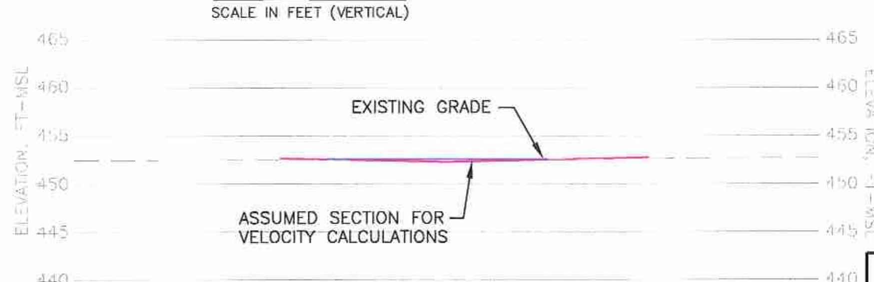


DISCHARGE POINT 12

DP12 IIF-A-115 IIF-A-116

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 13

DP13 IIF-A-115 IIF-A-116

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

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DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT UPDATED PERMITTED DISCHARGE POINT VELOCITY CALCULATIONS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

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SHEET IIIF-A-116

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APPENDIX IIIF-B

PERIMETER CHANNEL, DETENTION POND, AND CULVERT DESIGN

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Includes Pages IIIF-B-1 through IIIF-B-19

CONTENTS

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PERIMETER CHANNEL DESIGN

Perimeter channels have been designed to contain stormwater runoff from the 25-year storm frequency. A summary of the design information that is included in this Appendix is listed below.

- Flow rates used for the perimeter channel design were taken from the HEC-1 analysis included in Appendix IIIF-A.
- Perimeter channel design system information is summarized on Drawing IIIF.4 in Appendix IIIF.
- Channel profiles are presented on Drawings IIIF.5 through IIIF.8 in Appendix IIIF.
- Hydraulic calculations are summarized on pages IIIF-B-2.
- Channel Erosion Control Design information is included on page IIIF-B-5.

Prep By: CRM
Date: 2/21/2012

CAMELOT LANDFILL
1339-357-11-02-6B.6
PERIMETER CHANNEL HYDRAULIC ANALYSIS

Chkd By: RCE
Date: 2-28-12

Channel[2]	Station[2] From	Station[2] To	Flow Rate[3] (cfs)	Bottom Slope (ft/ft)	Bottom Width (ft)	Left Side Slope (ft/ft)	Right Side Slope (ft/ft)	Manning's n-Value	Normal Depth (ft)	Flow Vel. (fps)	Froude No.	Vel. Head (ft)	Energy Head (ft)	Flow Area[1] (sq.ft.)	Top width of Flow[1] (ft)	Depth Provided[7] (ft)
A[6]	0+00.00	4+61.95	31	0.0014	10	3	3	0.03	1.25	1.80	0.321	0.05	1.30	17.19	17.50	
A	4+61.95	10+42.64	31	0.0015	10	3	3	0.03	1.23	1.85	0.331	0.05	1.28	16.78	17.36	
A	10+42.64	18+25.15	31	0.0015	20	3	3	0.03	0.86	1.60	0.322	0.04	0.90	19.37	25.15	
B[6]	0+00.00	0+66.39	21	0.0142	0	3	3	0.03	1.28	4.24	0.932	0.28	1.56	4.96	7.71	
B	0+66.39	2+30.02	21	0.0011	0	3	3	0.03	2.07	1.63	0.282	0.04	2.11	12.90	12.44	
B	2+30.02	15+97.80	21	0.0016	0	3	3	0.03	1.93	1.87	0.336	0.05	1.99	11.21	11.60	
B	15+97.80	17+05.54	21	0.0020	0	3	3	0.03	1.85	2.04	0.373	0.06	1.92	10.31	11.13	
B	17+05.54	21+08.28	21	0.0020	15	3	3	0.03	0.74	1.66	0.361	0.04	0.78	12.69	19.42	
C	0+00.00	13+84.14	57	0.0010	15	3	3	0.03	1.59	1.82	0.283	0.05	1.64	31.35	24.52	
D	0+00.00	4+01.14	261	0.0010	15	3	3	0.03	3.57	2.84	0.315	0.13	3.70	91.86	36.43	
D	4+01.14	4+39.23	3-48" CMP CULVERTS (SEE NOTE 4)													
D	4+39.23	21+08.04	261	0.0010	15	3	3	0.03	3.57	2.84	0.315	0.13	3.70	91.86	36.43	
D	21+08.04	21+61.47	126	0.0125	15	3	3	0.03	1.22	5.54	0.968	0.48	1.70	22.74	22.31	
D	21+61.47	37+33.83	126	0.0010	15	3	3	0.03	2.44	2.31	0.300	0.08	2.53	54.56	29.66	
E	0+00.00	5+32.89	7	0.0050	0	3	3	0.03	1.04	2.18	0.533	0.07	1.11	3.22	6.21	
F	0+00.00	6+35.76	9	0.0050	0	3	3	0.03	1.14	2.32	0.544	0.08	1.22	3.87	6.82	
G	0+00.00	3+12.15	4	0.0050	0	3	3	0.03	0.84	1.89	0.514	0.06	0.90	2.12	5.04	
H	0+00.00	3+10.52	4	0.0050	0	3	3	0.03	0.84	1.89	0.514	0.06	0.90	2.12	5.04	
I	0+00.00	4+83.50	6	0.0050	0	3	3	0.03	0.98	2.10	0.530	0.07	1.04	2.86	5.86	
J	0+00.00	13+77.20	275	0.0010	10	3	3	0.03	4.16	2.94	0.317	0.13	4.29	93.48	34.95	
J	13+77.20	15+67.00	36" CMP CULVERT (SEE NOTE 5)													
J	15+67.00	16+13.94	17	0.0047	0	3	3	0.03	1.46	2.66	0.549	0.11	1.57	6.39	8.76	
J	16+13.94	16+67.60	17	0.0032	0	3	3	0.03	1.57	2.30	0.458	0.08	1.65	7.38	9.41	
J	16+67.60	23+72.35	17	0.0037	0	3	3	0.03	1.53	2.43	0.491	0.09	1.62	6.99	9.16	
K	0+00.00	2+02.21	118	0.0030	15	3	3	0.03	1.75	3.33	0.498	0.17	1.92	35.46	25.51	
K	2+02.21	6+16.92	173	0.0300	0	3	3	0.03	2.46	9.51	1.511	1.41	3.87	18.19	14.78	
L	0+00.00	1+37.63	53	0.0025	25	3	3	0.03	1.06	1.78	0.322	0.05	1.11	29.76	31.34	
M	0+00.00	3+13.50	80	0.0574	8	3	2.5	0.03	0.85	9.14	1.937	1.30	2.15	8.75	12.66	6.00
N	0+00.00	753.84	389	0.0020	20	17	22	0.03	2.26	2.69	0.409	0.11	2.37	144.75	108.12	3.00
O	0+00.00	12+00.29	32	0.0023	10	10	30	0.03	0.81	1.50	0.373	0.03	0.85	21.35	42.52	1.50
P	0+00.00	26+45.81	2664	0.0048	10	4.3	2.5	0.03	7.87	9.20	0.760	1.31	9.19	289.55	63.54	10.00
Q	0+00.00	9+22.87	2881	0.0044	10	3	3.5	0.03	8.41	9.18	0.735	1.31	9.72	313.81	64.65	10.00
R	0+00.00	3+06.76	73	0.0397	5	3	3	0.03	1.08	8.17	1.635	1.04	2.12	8.93	11.50	4.00

Note:
1) Calculations were performed using the HYDROCALC HYDRAULIC FOR WINDOWS Computer Program developed by Dodson and Associates (Version 1.2a, 1996).
2) Refer to Drawing IIIF.4 for channel locations.
3) Flow rates shown are the peak flow rates obtained from the HEC-1 model. See HEC-1 Output-Postdevelopment Conditions in Appendix IIIF-A.
4) Channel D is designed to flow through 3-48" CMP culverts (Culvert "2") at Stations 4+01.14 to 4+39.23. See Page IIIF-B-14 for Culvert Design.
5) Channel J is designed to flow through a 36" CMP culvert (Culvert "4") at Stations 13+77.20 to 15+67.00. See Page IIIF-B-16 for Culvert Design.
6) Channels A and B are each designed to convey a portion of the total runoff rate from Drainage Area S2 (52 cfs). The finalized design and usage of the operation support area, which is part of Drainage Area S2, may impact the proportion of runoff going into Channels A and B.
7) Channels M through R are existing, natural channels that do not accept runoff directly from the landfill development. The geometries listed in the table are average values approximated along the length of the channels. These calculations are provided to show that the existing channel system can convey runoff from the 25-year storm event within the existing channel banks inside the permit boundary.

Example Calculation: Calculate the normal depth for Channel D between stations 4+39.23 and 21+08.04.

List of Symbols

Q_d = peak flow rate for channel, cfs - obtained from HEC-1 Analysis (Appendix IIIF-A)
R = hydraulic radius, ft
n = Manning's roughness coefficient
S = channel slope, ft/ft
b = bottom width of channel, ft
z = z-ratio (ratio of run to rise for channel sideslope)
A_f = flow area, sf
g = gravitational acceleration = 32.2 ft/s^2
T = top width of flow, ft
d = normal depth of channel, ft

The program uses an iterative process to calculate the normal depth of the channel to satisfy Manning's Equation

$$Q = \frac{1.486}{n} A R^{0.67} S^{0.5}$$

Design Inputs:

Q_d =	261	cfs (for Channel D including Area A11)
S =	0.001	ft/ft
b =	15	ft
z =	3	(H) : 1 (V)
n =	0.03	

Step 1 - Based on the geometry of the channel cross-section, solve for R and A_f

$$R = \frac{bd + zd^2}{b + 2d(z^2 + 1)^{0.5}}$$

$$A_f = bd + zd^2$$

assume: d = 3.57 ft

R = 2.442 ft

A_f = 91.86 sf

solve for Q: Q = 261

if Q is not equal to Q_d, select a new d and repeat calculations

Step 2 - solve for velocity, T, Froude number, velocity head, and energy head

$Q = VA \Rightarrow \quad V = Q/A$

$V = 2.84$ ft/s

$T = b + 2(z \times d)$

$T = 36.43$ ft

$$F_r = \frac{V}{(gA/T)^{0.5}}$$

$F_r = 0.315$

$$\text{Velocity Head} = \frac{V^2}{2g}$$

Velocity Head = 0.13 ft

Energy Head = water elevation + velocity head

Energy Head = 3.70 ft

CHANNEL EROSION CONTROL DESIGN

Channel erosion controls have been designed for flow velocities resulted from the 25-year frequency flow rates. As shown on page IIIF-B-2 velocities in the perimeter channels range from 1.50 ft/s to 9.51 ft/s. The channel lining needed to protect against erosive velocities is shown on Drawings IIIF.5 through IIIF.8 in Appendix IIIF. All channels and drainage features will be inspected and maintained in accordance with the Site Operating Plan.

The following was used to select the type of channel lining material.

- Vegetation – used in all areas where velocities are less than 4 ft/s for channels.
- Turf reinforcement matting – used in channels for velocities between 4 ft/s and 13 ft/s. Please refer to page IIIF-B-6 for more information.
- 2-foot-thick Gabions – used at chute discharges in channels, areas in channels where flow velocities exceed 13 ft/s, and detention ponds (see Appendix IIIF-C – Final Cover Erosion Control Structure Design).

Channel lining details are presented on Drawings IIIF.10 in Appendix IIIF.

TECHNICAL DATA SHEET

MACMAT® NC10

Composite Turf Reinforcement Mat

MacMat® NC10 provides immediate erosion protection to prevent soil loss and creates the optimum micro-environment to enhance seed germination and plant emergence. The inclusion of the specially formulated MacMat® component, with its 95% open structure, adds the best permanent protection available. The biodegradable component of MacMat® NC10 is designed to create the right environment to enhance seed germination by insulating the seed bed, while absorbing and retaining optimal moisture.

Technical Data				
Physical Properties	**Property**	**Roll Value (MD)**		**Test Method**
	Tensile Strength	150 lbs/ft (2189 N/m^2)		ASTM D 5035 (modified)
	Thickness	0.4 in (10 mm)		ASTM D 5199
	Mass Unit/Area	15.0 oz/yd^2 (.508 kg/m^2)		ASTM D 5261
	UV Stability	80% (strength retained)		ASTM D G53/D4355 ASATM D 5035 (modified)
	Resiliency	80% (thickness retained)		ASTM D 6524
	Sediment Trapping Capacity	376 in^3/yd^2 (7367 cm^3/m^2)		Calculated
Performance Properties	**Property**	**Roll Value**		**Test Method**
		Unvegetated	Vegetated*	
	Permissible Velocity-30 min	13.0 ft/s (3.96 m/s)	19.0 ft/s (5.79 m/s)	Large Scale Flume Test[1]
	Permissible Velocity-50 hr	7.0 ft/s (2.13 m/s)	14.0 ft/s (4.26 m/s)	Large Scale Flume Test[1]
	Permissible Shear-30 min	3.1 lbs/ft^2 (.148 kN/m^2)	10.0 lbs/ft^2 (.478 kN/m^2)	Large Scale Flume Test[1]
	Permissible Shear-50 hr	2.2 lbs/ft^2 (.105 kN/m^2)	8.0 lbs/ft^2 (.383 kN/m^2)	Large Scale Flume Test[1]
	*Vegetated data extrapolated from actual test data with historically predictable results. [1]Flume test performed at independent laboratory-data and details available upon request.			
Index Properties	**Property**	**Roll Value (MD)**		**Test Method**
	"Benchscale" Shear (unvegetated)	>5 lbs/ft^2 (.239 kN/m^2)		ECTC TM #3
	Water Absorption	400%		ECTC Modified

Seller makes no warranty, express or implied, concerning the product furnished hereunder other than at the time of delivery it shall be of the quality and specifications stated herein. *ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY EXCLUDED AND, TO THE EXTENT THAT IT IS CONTRARY TO THE FOREGOING SENTENCE, ANY IMPLIED WARRANTY OF MERCHANTABILITY IS EXPRESSLY EXCLUDED.* Any recommendations made by the Seller concerning uses or applications of said product are believed reliable, and Seller makes no warranty of results to be obtained. The technical information supplied for this product type is subject to change at any time without notice.

This Data Sheet supersedes all previous Data Sheets for this style and is subject to change without notice.

MMAT-NC10 8/2006

DETENTION POND DESIGN

Detention ponds have been analyzed by using HEC-1, storage routing method. The input parameters for the model are presented in Appendix IIIF-A. A summary of HEC-1 results are presented on page IIIF-B-8. As can be seen on the table, during the 25-year storm event, none of the ponds flow over their spillways.

Downstream sides of the low-water outlets will be designed with either rock riprap or gabions as shown on pages IIIF-B-9 and IIIF-B-10.

Purpose: Demonstrate that the detention pond outlet structure designs are adequate to convey runoff from the various subbasins to their discharge points.

Method:
1. Use the 25-year, 24-hour flow rates and water surface elevations for the drainage areas that will discharge to each detention pond from the HEC-1 analysis (see Appendix IIIF-A).
2. Use the Weir Equation to calculate the flow rate over the spillways as appropriate.

Solution:

	P1	P2	P3
Bottom ELEV, ft[1]	454.0	454.0	453.0
Spillway ELEV, ft	458.0	458.0	458.0
Spillway Length, ft	25	25	25
Top of Road/Berm, ft	464.0	459.0	460.0
Discharge Pipe Downstream Invert ELEV, ft	453.00	452.6	452.35
Peak Inflow Q_{25}, cfs	904	616	368
Peak Outflow Q_{25}, cfs	28	118	53
Peak Stage in Pond Q_{25}, ft	457.46	457.72	455.87
Est. Flow (Q_{25}) over Spillway, cfs	--	--	--
Velocity (Q_{25}) over Spillway, fps	--	--	--

Note:
1) Details of the pond outlet structures are presented on Drawings IIIF.19 and IIIF.20. As shown, gabions are provided downstream of all the spillways.
2) The flow over the spillway is estimated using the formula $Q = CLH^{3/2}$ where $C = 2.64$, L is the length of the spillway in feet, and H is the head on the spillway in feet. The flow over the spillway conservatively assumes no flow through the low water outlet.
3) Calculations for velocity over the spillway were performed using the HYDROCALC HYDRAULICS FOR WINDOWS Computer Program developed by Dodson and Associates (Version 1.2a, 1996).

Required: Determine the minimum length and median diameter of riprap required at the detention pond outlet structures and creek culverts to control erosion in the detention pond outlet channels.

Reference:

1. Haan, Barfield, and Hayes, *Design Hydrology and Sedimentology for Small Catchments*, 1994.
2. Dodson's and Associates, Inc., *ProHec-1 Plus Program Documentation*, 1995.
3. Freeman, Gary E., J. Craig Fischenich, Gabion for Streambank Erosion Control, 2000. EMRRP Technical Notes Collection (ERDC TN-EMRRP-SR-22), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Solution: The riprap will be designed for the 25-year flow rates at the detention pond outlet structures and culverts. The flow at the outlet structures and culverts can be divided into two categories:

1. Flow over the Spillway/Road

As shown on pages IIIF-B-8 through IIIF-B-10, none of the detention ponds nor any creek culverts are expected to have flow over the spillways or roadways during the 25-year storm event. Erosion protection calculations for the drainage structures will be based on flow through low water outlets/culverts only.

Flow Structure Spillway Topslope	25-Year Flow Rate (cfs)	25-Year Velocity (ft/s)	25-Year Flow Depth (ft)	25-Year Foude Number	25-Year Velocity Head (ft)	25-Year Energy Head (ft)	25-Year Flow Area (sq. ft.)	25-Year Top Width (ft)
P1	--	--	--	--	--	--	--	--
P2	--	--	--	--	--	--	--	--
P3	--	--	--	--	--	--	--	--
Culvert "1"	--	--	--	--	--	--	--	--
Culvert "2"	--	--	--	--	--	--	--	--
Culvert "3"	--	--	--	--	--	--	--	--
Culvert "4"	--	--	--	--	--	--	--	--
Culvert "5"	--	--	--	--	--	--	--	--
Culvert "6"	--	--	--	--	--	--	--	--
Culvert "7"	--	--	--	--	--	--	--	--

Flow Structure Spillway Sideslope	25-Year Flow Rate (cfs)	25-Year Velocity (ft/s)	25-Year Flow Depth (ft)	25-Year Foude Number	25-Year Velocity Head (ft)	25-Year Energy Head (ft)	25-Year Flow Area (sq. ft.)	25-Year Top Width (ft)
P1	--	--	--	--	--	--	--	--
P2	--	--	--	--	--	--	--	--
P3	--	--	--	--	--	--	--	--
Culvert "1"	--	--	--	--	--	--	--	--
Culvert "2"	--	--	--	--	--	--	--	--
Culvert "3"	--	--	--	--	--	--	--	--
Culvert "4"	--	--	--	--	--	--	--	--
Culvert "5"	--	--	--	--	--	--	--	--
Culvert "6"	--	--	--	--	--	--	--	--
Culvert "7"	--	--	--	--	--	--	--	--

2. Flow through the Low Water Outlet

The flow rate through the low water outlet (LWO) is summarized below.

Flow Structure	Pond Bottom Elev (ft-msl)	LWO Invert Elev. Upstream (ft-msl)	LWO Invert Elev. Downstream (ft-msl)	LWO Diameter (in)	25-Year Flow Rate[2] (cfs)	25-Year Outlet Velocity[1] (ft/s)
P1	454.00	454.00	453.00	24	28.0	9.23
P2	454.00	454.00	452.60	2-36	59.0	10.60
P3	453.00	453.00	452.35	36	53.0	7.36
Culvert "1"	457.70	457.70	454.00	24	21.0	6.68
Culvert "2"	455.70	455.70	453.80	3-48	87.0	13.83
Culvert "3"	454.30	454.30	454.00	4-48	68.8	5.95
Culvert "4"	457.00	457.00	455.70	36	17.0	2.41
Culvert "5"	459.00	459.00	458.50	24	15.0	6.41
Culvert "6"	456.00	456.00	455.50	36	30.0	6.89
Culvert "7"	453.10	453.10	452.80	4-48	97.3	7.74

[1] Velocities through the low water outlet for P1, P2, and P3 were calculated using the HYDROCALC HYDRAULICS FOR WINDOWS program developed by Dodson and Associates (Version 1.2a, 1996). All other low water outlet velocitied are provided in the HEC-RAS output file included in Appendix IIIF-A.

[2] The flowrates for all low water outlets are the peak discharges for the respective areas as calculated by HEC-1 since the spillway crest is not overtopped in the 25-year event. Flowrates shown for P2, Culvert 2, Culvert 3, and Culvert 7 are the flow in each pipe of the culvert system. The total 25-year flowrate discharging from P2 is 118 cfs / 2 pipes = 59 cfs, from Culvert 2 = 261 cfs / 3 pipes = 87 cfs, from Culvert 3 = 275 cfs / 4 pipes = 68.8 cfs, and from Culvert 7 is 389 cfs / 4 pipes = 97.3 cfs.

The velocity through the low water outlet is larger than the velocity over the spillway, when there is a low water outlet present. The flowrate through the low water outlet is used to design the riprap apron.

The nomograph used for design of the length of the riprap and the median diameter are shown on page IIIF-B-11 (Figure 5.25).

The minimum riprap length and diameter for each outlet is summarized below. The length of the riprap is increased by 20 percent to provide for a conservative design.

Pond	Riprap Design Flowrate (cfs)	Pipe Diameter (in)	Riprap Length (ft)	Adjusted Length L x 1.2 (ft)	Median Rock Diameter (ft)
P1	28.0	24	28	34	1.65
P2	59.0	2-36	18	22	1.40
P3	53.0	36	10	12	1.20
Culvert "1"	21.0	24	10	12	1.20
Culvert "2"	87.0	3-48	10	12	1.20
Culvert "3"	68.8	4-48	10	12	1.20
Culvert "4"	17.0	36	10	12	1.20
Culvert "5"	15.0	24	10	12	1.20
Culvert "6"	30.0	36	10	12	1.20
Culvert "7"	97.3	4-48	10	12	1.20

Apron width required for the ponds (e.g., width of erosion protection in outlet channel) are:
W_{req}=LWO diameter + 0.4*(RipRap Length)

Pond	W_{req} (ft)	$W_{provided}$ (ft)
P1	17.2	60.0
P2	13.2	202.0
P3	10.0	142.0

The riprap will be provided over the entire width of the spillway of ponds P2 and P3 and the outlet channel downstream of all the spillways/low water outlets.

The median diameter of riprap is intended to determine the minimum diameter of the riprap that will be used. As an alternative, 2-foot thick gabions with a d_{50} of 6-inches can be used.

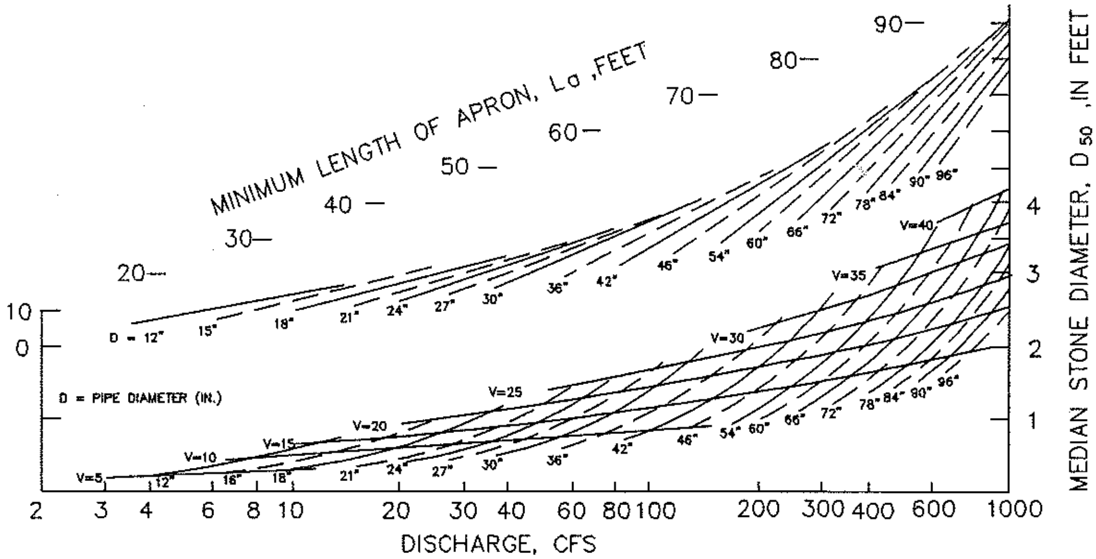


Figure 5.24 Design of outlet protection—minimum tailwater condition, $T_w < 0.5D$ (Environmental Protection Agency, 1976).

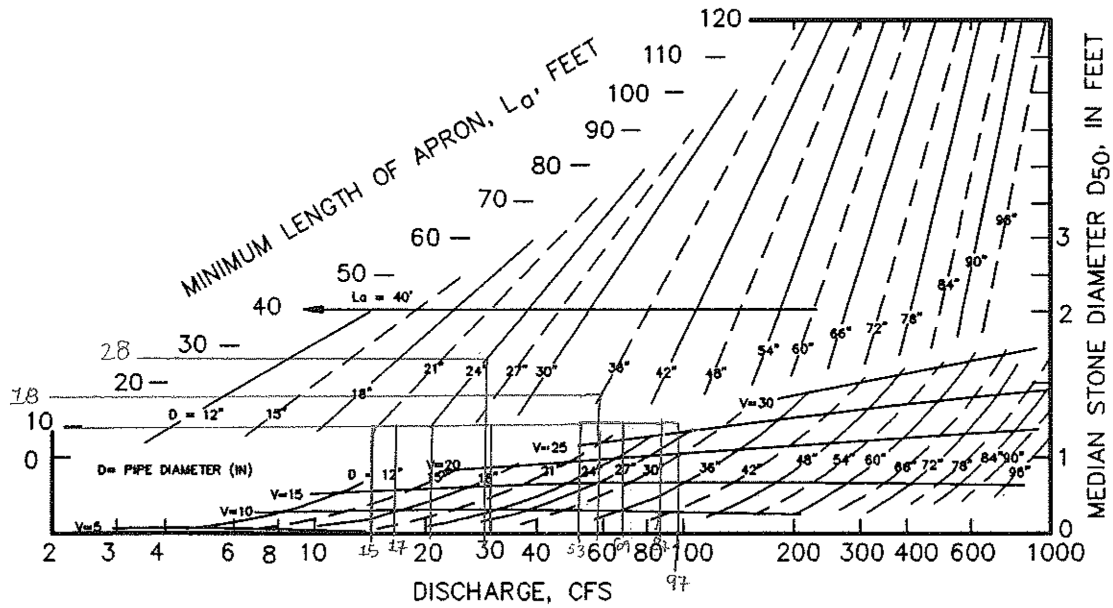
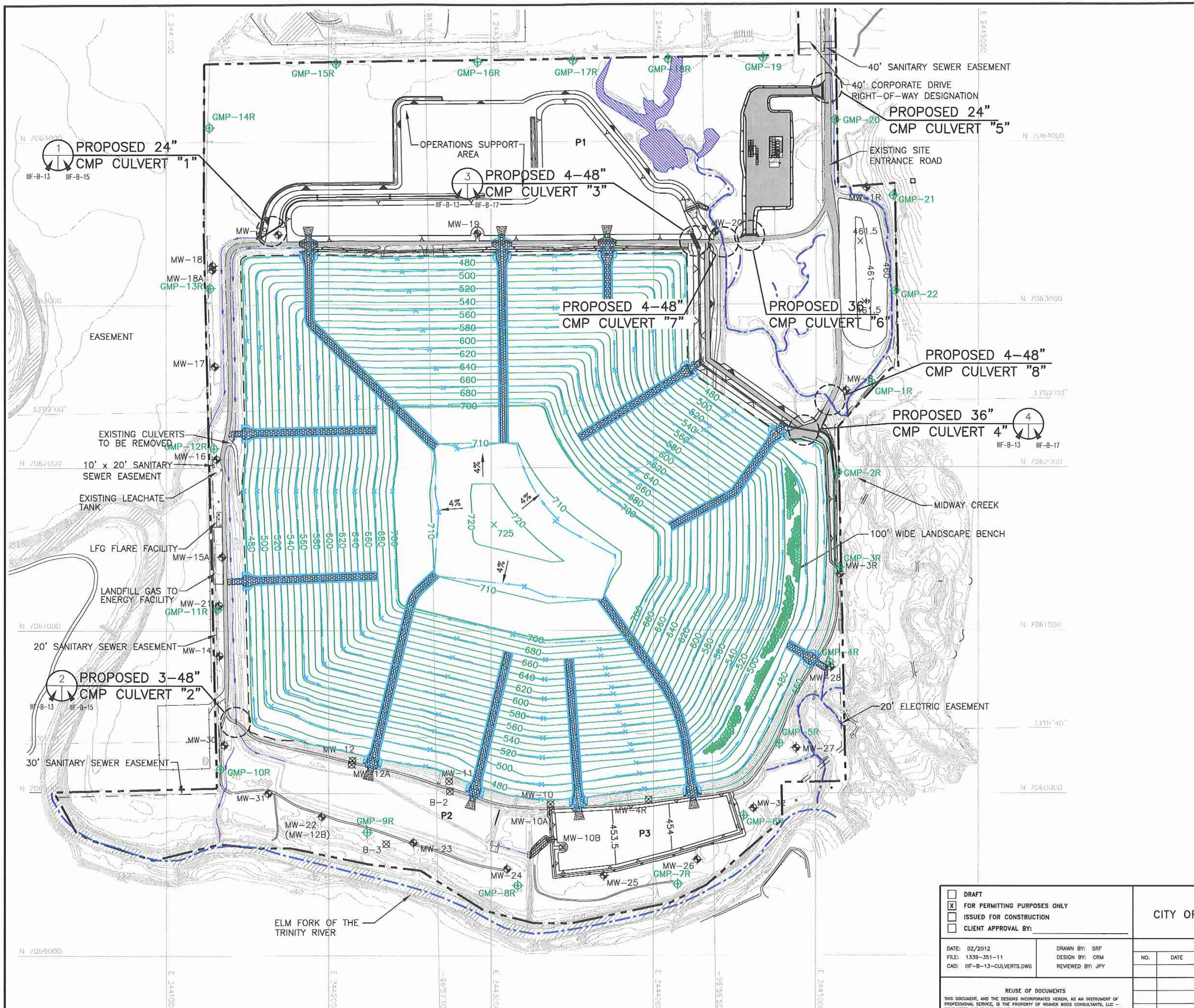


Figure 5.25 Design of outlet protection—maximum tailwater condition, $T_w \geq 0.5D$ (Environmental Protection Agency, 1976).

into the riser 3 ft below its top, what discharge will pass through the four holes with the water level at 1, 2, 4, and 8 ft above the riser? (c) What is the total discharge through the pipe? (d) How might the orifices be sized to provide better stormwater control? (e) Explain whether you would expect two rows (each consisting of four holes) of 8-in.-diameter holes to provide better results? Assume that one row is 2 ft below the riser invert and the other row is 4 ft below the riser invert.

(5.6) A gravel roadway is constructed in a low-lying area such that the roadway is frequently overtopped as a result of severe storms. The roadway is 40 ft wide, and its elevation is 36 ft. (a) If the water level upstream of the roadway is 2 ft above the crest of the roadway, what is the discharge across the roadway? (b) If the roadway is paved, what upstream depth would be required to carry the same flow? (c) Would paving reduce flooding problems?

CULVERT DESIGN



LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- STATE PLANE COORDINATE SYSTEM
- GEODETIC COORDINATE SYSTEM
- EXISTING CONTOUR (SEE NOTE 1)
- REGRADED BUFFER ZONE AREA
- FINAL COVER CONTOUR
- DRAINAGE LETDOWN
- DRAINAGE SWALE
- EASEMENT BOUNDARY
- MW-8 PERMITTED GROUNDWATER MONITORING WELL
- MW-12 PERMITTED GROUNDWATER OBSERVATION WELL
- GMP-14R PROPOSED GAS MONITORING PROBE
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 3)
- USACE JURISDICTIONAL WETLANDS

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.
3. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

2-28-12

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY:

DATE: 02/2012	DRAWN BY: SRF
FILE: 1339-351-11	DESIGN BY: CRM
CAD: IIIF-B-13-CULVERTS.DWG	REVIEWED BY: JPY

PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT ANALYZED CULVERT LOCATIONS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL; NAPERVILLE, IL; COLUMBUS, OH; DENVER, CO; FORT WORTH, TX (817) 735-9770; GRIFFITH, IN; SOUTH BEND, IN; SPRINGFIELD, IL; ST. LOUIS, MO

SHEET IIIF-B-13

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Required: Design culverts to convey the flow.

Method: Use HYDROCALC Hydraulics for Windows computer program to determine number and size of the culverts.
Use total 25-year frequency storm event flow estimated by HEC-1 included in Appendix IIIF-A.

For proposed 24" CMP culvert at downstream end of Channel "B", Culvert "1"

Total Flow=	21	cfs
No. of Culverts=	1	
Culvert Span=	--	inches
Culvert Rise=	--	inches
Culvert Diameter=	24	inches

Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth[2] (ft)	Headwater Inlet Control (ft)	Headwater Outlet Control (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
1	--	--	2	2	2	0.024	0.8	154.8	454.0	457.7	21.0	1.59	3.60	3.01	2.00	1.64	2.00	6.68

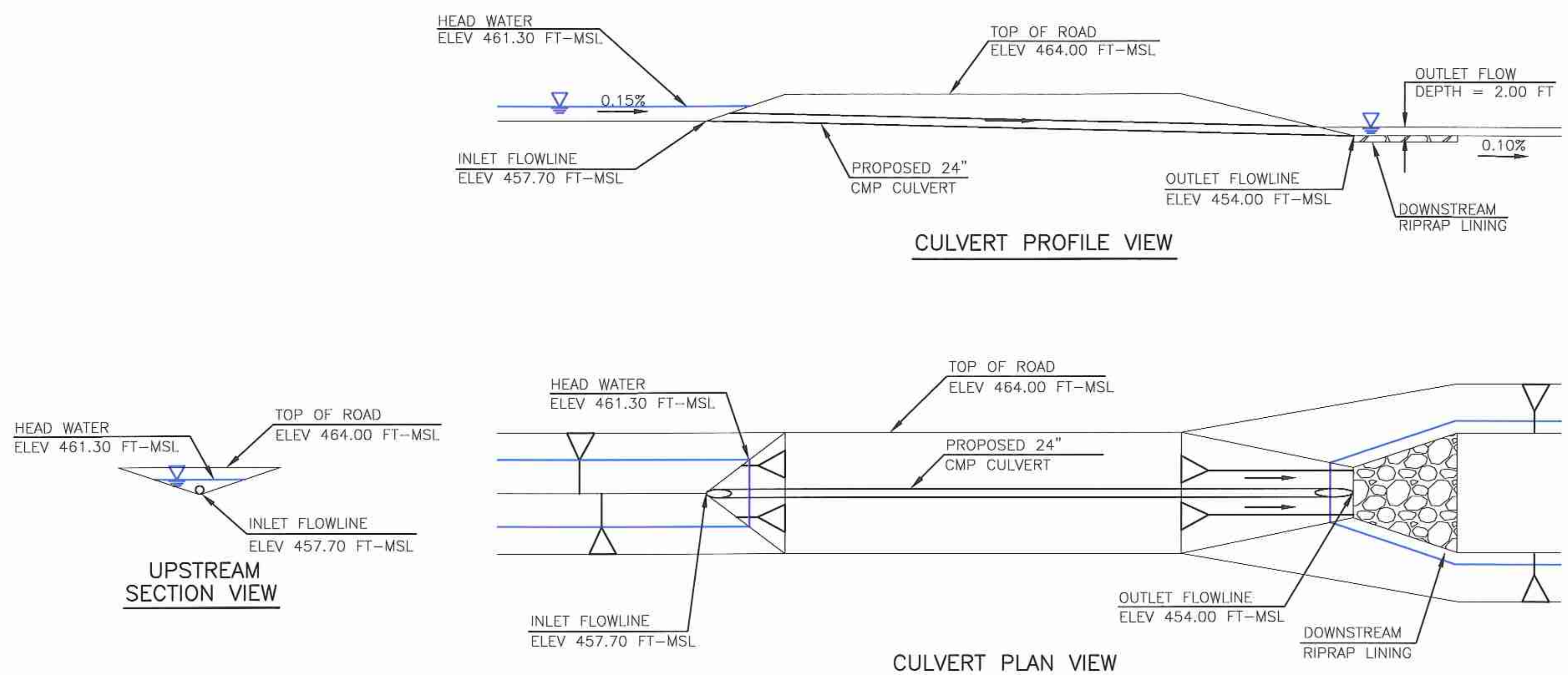
1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Tailwater depth is assumed to be the 25-year, 24-hour storm event flow depth in Channel "C" (see page IIIF-B-2 for flow depths).
3. Culvert crossing cross sections are shown on Page III-F-B-15.

For proposed 3-48" CMP culverts under access road in Channel "D", Culvert "2":

Total Flow=	261	cfs
No. of Culverts=	3	
Culvert Span=	--	inches
Culvert Rise=	--	inches
Culvert Diameter=	48	inches

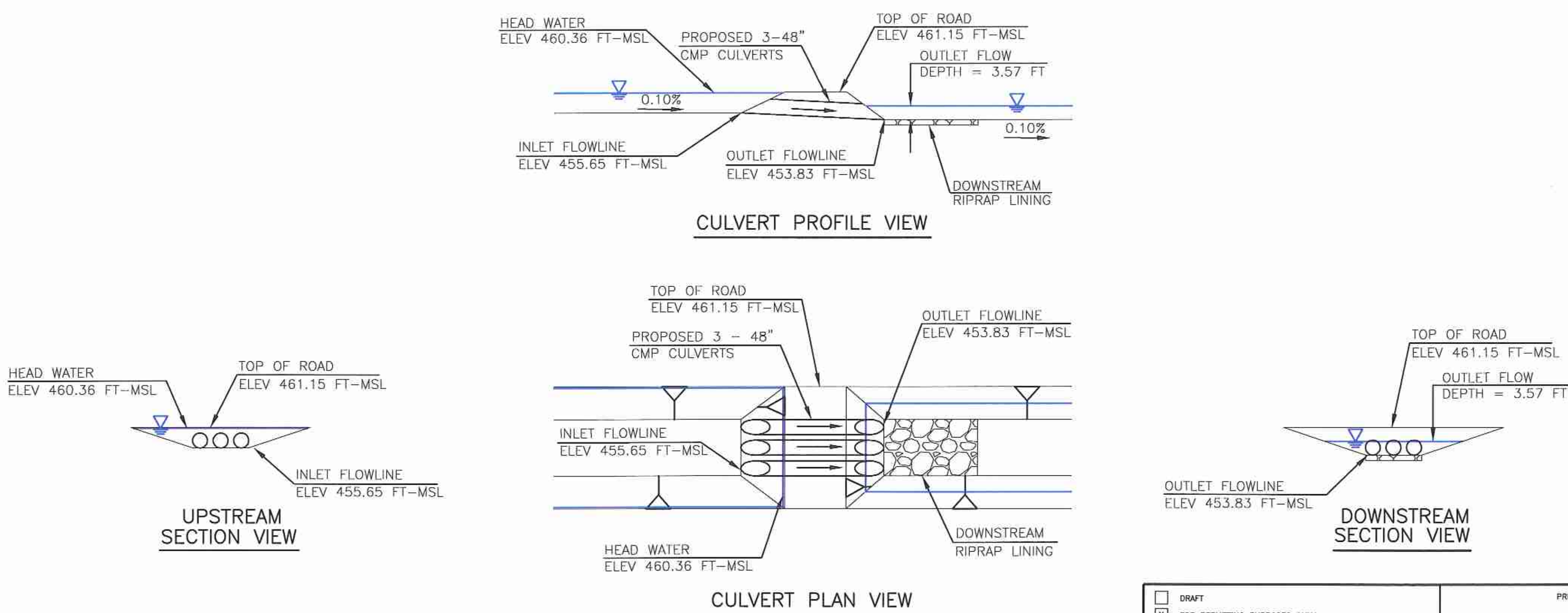
Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth[2] (ft)	Headwater Inlet Control (ft)	Headwater Outlet Control (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
2	--	--	2	2	4	0.024	0.8	38.1	453.8	455.7	87.0	3.57	4.71	3.57	2.00	2.83	3.57	13.83

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Tailwater depth is assumed to be the 25-year, 24-hour storm event flow depth in Channel "D" downstream of the culvert (see page IIIF-B-2 for flow depths).
3. Culvert crossing cross sections are shown on Page III-F-B-15.



LEGEND:
- FLOW DIRECTION
- RIPRAP
- DESIGN WATER SURFACE

CULVERT "1" SECTIONS (1: IIIF-B-13, IIIF-B-15)



0 20 40
SCALE IN FEET

CULVERT "2" SECTIONS (2: IIIF-B-13, IIIF-B-15)

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY:

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-B-15-CROSS SECTIONS.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
CULVERT CROSS SECTIONS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants

TBPE REGISTRATION NO. F-3727

CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735-9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

SHEET IIIF-B-15

For proposed 4-48" CMP culverts under access road at the downstream end of Channel "J", Culvert "3":

Total Flow= 275 cfs
No. of Culverts= 4
Culvert Span= -- inches
Culvert Rise= -- inches
Culvert Diameter= 48 inches

Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth² (ft)	Headwater Inlet Control (ft)	Headwater Outlet Control (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
3	--	--	2	2	4	0.024	0.8	101.0	454.0	454.3	68.8	3.46	3.90	4.78	4.00	2.51	3.46	5.95

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Tailwater depth is assumed to be the 25-year, 24-hour storm event flow depth in Pond P1 (see page IIIF-B-8 for Pond flow depths).
3. Culvert crossing cross sections are shown on Page III-F-B-17.

For proposed 36" CMP culvert under access road in Channel "J", Culvert "4":

Total Flow= 17 cfs
No. of Culverts= 1
Culvert Span= -- inches
Culvert Rise= -- inches
Culvert Diameter= 36 inches

Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth² (ft)	Headwater Inlet Control (ft)	Headwater Outlet Control (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
4	--	--	2	2	3	0.024	0.8	189.8	455.7	457.0	17.0	4.06	1.93	3.34	1.62	1.32	3.00	2.41

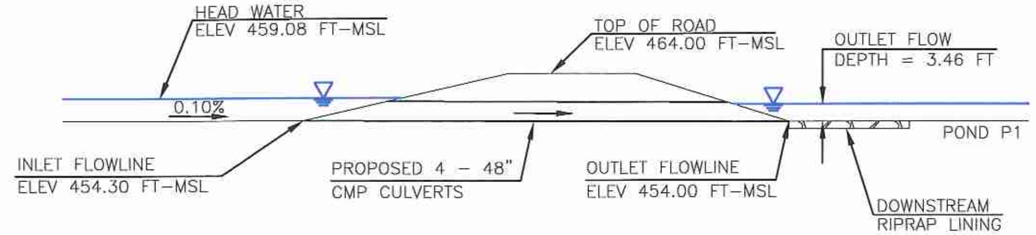
1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Tailwater depth is assumed to be the 25-year, 24-hour storm event flow depth in Channel "J" downstream of the culvert (see page IIIF-B-2 for flow depths).
3. Culvert crossing cross sections are shown on Page III-F-B-17.

LEGEND:

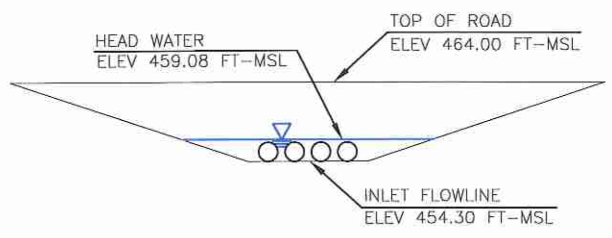
FLOW DIRECTION

RIPRAP

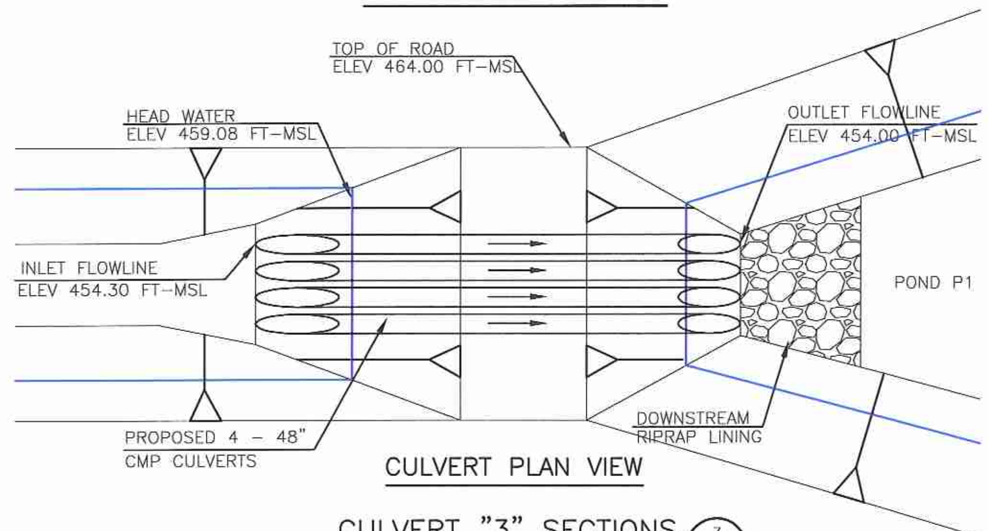
DESIGN WATER SURFACE



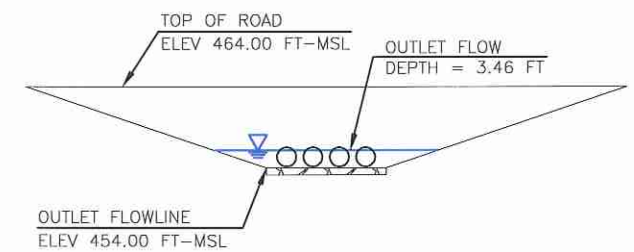
CULVERT PROFILE VIEW



UPSTREAM SECTION VIEW

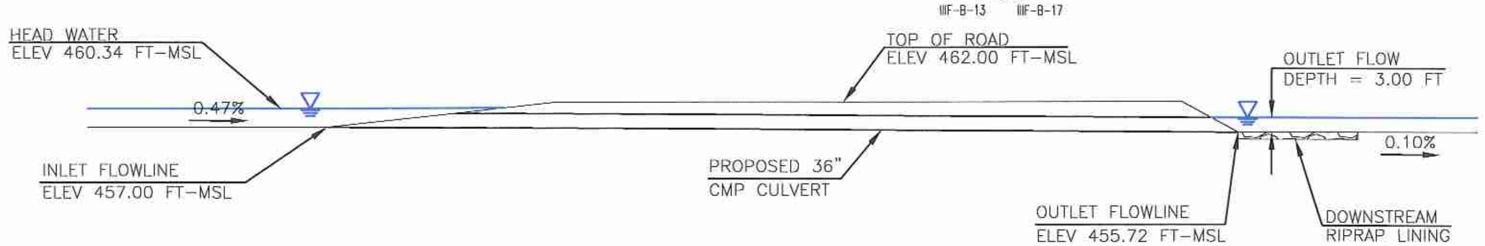


CULVERT PLAN VIEW

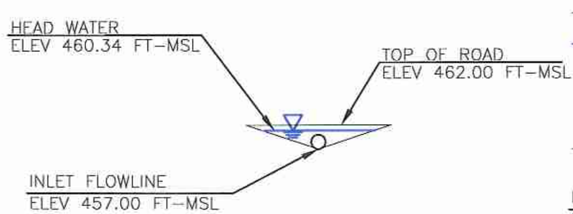


DOWNSTREAM SECTION VIEW

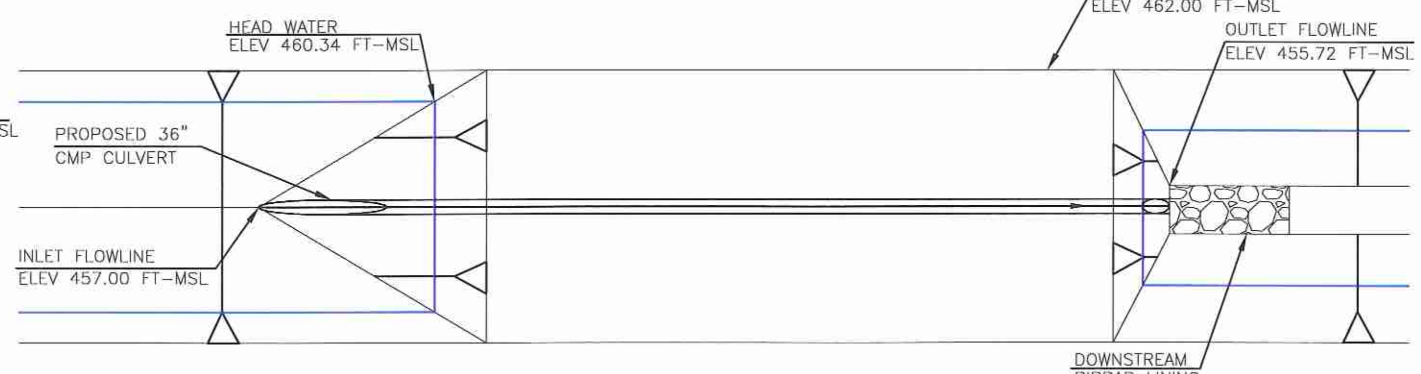
CULVERT "3" SECTIONS (3) IIIF-B-13 IIIF-B-17



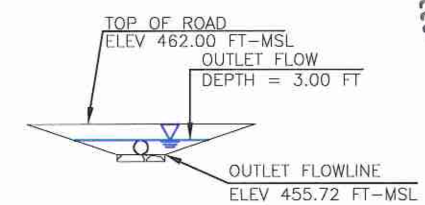
CULVERT PROFILE VIEW



UPSTREAM SECTION VIEW



CULVERT PLAN VIEW



DOWNSTREAM SECTION VIEW

CULVERT "4" SECTIONS (4) IIIF-B-13 IIIF-B-17

STATE OF TEXAS
NEVZAT TURAN
84059
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PROFESSIONAL ENGINEER

2-28-12

0 20 40
SCALE IN FEET

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION ☐ CLIENT APPROVAL BY:	PREPARED FOR CITY OF FARMERS BRANCH	MAJOR PERMIT AMENDMENT CULVERT CROSS SECTIONS CAMELOT LANDFILL DENTON COUNTY, TEXAS	
DATE: 02/2012 FILE: 1339-351-11 CAD: IIIF-B-17-CROSS SECTIONS.DWG	DRAWN BY: SRF DESIGN BY: CRM REVIEWED BY: JPY		

REVISIONS

NO.	DATE	DESCRIPTION

REUSE OF DOCUMENTS

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SHEET IIIF-B-17

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-B\IIIF-B-17-CULVERT CROSS SECTIONS.dwg, jwilson, 1:2

For proposed 24" CMP culverts under entrance facility access road, Culvert "5":

Total Flow= 15 [2] cfs
No. of Culverts= 1
Culvert Span= -- inches
Culvert Rise= -- inches
Culvert Diameter= 24 inches

Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth[3] (ft)	Headwater Inlet Control[4] (ft)	Headwater Outlet Control[4] (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
5	--	--	2	2	2	0.024	0.8	101.0	458.5	459.0	15.0	0.00	2.25	2.95	2.00	1.40	1.40	6.41

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Flow rate is an estimated portion of the total peak flow rate of Drainage Area S4 (see Appendix IIIF-A).
3. There is no assumed tailwater depth due to the geometry downstream of the culvert.
4. Culvert calculations are performed to show that installation of the culvert will not cause overtopping of the road. The road elevation is 462.00, which gives 3.00 feet of available headwater.

For proposed 36" CMP culverts under entrance facility access road, Culvert "6":

Total Flow= 30 [2] cfs
No. of Culverts= 1
Culvert Span= -- inches
Culvert Rise= -- inches
Culvert Diameter= 36 inches

Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth[2] (ft)	Headwater Inlet Control[4] (ft)	Headwater Outlet Control[4] (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
6	--	--	2	2	3	0.024	0.8	101.1	455.5	456.0	30.0	0.00	2.73	3.13	3.00	1.77	1.77	6.89

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Flow rate is an estimated portion of the total peak flow rate of Drainage Area S4 (see Appendix IIIF-A).
3. There is no assumed tailwater depth due to the geometry downstream of the culvert.
4. Culvert calculations are performed to show that installation of the culvert will not cause overtopping of the road. The road elevation is 462.00, which gives 6.00 feet of available headwater.

For proposed 4-48" CMP culverts under access road in Channel "N", Culvert "7":

Total Flow= 389 cfs
No. of Culverts= 4
Culvert Span= -- inches
Culvert Rise= -- inches
Culvert Diameter= 48 inches

Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth[2] (ft)	Headwater Inlet Control[3] (ft)	Headwater Outlet Control[3] (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
7	--	--	2	2	4	0.024	0.8	72.3	452.8	453.1	97.3	2.26	5.69	5.01	4.00	2.99	4.00	7.74

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Tailwater depth is assumed to be the 25-year, 24-hour storm event flow depth in Channel "N" downstream of the culvert (see page IIIF-B-2 for flow depths).
3. Culvert calculations are performed to show that installation of the culvert will not cause overtopping of the road. The road elevation is 459.00, which gives 6.9 feet of available headwater.

For proposed 4-48" CMP culverts under access road at south end of Channel "N", Culvert "8":

Total Flow= 426 cfs
No. of Culverts= 4
Culvert Span= -- inches
Culvert Rise= -- inches
Culvert Diameter= 48 inches

Culvert ID	Culvert Span (ft)	Culvert Span (ft)	FHWA Chart Number	FHWA Scale Number	Culvert Diameter (ft)	Manning's Coefficient	Entrance Loss Coefficient	Culvert Length (ft)	Downstream Invert Elevation (ft msl)	Upstream Invert Elevation (ft msl)	Flow Rate (cfs)	Tailwater Depth[2] (ft)	Headwater Inlet Control[3] (ft)	Headwater Outlet Control[3] (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
8	--	--	2	2	4	0.024	0.8	90.5	452.0	452.3	106.5	2.26	6.33	5.85	4.00	3.12	4.00	8.48

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Tailwater depth is assumed to be the 25-year, 24-hour storm event flow depth in Channel "N" downstream of the culvert (see page IIIF-B-2 for flow depths).
3. Culvert calculations are performed to show that installation of the culvert will not cause overtopping of the road. The road elevation is 460.00, which gives 7.7 feet of available headwater.

APPENDIX IIIF-C

FINAL COVER EROSION CONTROL STRUCTURE DESIGN

STATE OF TEXAS
NEVZAT TURAN
84059
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2-28-12

Includes pages IIIF-C-1 through IIIF-C-18

CONTENTS

STATE OF TEXAS
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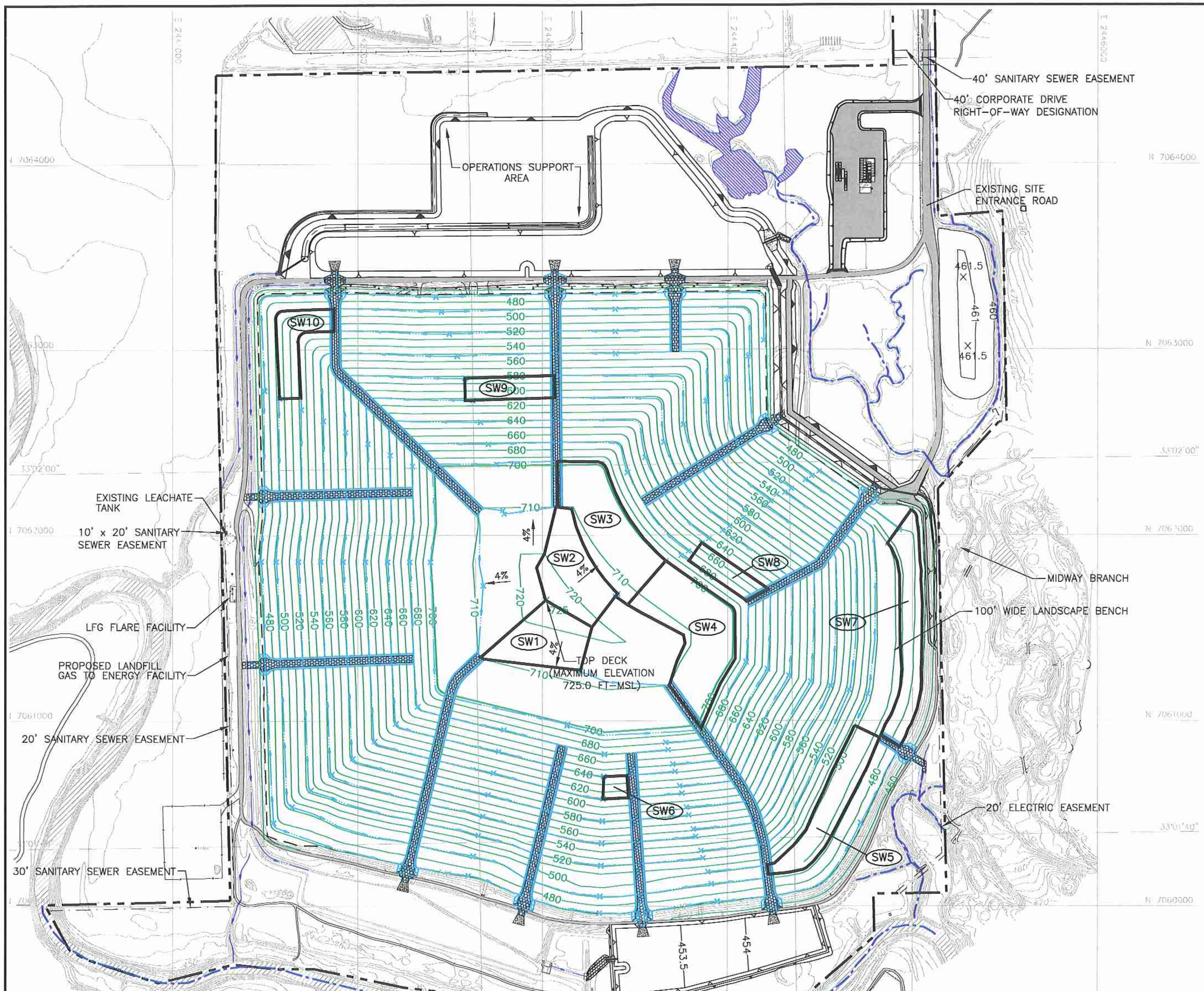
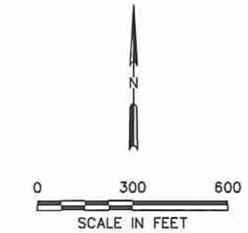
DRAINAGE SWALE DESIGN

- The drainage swale layout is shown on Drawing IIIF.1 – Drainage Structure Plan. A swale detail is provided on Drawing IIIF.9 – Drainage Details.
- Typical Swale Design Summary:
  - Typical swale drainage areas analyzed are shown on sheet IIIF-C-2.
  - Hydraulic calculations are summarized on page IIIF-C-5.
  - Maximum normal depth is 1.59 feet (Drainage Area SW7).
  - Maximum flow velocity is 2.89 fps (Drainage Area SW7).
  - Vegetation will be established on the swales to protect against erosion.
  - Typical swale drainage areas were selected such that all slope conditions (4% and 25%) are included in this analysis. Additionally, swales with large individual drainage areas and short and long swale lengths are included in this analysis.





LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- STATE PLANE COORDINATE SYSTEM
- GEODETIC COORDINATE SYSTEM
- EXISTING CONTOUR (SEE NOTE 1)
- REGRADED BUFFER ZONE AREA
- PROPOSED FINAL COVER CONTOUR
- PROPOSED LETDOWN STRUCTURE
- DRAINAGE SWALE
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 3)
- USACE JURISDICTIONAL WETLANDS
- (SW1) TYPICAL SWALE DRAINAGE AREA DESIGNATION
- TYPICAL SWALE DRAINAGE AREA BOUNDARY

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. MAXIMUM FINAL COVER ELEVATION IS 725 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 721.5 FT-MSL.
3. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.

STATE OF TEXAS — NEVZAT TURAN — 84059 — LICENSED PROFESSIONAL ENGINEER

2-28-12

TYPICAL SWALE DRAINAGE AREA DESIGNATION	AREA (ACRES)
SW1	3.01
SW2	3.40
SW3	5.01
SW4	5.59
SW5	3.01
SW6	0.36
SW7	3.38
SW8	1.12
SW9	1.34
SW10	1.80

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
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- [ ] CLIENT APPROVAL BY:

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-C-2-DRAINAGE AREAS.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

REUSE OF DOCUMENTS

PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT TYPICAL SWALE DRAINAGE AREAS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

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SHEET IIIF-C-2

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-C\IIIF-C-2-SWALE DRAINAGE AREAS.dwg, jwilson, 1:2

Required: Analyze typical swales to determine the adequacy of the swale design.

Method: 1. Determine the 25-year, 24-hour flow rates for the typical swale drainage areas (see sheet IIIF-C-2) by the Rational Method.

Reference: 1. State of Texas, Department of Transportation, Bridge Division, Hydraulic Design Manual, April 2002.

Solution: 1. Determine the 25-year intensity flow rates.

$$Q = CIA$$

Where:
C= 0.7 (runoff coefficient, Ref 1.)
I = intensity in/hr
A= drainage area, ac

$$I = \frac{b}{(t_c + d)^e}$$

b = 90 From Ref 1, for Denton County
d = 8.5 25-year storm event
e = 0.781
t_c is assumed to be 10 min.

I = 9.22 in/hr

Swale	Area (ac)	Flow Rate (cfs)
SW1	3.01	19.4
SW2	3.40	21.9
SW3	5.01	32.3
SW4	5.59	36.1
SW5	3.01	19.4
SW6	0.36	2.3
SW7	3.38	21.8
SW8	1.12	7.2
SW9	1.34	8.6
SW10	1.80	11.6

METRIC UNITS: e is in inches, b is unitless, and d is in minutes

County name	2-year e	2-year b	2-year d	5-year e	5-year b	5-year d	10-year e	10-year b	10-year d	25-year e	25-year b	25-year d	50-year e	50-year b	50-year d	100-year e	100-year b	100-year d
Dawson	0.820	1118	10.0	0.818	1499	10.4	0.814	1727	10.4	0.807	1956	10.4	0.801	2184	10.4	0.798	2362	10.0
De Witt	0.810	1651	8.9	0.765	1905	8.7	0.758	1981	8.7	0.758	2286	8.7	0.747	2438	8.7	0.739	2591	8.9
Deaf Smith	0.847	1219	10.7	0.844	1524	9.3	0.794	1549	9.3	0.831	2083	9.3	0.837	2388	9.3	0.830	2718	10.7
Delta	0.788	1372	8.2	0.783	1727	9.1	0.775	1956	9.1	0.770	2261	9.1	0.759	2388	9.1	0.753	2540	8.2
Benton	0.789	1295	8.0	0.777	1651	8.5	0.779	1956	8.5	0.781	2286	8.5	0.780	2591	8.5	0.769	2718	8.0
Dickens	0.810	1143	9.4	0.807	1549	10.0	0.803	1803	10.0	0.808	2159	10.0	0.808	2438	10.0	0.809	2769	9.4
Dimmit	0.830	1524	9.6	0.806	1880	9.4	0.795	2083	9.4	0.783	2388	9.4	0.781	2667	9.4	0.779	2870	9.6
Donley	0.839	1321	11.0	0.832	1727	10.6	0.825	2007	10.6	0.836	2438	10.6	0.823	2616	10.6	0.845	3277	11.0
Duval	0.826	1778	8.8	0.802	2007	9.2	0.781	2134	9.2	0.772	2388	9.2	0.755	2489	9.2	0.750	2642	8.8
Eastland	0.780	1143	8.0	0.772	1473	7.8	0.771	1753	7.8	0.772	2057	7.8	0.775	2337	7.8	0.770	2565	8.0
Ector	0.812	991	9.5	0.821	1422	10.5	0.816	1651	10.5	0.789	1727	10.5	0.802	2083	10.5	0.800	2261	9.5
Edwards	0.790	1118	8.2	0.759	1372	7.5	0.759	1600	7.5	0.769	1930	7.5	0.776	2235	7.5	0.772	2540	8.2
El Paso	0.797	610	9.5	0.802	864	12.0	0.795	1067	12.0	0.843	1524	12.0	0.900	2286	12.0	0.825	1651	9.5
Ellis	0.798	1422	8.4	0.788	1803	8.8	0.777	2007	8.8	0.771	2311	8.8	0.766	2489	8.8	0.760	2667	8.4
Erath	0.780	1194	7.7	0.772	1549	8.1	0.770	1829	8.1	0.765	2261	8.1	0.772	2438	8.1	0.765	2616	7.7
Falls	0.801	1524	8.0	0.786	1829	8.5	0.771	2007	8.5	0.772	2362	8.5	0.750	2388	8.5	0.748	2591	8.0
Fannin	0.790	1372	8.3	0.778	1676	9.1	0.782	2007	9.1	0.782	2362	9.1	0.779	2515	9.1	0.762	2616	8.3
Fayette	0.805	1651	8.3	0.782	1854	8.2	0.758	1930	8.2	0.758	2235	8.2	0.743	2388	8.2	0.740	2540	8.3
Fisher	0.786	1041	8.6	0.779	1397	9.5	0.793	1778	9.5	0.790	2108	9.5	0.798	2438	9.5	0.788	2591	8.6
Floyd	0.829	1219	10.1	0.821	1600	10.0	0.890	1803	10.0	0.818	2159	10.0	0.813	2464	10.0	0.822	2794	10.1
Foard	0.810	1219	9.8	0.787	1524	9.5	0.806	1956	9.5	0.807	2311	9.5	0.817	2769	9.5	0.806	2946	9.8
Fort Bend	0.804	1778	7.9	0.760	1803	8.1	0.751	2032	8.1	0.729	2134	8.1	0.726	2311	8.1	0.710	2337	7.9
Franklin	0.780	1346	8.1	0.782	1753	8.8	0.765	1880	8.8	0.759	2134	8.8	0.751	2261	8.8	0.745	2413	8.1
Freestone	0.803	1575	8.5	0.795	1956	9.0	0.769	2032	9.0	0.775	2413	9.0	0.749	2388	9.0	0.745	2540	8.5
Frio	0.814	1549	9.3	0.789	1803	9.1	0.789	2083	9.1	0.772	2261	9.1	0.765	2438	9.1	0.769	2794	9.3
Gaines	0.820	1067	10.0	0.832	1473	10.0	0.805	1600	10.0	0.797	1778	10.0	0.807	2134	10.0	0.813	2413	10.0
Galveston	0.787	1702	7.8	0.739	1676	7.6	0.742	1981	7.6	0.727	2159	7.6	0.704	2235	7.6	0.690	2159	7.8
Garza	0.812	1118	9.4	0.811	1524	10.2	0.800	1702	10.2	0.810	2108	10.2	0.799	2235	10.2	0.800	2540	9.4
Gillespie	0.787	1245	8.5	0.766	1524	8.1	0.767	1803	8.1	0.765	2083	8.1	0.764	2388	8.1	0.765	2642	8.5
Glasscock	0.801	1016	9.1	0.796	1397	10.0	0.803	1676	10.0	0.789	1880	10.0	0.789	2108	10.0	0.784	2337	9.1
Goliad	0.812	1651	9.1	0.789	1905	8.7	0.758	1956	8.7	0.755	2261	8.7	0.746	2464	8.7	0.738	2565	9.1
Gonzales	0.801	1549	8.4	0.788	1880	8.6	0.763	1956	8.6	0.760	2261	8.6	0.747	2413	8.6	0.745	2642	8.4
Gray	0.845	1372	10.8	0.837	1778	10.8	0.836	2108	10.8	0.842	2515	10.8	0.841	2896	10.8	0.846	3175	10.8
Grayson	0.790	1321	8.3	0.778	1651	8.9	0.779	1981	8.9	0.790	2413	8.9	0.781	2642	8.9	0.769	2743	8.3
Gregg	0.783	1422	8.1	0.783	1803	8.6	0.750	1829	8.6	0.753	2134	8.6	0.740	2210	8.6	0.737	2388	8.1
Grimes	0.808	1727	8.0	0.784	1905	8.3	0.760	2057	8.3	0.744	2210	8.3	0.742	2413	8.3	0.721	2388	8.0
Guadalupe	0.796	1473	8.4	0.787	1829	8.7	0.772	1981	8.7	0.765	2261	8.7	0.750	2362	8.7	0.754	2667	8.4
Hale	0.834	1219	10.3	0.827	1549	9.9	0.815	1753	9.9	0.823	2134	9.9	0.812	2337	9.9	0.817	2642	10.3
Hall	0.829	1270	10.4	0.821	1676	10.3	0.815	1905	10.3	0.822	2337	10.3	0.819	2616	10.3	0.830	3200	10.4
Hamilton	0.779	1219	7.3	0.770	1575	8.3	0.761	1829	8.3	0.778	2261	8.3	0.766	2413	8.3	0.761	2616	7.3
Hansford	0.865	1448	10.4	0.846	1854	11.3	0.842	2134	11.3	0.862	2642	11.3	0.867	3150	11.3	0.839	2946	10.4
Hardeman	0.815	1245	10.0	0.794	1549	9.5	0.810	1981	9.5	0.816	2413	9.5	0.817	2794	9.5	0.810	3048	10.0
Hardin	0.788	1727	8.4	0.738	1651	7.5	0.740	1880	7.5	0.720	2032	7.5	0.718	2210	7.5	0.700	2210	8.4
Harris	0.800	1727	7.9	0.749	1778	7.7	0.753	2057	7.7	0.724	2057	7.7	0.728	2311	7.7	0.706	2311	7.9
Harrison	0.771	1346	8.0	0.773	1753	8.4	0.750	1778	8.4	0.747	2032	8.4	0.730	2083	8.4	0.732	2286	8.0
Hartley	0.858	1295	10.8	0.855	1702	10.2	0.814	1702	10.2	0.840	2159	10.2	0.863	2692	10.2	0.832	2718	10.8
Haskell	0.790	1143	8.9	0.779	1448	9.2	0.799	1880	9.2	0.787	2159	9.2	0.805	2616	9.2	0.788	2692	8.9
Hays	0.796	1422	8.2	0.783	1753	8.6	0.776	1981	8.6	0.765	2210	8.6	0.747	2286	8.6	0.755	2642	8.2
Hemphill	0.845	1422	10.6	0.851	1930	10.7	0.842	2210	10.7	0.843	2616	10.7	0.840	2921	10.7	0.847	3353	10.6
Henderson	0.800	1524	8.7	0.796	1956	9.0	0.770	2007	9.0	0.773	2362	9.0	0.752	2362	9.0	0.749	2591	8.7
Hidalgo	0.831	1880	9.6	0.795	2032	9.2	0.778	2210	9.2	0.771	2489	9.2	0.749	2515	9.2	0.740	2616	9.6
Hill	0.799	1448	8.2	0.790	1829	8.8	0.777	1981	8.8	0.773	2311	8.8	0.764	2489	8.8	0.759	2667	8.2
Hockley	0.832	1168	9.9	0.832	1524	10.0	0.807	1626	10.0	0.812	1981	10.0	0.810	2210	10.0	0.817	2565	9.9
Hood	0.782	1219	7.7	0.773	1600	8.3	0.773	1905	8.3	0.782	2286	8.3	0.773	2489	8.3	0.766	2667	7.7
Hopkins	0.788	1372	8.3	0.783	1778	9.1	0.775	1956	9.1	0.767	2235	9.1	0.754	2362	9.1	0.750	2540	8.3
Houston	0.797	1600	8.2	0.780	1854	8.3	0.757	1981	8.3	0.748	2184	8.3	0.740	2362	8.3	0.727	2388	8.2
Howard	0.805	1067	9.2	0.800	1422	10.1	0.802	1651	10.1	0.796	1930	10.1	0.791	2184	10.1	0.788	2413	9.2
Hudspeth	0.800	686	9.4	0.840	1118	11.4	0.827	1270	11.4	0.819	1524	11.4	0.856	1981	11.4	0.833	1956	9.4
Hunt	0.793	1397	8.4	0.785	1753	9.2	0.783	2032	9.2	0.776	2362	9.2	0.764	2515	9.2	0.758	2642	8.4
Hutchinson	0.860	1422	10.4	0.844	1778	11.0	0.837	2032	11.0	0.851	2540	11.0	0.863	3073	11.0	0.837	2921	10.4

Prep By: CRM
Date: 2/21/2012

CAMELOT LANDFILL
1339-351-11-02
SWALE ANALYSIS

Chkd By: RCE
Date: 2-28-12

Swale	Flow Rate (cfs)	Bottom Slope (ft/ft)	n-value	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude No.	Velocity Head (ft)	Energy Head (ft)	Flow Area (sq. ft.)	Top Width of Flow (ft)
SW1	19.4	0.005	0.03	2	25	0	0.85	1.97	0.531	0.06	0.91	9.86	23.07
SW2	21.9	0.005	0.03	2	25	0	0.89	2.03	0.535	0.06	0.96	10.79	24.13
SW3	32.3	0.005	0.03	2	25	0	1.03	2.24	0.549	0.08	1.11	14.43	27.92
SW4	36.1	0.005	0.03	2	25	0	1.08	2.31	0.554	0.08	1.16	15.65	29.07
SW5	19.4	0.005	0.03	2	4	0	1.52	2.81	0.568	0.12	1.64	6.91	9.11
SW6	2.3	0.005	0.03	2	4	0	0.68	1.65	0.498	0.04	0.72	1.40	4.09
SW7	21.8	0.005	0.03	2	4	0	1.59	2.89	0.572	0.13	1.72	7.55	9.52
SW8	7.2	0.005	0.03	2	4	0	1.05	2.18	0.532	0.07	1.12	3.30	6.29
SW9	8.6	0.005	0.03	2	4	0	1.12	2.29	0.540	0.08	1.20	3.75	6.71
SW10	11.6	0.005	0.03	2	4	0	1.25	2.46	0.549	0.09	1.35	4.71	7.52

Note: Calculations were performed using the HYDROCALC HYDRAULICS program developed by Dodson and Associates (Version 1.2a, 1996).

Maximum flow depth is 1.59 ft < 2.0 ft (swale height).

Design is okay.

Example Calculation: Calculate the normal depth for the swale for drainage area SW3 (see sheet IIIF-C-2).

List of Symbols

Q_d = design flow rate for channel, cfs
R = hydraulic radius, ft
n = Manning's roughness coefficient
S = channel slope, ft/ft
b = bottom width of channel, ft
z_r = z-ratio (ratio of run to rise for channel sideslope) for right sideslope of swale
z_l = z-ratio (ratio of run to rise for channel sideslope) for left sideslope of swale
A_f = flow area, sf
g = gravitational acceleration = 32.2 ft/s^2
T = top width of flow, ft
d = normal depth of swale, ft

The program uses an iterative process to calculate the normal depth of the swale to satisfy Manning's Equation

$$Q = \frac{1.486}{n} A R^{0.67} S^{0.5}$$

Design Inputs:

Q_d =	32.3	cfs (from page IIIF-C-3)
S =	0.005	ft/ft
b =	0	ft
z_r =	2	(H) : 1 (V)
z_l =	25	(H) : 1 (V)
n =	0.03	

Step 1 - Based on the geometry of the swale cross-section, solve for R and A_f

$$R = \frac{bd + 1/2d^2(z_r + z_l)}{b + d((z_l^2 + 1)^{0.5} + (z_r^2 + 1))}$$

$$A_f = bd + 1/2d^2(z_r + z_l)$$

assume: d = 1.03 ft

R = 0.510 ft

A_f = 14.43 sf

solve for Q: $Q = 32.3$

if Q is not equal to Q_d, select a new d and repeat calculations

Step 2 - solve for velocity, T, Froude number, velocity head, and energy head

$Q = VA \Rightarrow \quad V = Q/A$

$V = 2.24$ ft/s

$T = b + d(z_l + z_r)$

$T = 27.92$ ft

$$F_r = \frac{V}{(gA/T)^{0.5}}$$

$F_r = 0.549$

$$\text{Velocity Head} = \frac{V^2}{2g}$$

Velocity Head = 0.08 ft

Energy Head = water elevation + velocity head

Energy Head = 1.11 ft

DRAINAGE LETDOWN (OR CHUTE) DESIGN

Chute Design

The letdown structures are designed using gabions as a liner. Bedding for the gabions will be prepared subgrade soil overlain by 8 oz/sy geotextile (refer to Drawing IIIF.9). The gabions are placed along the entire chute to protect the chute bottom and the final cover from erosion due to potential erosive velocities. Tumbling flow concrete energy dissipators will be placed at the bottom end of the letdown structure to dissipate excess energy present in the water as it travels down the two and three percent slopes in the low-water crossings over the perimeter road.

The following design information is included in this Appendix:

- Flow rates used in the chutes are presented in Appendix IIIF-A – HEC-1 computer program output file.
- Hydraulic calculations are summarized on pages IIIF-C-9 and IIF-C-10, and the calculation procedure is provided on pages IIIF-C-11 and IIIF-C-12.
- Chute layouts and drainage areas are shown on Sheet IIIF-C-13.
- The chute energy dissipater sizing calculation procedure is provided on pages IIIF-C-14 through IIIF-C-18.
- Additional stormwater details are included on Drawings IIIF.10 through IIIF.12.

Prep By: CRM
Date: 2/21/2012

Chkd By: RCE
Date: 2-28-12

CAMELOT LANDFILL
1339-351-11-02
CHUTE ANALYSIS
NORMAL DEPTH CALCULATIONS FOR
GABION-LINED CHUTES

Drainage Area	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)
TOPSLOPE (4%) AREAS												
A1T	27	0.04	0.04	4.0	4.0	13.0	0.45	4.04	1.123	0.25	0.71	6.68
A2T	57	0.04	0.04	4.0	4.0	13.0	0.69	5.20	1.193	0.42	1.11	10.96
A7T	66	0.04	0.04	4.0	4.0	13.0	0.75	5.46	1.207	0.46	1.22	12.09
A10T	62	0.04	0.04	4.0	4.0	13.0	0.73	5.34	1.201	0.44	1.17	11.59
SIDESLOPE (25%) AREAS												
A1S	156	0.25	0.04	4.0	4.0	13.0	0.73	13.40	3.005	2.79	3.52	11.64
A2S	195	0.25	0.04	4.0	4.0	13.0	0.83	14.40	3.058	3.22	4.05	13.54
A3	61	0.25	0.04	4.0	4.0	13.0	0.43	9.75	2.784	1.48	1.90	6.26
A4	100	0.25	0.04	4.0	4.0	13.0	0.57	11.56	2.900	2.07	2.64	8.65
A5	134	0.25	0.04	4.0	4.0	13.0	0.67	12.74	2.969	2.52	3.19	10.52
A6	73	0.25	0.04	4.0	4.0	13.0	0.47	10.38	2.826	1.67	2.15	7.03
A7S	201	0.25	0.04	4.0	4.0	13.0	0.84	14.54	3.065	3.29	4.13	13.82
A8	80	0.25	0.04	4.0	4.0	13.0	0.50	10.71	2.847	1.78	2.28	7.47
A9	105	0.25	0.04	4.0	4.0	13.0	0.58	11.75	2.911	2.14	2.73	8.94
A10S	180	0.25	0.04	4.0	4.0	13.0	0.79	14.03	3.039	3.06	3.85	12.83
A11	158	0.25	0.04	4.0	4.0	13.0	0.74	13.45	3.008	2.81	3.55	11.75
A12	114	0.25	0.04	4.0	4.0	13.0	0.61	12.08	2.931	2.27	2.88	9.44

Prep By: CRM
Date: 2/28/2012

Chkd By: RCE
Date: 2-28-12

CAMELOT LANDFILL
1339-351-11-02
CHUTE ANALYSIS
NORMAL DEPTH CALCULATIONS FOR
GABION-LINED CHUTES

Drainage Area	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
LOW WATER CROSSING (2%) AREAS													
A1S	156	0.02	0.04	8.0	8.0	13.0	1.33	4.95	0.910	0.38	1.71	31.52	34.32
A2S	195	0.02	0.04	8.0	8.0	13.0	1.49	5.26	0.924	0.43	1.92	37.07	36.81
A3	61	0.02	0.04	8.0	8.0	13.0	0.82	3.79	0.853	0.22	1.05	16.08	26.15
A4	100	0.02	0.04	8.0	8.0	13.0	1.06	4.37	0.883	0.30	1.36	22.88	30.02
A5	134	0.02	0.04	8.0	8.0	13.0	1.23	4.74	0.901	0.35	1.58	28.24	32.75
A6	73	0.02	0.04	8.0	8.0	13.0	0.90	4.00	0.863	0.25	1.15	18.27	27.45
A7S	201	0.02	0.04	8.0	8.0	13.0	1.51	5.30	0.926	0.44	1.95	37.89	37.17
A8	80	0.02	0.04	8.0	8.0	13.0	0.95	4.10	0.869	0.26	1.21	19.51	28.16
A9	105	0.02	0.04	8.0	8.0	13.0	1.09	4.43	0.886	0.31	1.40	23.70	30.45
A10S	180	0.02	0.04	8.0	8.0	13.0	1.59	5.86	0.944	0.53	2.12	30.73	25.70
A11	158	0.02	0.04	8.0	8.0	13.0	1.34	4.97	0.911	0.38	1.72	31.82	34.46
A12	114	0.02	0.04	8.0	8.0	13.0	1.14	4.53	0.891	0.32	1.46	25.14	31.20

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

Example Calculation: Calculate the normal depth for the chute for drainage area A1S.

List of Symbols

Q_d = design flow rate for channel, cfs
R = hydraulic radius, ft
n = Manning's roughness coefficient
S = channel slope, ft/ft
b = bottom width of channel, ft
z = z-ratio (ratio of run to rise for channel sideslope)
A_f = flow area, sf
g = gravitational acceleration = 32.2 ft/s^2
T = top width of flow, ft
d = normal depth of chute, ft

The program uses an iterative process to calculate the normal depth of the chute to satisfy Manning's Equation

$$Q = \frac{1.486}{n} A R^{0.67} S^{0.5}$$

Design Inputs:

Q_d =	156	cfs (from HEC-1 analysis, Appendix IIIF-A)
S =	0.25	ft/ft
b =	13	ft
z =	4	(H) : 1 (V)
n =	0.04	

Step 1 - Based on the geometry of the chute cross-section, solve for R and A_f

$$R = \frac{bd + zd^2}{b + 2d(z^2 + 1)^{0.5}}$$

$$A_f = bd + zd^2$$

assume: d = 0.73 ft

R = 0.611 ft

A_f = 11.64 sf

solve for Q: Q = 156

if Q is not equal to Q_d, select a new d and repeat calculations

Step 2 - solve for velocity, T, Froude number, velocity head, and energy head

$Q = VA \Rightarrow \quad V = Q/A$

$V = 13.40$ ft/s

$T = b + 2(z \times d)$

$T = 18.85$ ft

$$F_r = \frac{V}{(gA/T)^{0.5}}$$

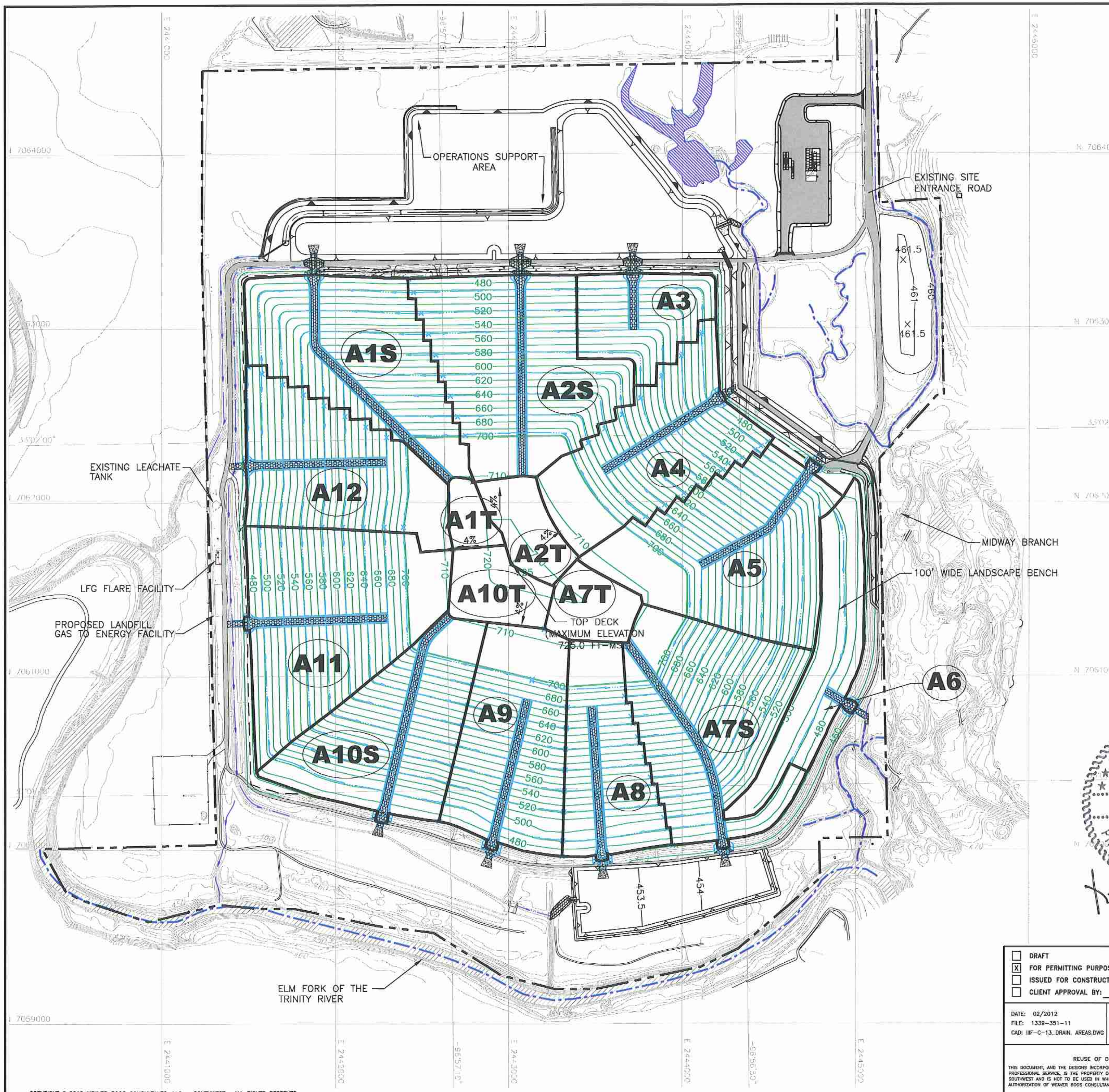
$F_r = 3.005$

$$\text{Velocity Head} = \frac{V^2}{2g}$$

Velocity Head = 2.79 ft

Energy Head = water elevation + velocity head

Energy Head = 3.52 ft



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 STATE PLANE COORDINATE SYSTEM
- 33°02'00" GEODETIC COORDINATE SYSTEM
- 500 EXISTING CONTOUR (SEE NOTE 1)
- 600 REGRADED BUFFER ZONE AREA
- 600 PROPOSED FINAL COVER CONTOUR
- PROPOSED LETDOWN STRUCTURE
- DRAINAGE SWALE
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 3)
- USACE JURISDICTIONAL WETLANDS
- DRAINAGE AREA BOUNDARY
- A3 DRAINAGE AREA DESIGNATION

DRAINAGE AREA DESIGNATION	AREA (ACRES)
A1T	2.07
A2T	4.56
A7T	4.90
A10T	4.20
A1S	20.17
A2S	23.32
A3	8.66
A4	18.25
A5	23.05
A6	10.87
A7S	22.89
A8	12.65
A9	17.25
A10S	18.55
A11	24.67
A12	18.13

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
2-28-12

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. MAXIMUM FINAL COVER ELEVATION IS 725 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 721.5 FT-MSL.
3. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY:

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-C-13_DRAIN. AREAS.DWG
DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

REUSE OF DOCUMENTS

MAJOR PERMIT AMENDMENT
LETDOWN STRUCTURE DRAINAGE AREAS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO
FORT WORTH, TX (817) 735-9770
GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

SHEET IIIF-C-13

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-C\IIIF-C-13-LETDOWN STRUCTURE DRAINAGE AREAS.dwg, jwilson, 1:2

CAMELOT LANDFILL
1339-351-11-02
EROSION CONTROL STRUCTURE MODIFICATION
GABION-LINED CHUTE DESIGN
25-YEAR, 24 HOUR STORM

Required: Provide design for a gabion-lined letdown structure (or chute).

Method:

1. Design the energy dissipator system at the downstream end of the proposed "tumbling flow" chutes.
   The tumbling flow regime consists of a series of hydraulic jumps and overfalls designed to maintain critical velocity in the chutes. Tumbling flow occurs only in the energy dissipators located at the downstream end of the chutes.

Assumptions:

1. The gabion-lined chute will transition to its maximum width for the energy dissipator design where maximum total flow for chute is expected to occur.
2. Concrete block will be designed for a maximum height of 3 1/2 feet.
3. Proposed chutes will convey runoff from the following chute drainage area:

Proposed Chute	Chute Drainage Areas	25-Year Total Flow (cfs)[1]
1	A1S	156
2	A2S	195
3	A3	61
4	A4	100
5	A5	134
6	A6	73
7	A7S	201
8	A8	80
9	A9	105
10	A10S	180
11	A11	158
12	A12	114

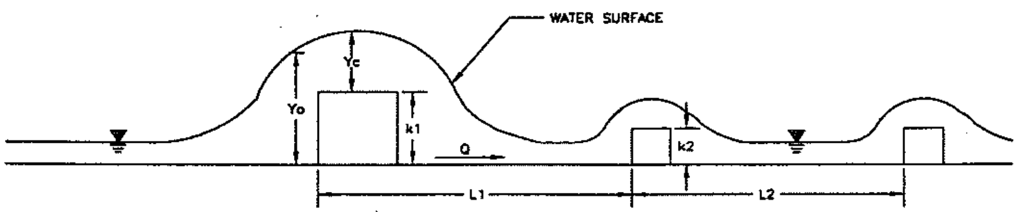
[1] From HEC-1 Analysis, Appendix IIIF-A

References:

1. Gamelsky, S.G., *Innovations in Stormwater Management for Landfill Closure* Technical Paper
2. Koerner, R.M., *Designing with Geosynthetics*, 3rd Edition, Prentice-Hall, Inc, 1994.
3. Morris, H.M., *Hydraulics of Energy Dissipators in Steep Rough Channels*, Bulletin 19, Research Division, Virginia Polytechnic Institute, Blacksburg, Virginia.

Solution: 1. Energy Dissipator Design

1. Tumbling Flow Energy Dissipators



Definition of Terms/Variables:

Q =	flow rate (cfs)
q =	unit flow (cfs/ft width)
Y_C =	critical depth (ft)
Y_O =	approach depth (ft)
k_1 =	height of initial element (ft)
k_2 =	height of secondary elements (ft)
L_1 =	distance between initial and secondary elements (ft)
L_2 =	distance between secondary elements (ft)
W =	bottom width of chute (ft)
g =	acceleration due to gravity, 32.2 ft/s^2
S =	slope of channel (percent)
x =	slope of channel (degrees)
n =	Manning's Coefficient

CAMELOT LANDFILL
1339-351-11-02
EROSION CONTROL STRUCTURE MODIFICATION
GABION-LINED CHUTE DESIGN
25-YEAR, 24 HOUR STORM

Design Equations:

$q = Q/W$ (Ref 3, page 93, Item 6)

$Y_C = (q^2/g)^{1/3}$ (Ref 3, page 92, Item 3)

$Y_o = (nq/(1.5\tan(x)^{0.5}))^{3/5}$ (Ref 3, page 28, Eqn 24)

$y_1 = 0.35\, q^{2/3}$ (Ref 1, page 93, Item 7)

$K_1 = Y_c\{[(2/1 - 0.01S)(Y_c/Y_o)]^{0.5} - (1 - 0.01S)^2$ (Ref 3, page 93, Item 5)

$K_2 = \dfrac{Y_C}{(3\text{-}0.037S)^{2/3}}$ (Ref 1, page 92, Item 3)

$L_1 = (1 + 0.01S)K_1 + Y_c(K_1/g\cos(x))^{0.5}$ (Ref 1, page 42, Eqn 31)

$L_2 = 8.5\, K_2$

Note: use the greater of L_1 and L_2

Chute parameters:

Slope (S) =	25	%
Manning's coefficient (n) =	0.04	
Slope (x) =	14.04	deg
g =	32.2	ft/s^2

CAMELOT LANDFILL
1339-351-11-02
EROSION CONTROL STRUCTURE MODIFICATION
GABION-LINED CHUTE DESIGN
25-YEAR, 24 HOUR STORM

Chute	Q'	W	q	Y_C	Y_O	y_1	K_1	K_2
1	156	14	11.14	1.57	0.73	1.75	3.45	0.96
2	195	18	10.83	1.54	0.72	1.71	3.38	0.95
3	61	13	4.69	0.88	0.44	0.98	1.87	0.54
4	100	13	7.69	1.22	0.59	1.36	2.65	0.75
5	134	13	10.31	1.49	0.70	1.66	3.26	0.92
6	73	13	5.62	0.99	0.49	1.11	2.12	0.61
7	201	18	11.17	1.57	0.73	1.75	3.45	0.97
8	80	13	6.15	1.06	0.51	1.18	2.26	0.65
9	105	13	8.08	1.27	0.60	1.41	2.74	0.78
10	180	16	11.25	1.58	0.74	1.76	3.47	0.97
11	158	15	10.53	1.51	0.71	1.68	3.31	0.93
12	114	13	8.77	1.34	0.63	1.49	2.91	0.82

Chute	L_1	L_2	L_2 Used
1	4.83	8.92	8.9
2	4.73	8.75	8.8
3	2.55	5.01	5.0
4	3.67	6.96	7.0
5	4.56	8.46	8.5
6	2.91	5.65	5.6
7	4.84	8.93	8.9
8	3.11	6.00	6.0
9	3.80	7.19	7.2
10	4.86	8.97	9.0
11	4.63	8.59	8.6
12	4.04	7.60	7.6

Design Summary

Chute	Height of Concrete Weir (K_1) (ft)	Height of Secondary Element (K_2) (ft)	Length Between Weir and First Element (L_1) (ft)	Length Between Elements (L_2) (ft)
1	3.5	0.96	4.83	8.9
2	3.5	0.95	4.73	8.8
3	3.0	0.75	2.55	5.0
4	3.0	0.75	3.67	7.0
5	3.5	0.92	4.56	8.5
6	3.0	0.75	2.91	5.6
7	3.5	0.97	4.84	8.9
8	3.0	0.75	3.11	6.0
9	3.0	0.78	3.80	7.2
10	3.5	0.97	4.86	9.0
11	3.5	0.93	4.63	8.6
12	3.0	0.82	4.04	7.6

APPENDIX IIIF-D

EROSION LAYER EVALUATION

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

Includes pages IIIF-D-1 through IIIF-D-37

EROSION LAYER EVALUATION

This appendix presents the supporting documentation for evaluation of the thickness of the erosion layer for the final cover system at the Camelot Landfill. The evaluation is based on the premise of adding excess soil to increase the time required before maintenance is needed as recommended in the EPA Solid Waste Disposal Facility Criteria Technical Manual (EPA 530-R-93-017, November 1993).
The design procedure is as follows:

1. Minimum thickness of the erosion layer at the end of the 30-year postclosure period is evaluated based on the depth of frost penetration or 6 inches, whichever is greater. For Denton County, the approximate depth of frost penetration is approximately 6.1 inches (see IIIF-D-9). Therefore, the minimum erosion layer thickness is 6.1 inches.

2. Soil loss is calculated using the Universal Soil Loss Equation (USLE) by following SCS procedures. The soil loss is adjusted by a safety factor of 2 and is then converted to a thickness. The thickness of the soil loss over a 30-year postclosure period is added to the minimum thickness of the erosion layer (from Step 1) to yield an initial thickness to be placed at closure of the site. According to the USLE, the typical 4 percent topslope and 25 percent side slope require a minimum of 6.199 inches and 6.955 inches, respectively, for the erosion layer. These USLE requirements include the 6.1-inch minimum required by regulations. Conservatively, a 24-inch erosion layer is proposed over final cover. These calculations begin on page IIIF-D-3.

3. Stormwater flows over the final cover system by (1) sheet flow over the topslope and sideslopes and (2) channelized flow in the drainage berms (or swales). As discussed in Section 2.2 and Appendix IIIF-C, flow also occurs in the letdown structures. The letdown structures are lined with gabions to prevent erosion given that the velocities in the letdowns are over 5 ft/sec.

   Sheet flow velocities for the topslope and sideslope cases for a 25-year storm event are calculated to be less than permissible nonerosive velocities. A permissible nonerosive velocity is defined as 5.0 ft/sec or less. Calculated sheet flow velocities range from 0.33 to 0.45 ft/sec for topslope and sideslope cases. The supporting calculations are presented on pages IIIF-D-17 through IIIF-D-25.

   Channelized flow for drainage swales is also calculated to be less than permissible nonerosive velocities. Calculated channelized flow velocities range from 1.65 to

3.24 ft/sec for the drainage swales. The supporting calculations are presented on pages IIIF-C-3 through IIIF-C-7.

4. Vegetation for the site will be native and introduced grasses with root depths of 6 inches to 8 inches. The seeding is specified on the attached pages IIIF-D-26 through IIIF-D-37. The seeding included on pages IIIF-D-26 through IIIF-D-37 is specified by TxDOT for temporary and permanent erosion control for Denton County, Texas (Fort Worth District).

5. Native and introduced grasses will be hydroseeded with fertilizer on the disked (parallel to contours) erosion layer upon final grading. Temporary cold weather vegetation will be established if needed. Irrigation will be employed for 6 to 8 weeks or until vegetation is well established. Erosion control measures such as silt fences and straw bales will be used to minimize erosion until the vegetation is established. Areas that experience erosion or do not readily vegetate after hydroseeding will be reseeded until vegetation is established or the soil will be replaced with soil that will support the grasses.

6. Slope stability information is included in Appendix IIIJ.

Required: Determine expected soil loss and minimum thickness for the erosion layer.

Method: Expected soil loss is calculated using the Universal Soil Loss Equation. Minimum erosion layer thickness is determined by adding the minimum thickness allowed by TCEQ to the expected soil loss.

References:

1. SCS National Engineering Handbook, Chapter 3 - Erosion.
2. TNRCC, *Use of the USLE in Final Cover/Configuration Design*, 1993.
3. United States Department of Agriculture, National Resource Conservation Service, Web Soil Survey for Denton County, Texas (http://websoilsurvey.nrcs.usda.gov).
4. United States Environmental Protection Agency, *Solid Waste Disposal Facility Criteria Technical Manual*, 1993.

Solution:

1. Soil Loss Equation: $A=RKL_SCP$

Where:

$A=$ Soil loss (tons/ac/yr)
$R=$ Rainfall factor
$K=$ Soil erodibility factor
$L_S=$ Slope length/slope gradient factor
$C=$ Plant cover or cropping management factor
$P=$ Erosion practice factor

The rainfall factor, R, represents the average intensity for the maximum intensity, 30 minute storms over a 22 year period of record compiled by the SCS. Using Figure 1 (Ref 2), Average Annual Values of the R Factor, the R factor for Denton County is:

$R =$ 275

The soil erodibility factor, K, factor represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. Assume an organic matter content of 2% to determine the K factor. The site top soil will consist of silty clay with high organic content. Clean compost as a soil amendment maybe added to final cover top soil as necessary to protect against erosion. Therefore, the following is a K value for the site.

$K =$ 0.25

The slope length/slope gradient factor, L_s, represents the erosion of the soil due to both slope length and degree of slope. The slopes of interest are the typical side slope and top slope conditions.
See sheet IIIF-D-7 for the locations of the slopes analyzed.

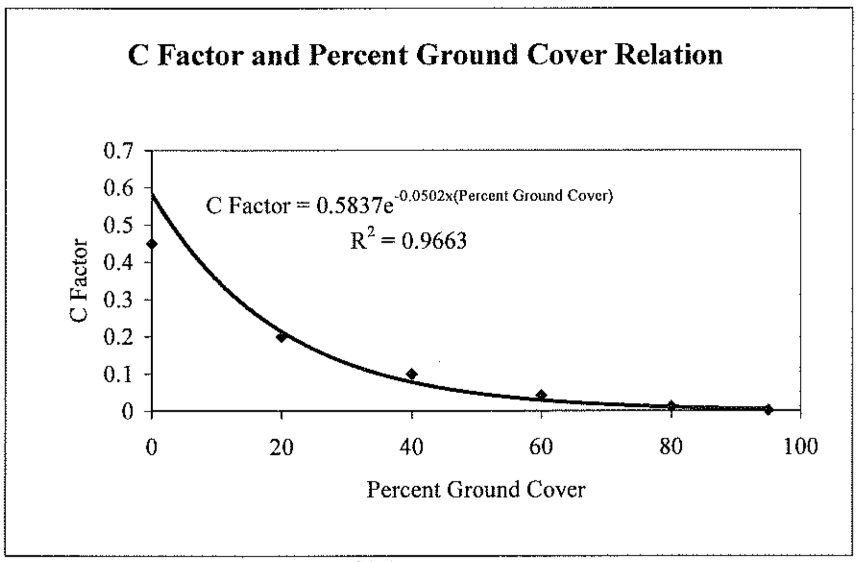
Case 1.	Typical Top Slope				Case 2.	Longest Top Slope		
	slope =	4	%			slope =	4	%
	length =	500	ft			length =	600	ft
Case 3.	Typical Side Slope				Case 4.	Longest Side Slope		
		25	%				25	%
		120	ft				126	ft

Using the above information and Figure 2 (Ref 2, p.9), the L_s factors are determined.

Case	Slope (%)	Slope Length (ft)	L_s
1. Typical Top Slope	4	500	0.75
2. Longest Top Slope	4	600	0.81
5. Typical Side Slope	25	120	6.50
6. Longest Side Slope	25	126	6.60

The plant cover or cropping management factor, C, represents the percentage of soil loss that would occur if the surface were partially protected by some combination of cover and management practices. C Factor for Permanent Pasture, Range, and Idle Land with No Appreciable Canopy has the following relation with percent ground cover (GC) (from Ref 2, p.7).

% GC	C Factor:
0	0.45
20	0.2
40	0.1
60	0.042
80	0.013
95	0.003



C Factor= $0.5837e^{(-0.0502x90)}$
C Factor= 0.0064 (for 90% ground cover)

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration , and runoff velocity. Contouring for this site will be done only to establish vegetation.

P = 1.00

2. Soil loss calculations

Slope Condition	R	K	L_s	C	P	A (tons/ac/yr)
1. Typical Top Slope 4% slope 500 ft length	275	0.25	0.75	0.0064	1.00	0.33
2. Longest Top Slope 4% slope 600 ft length	275	0.25	0.81	0.0064	1.00	0.35
3. Typical Side Slope 25% slope 120 ft length	275	0.25	6.50	0.0064	1.00	2.85
4. Longest Side Slope 25% slope 126 ft length	275	0.25	6.60	0.0064	1.00	2.89

Note: Erosion layer will be maintained to provide 90% ground cover.

3. Erosion layer thickness calculations:

$$T_{el} = 6.1\,in + \frac{AYF(2000 lb/ton)(12 in/ft)}{w(43{,}560 sf/ac)}$$

Where:
T_{el} = Erosion layer thickness
A = Soil loss (ton/ac/yr)
Y = Postclosure period (yr)
F = Factor of Safety
w = Specific weight of soil (pcf)

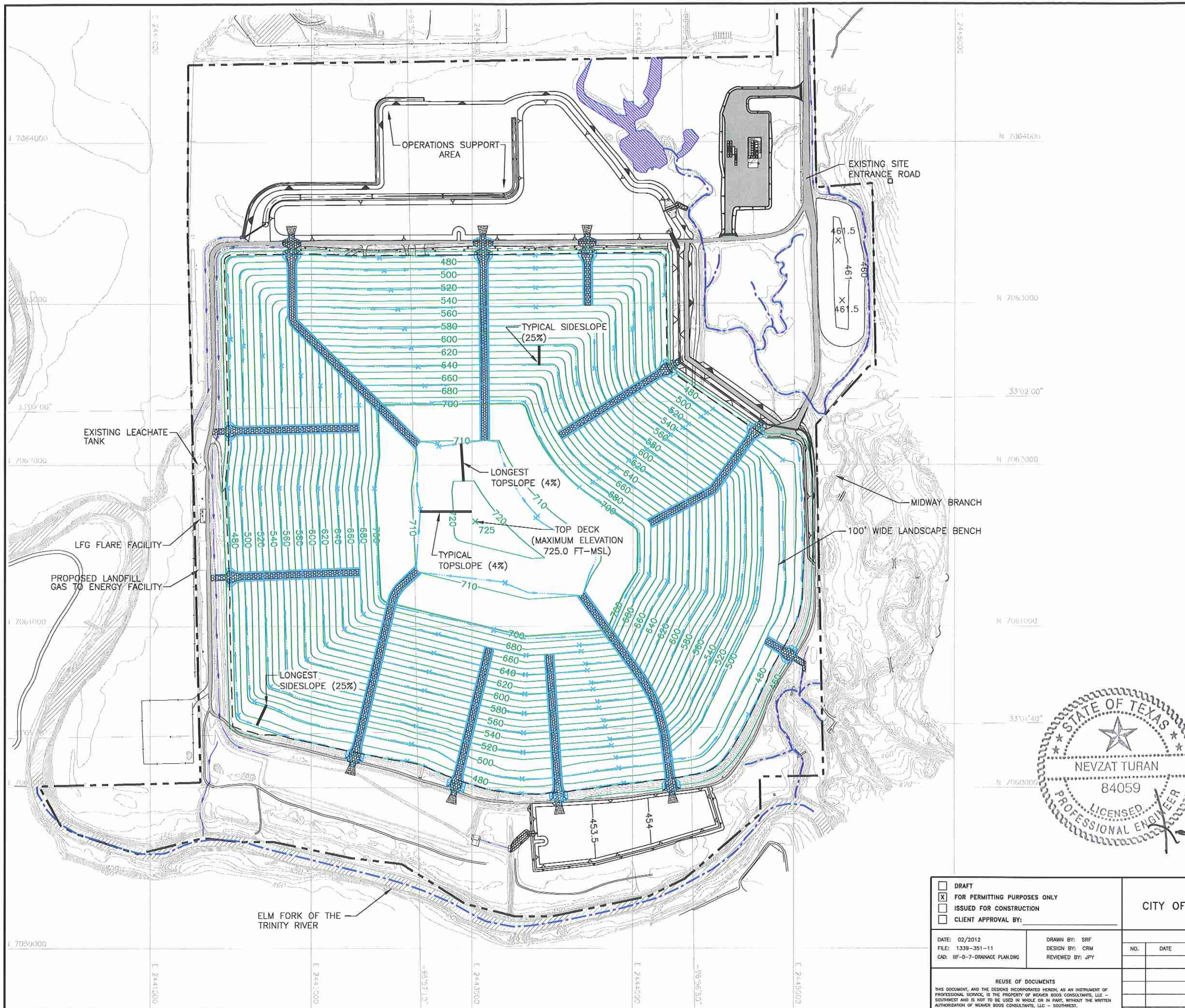
Y = 30 yr
F = 2
w = 110 pcf

1. Typical Top Slope Thickness:			
	T_{el}, Required thickness[1] =	6.199	in
	Total estimated soil loss =	0.099	in
	Specified thickness =	24.000	in
2. Longest Top Slope Thickness:			
	T_{el}, Required thickness[1] =	6.207	in
	Total estimated soil loss =	0.107	in
	Specified thickness =	24.000	in
3. Typical Sideslope Thickness:			
	T_{el}, Required thickness[1] =	6.955	in
	Total estimated soil loss =	0.855	in
	Specified thickness =	24.000	in
4. Longest Sideslope Thickness:			
	T_{el}, Required thickness[1] =	6.968	in
	Total estimated soil loss =	0.868	in
	Specified thickness =	24.000	in

Note: [1]Required thicknesses include 6.1 inch minimum required and estimated soil loss.

4. Summary:

Calculated erosion losses are shown in Step 2 above.
The erosion layer will be a minimum of 24 inches thick.
As shown above, this is a conservative design considering
the maximum expected soil loss for a 30 year period is 0.900 inches.



SCALE IN FEET: 0 300 600

N

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- N 7064000 — STATE PLANE COORDINATE SYSTEM
- 33°20'00" — GEODETIC COORDINATE SYSTEM
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- 600 — REGRADED BUFFER ZONE AREA
- 600 — PROPOSED FINAL COVER CONTOUR
- PROPOSED LETDOWN STRUCTURE
- DRAINAGE SWALE
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 4)
- USACE JURISDICTIONAL WETLANDS

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.
3. MAXIMUM FINAL COVER ELEVATION IS 725 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 721.5 FT-MSL.
4. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.

STATE OF TEXAS
NEVZAT TURAN
84059
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PROFESSIONAL ENGINEER

2-28-12

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- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY:

PREPARED FOR
CITY OF FARMERS BRANCH

MAJOR PERMIT AMENDMENT
DRAINAGE STRUCTURE PLAN

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

DATE: 02/2012	DRAWN BY: SRF
FILE: 1339-351-11	DESIGN BY: CRM
CAD: IIIF-D-7-DRAINAGE PLAN.DWG	REVIEWED BY: JPY

REVISIONS

NO.	DATE	DESCRIPTION

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SHEET IIIF-D-7

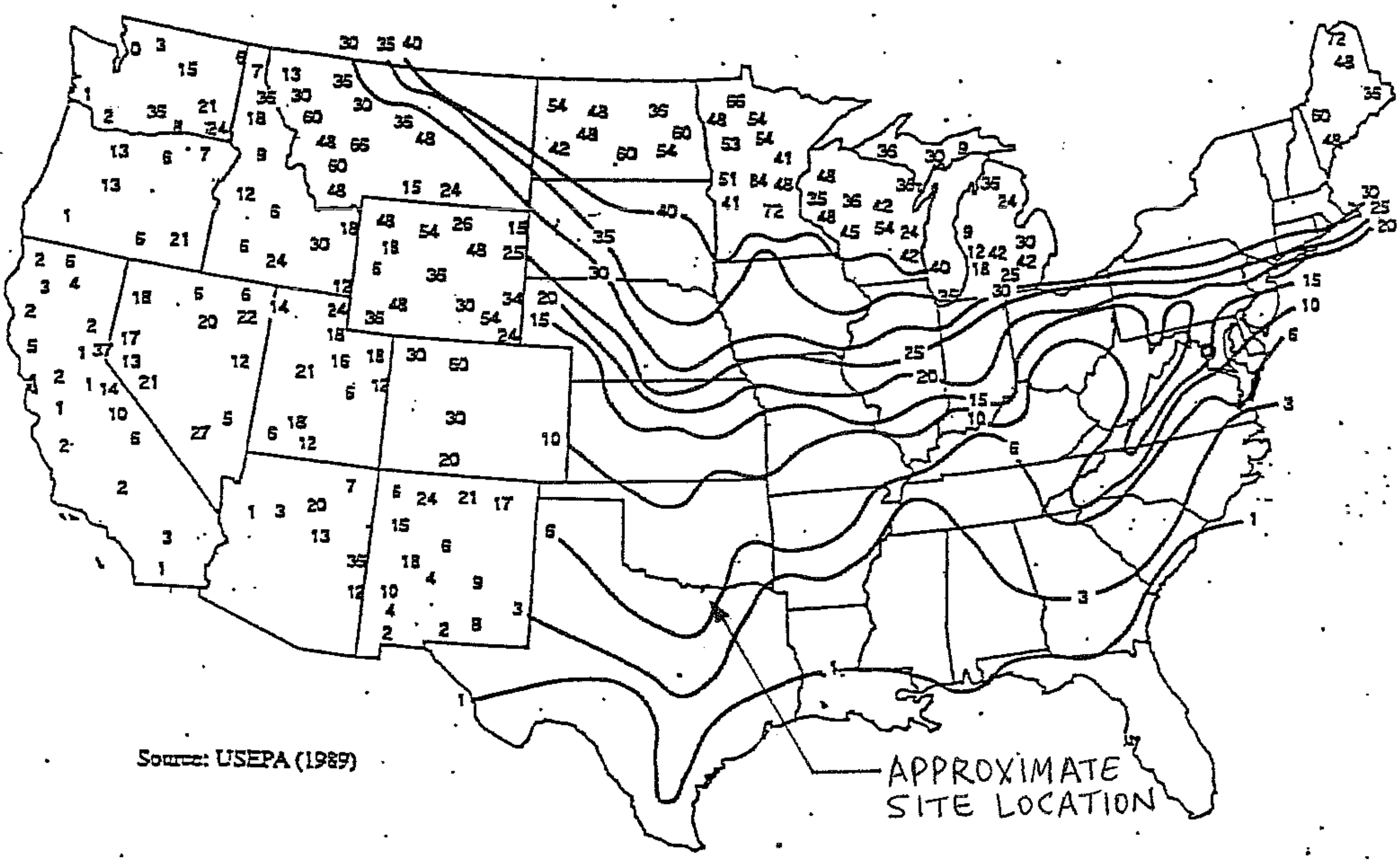
O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-D\IIIF-D-7 DRAINAGE STRUCTURE PLAN.dwg, jwilson, 1:2

EPA

Solid Waste Disposal Facility Criteria

Technical Manual

Printed on Recycled Paper



Source: USEPA (1989)

Figure 6-4
Regional Depth of Frost Penetration in Inches

Map Unit Legend

Denton County, Texas (TX121)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
3	Altoga silty clay, 5 to 8 percent slopes	77.8	3.6%
4	Altoga silty clay, 5 to 12 percent slopes, eroded	68.7	3.2%
5	Aquilla loamy fine sand, 2 to 5 percent slopes	37.7	1.7%
6	Arents, gently undulating	36.7	1.7%
7	Arents, hilly	102.5	4.7%
9	Bastsil fine sandy loam, 1 to 3 percent slopes	35.8	1.6%
10	Bastsil fine sandy loam, 3 to 5 percent slopes	32.7	1.5%
21	Burleson clay, 0 to 1 percent slopes	61.0	2.8%
22	Burleson clay, 1 to 3 percent slopes	80.7	3.7%
27	Crockett fine sandy loam, 1 to 3 percent slopes	79.8	3.7%
32	Ferris-Heiden clay, 5 to 15 percent slopes	66.5	3.1%
33	Frio silty clay, occasionally flooded	391.4	18.0%
44	Houston Black clay, 1 to 3 percent slopes	3.7	0.2%
53	Lewisville clay loam, 3 to 5 percent slopes	23.5	1.1%
63	Ovan clay, occasionally flooded	590.5	27.2%
70	Seagoville clay, occasionally flooded	54.2	2.5%
72	Silstid loamy fine sand, 1 to 5 percent slopes	0.8	0.0%
78	Trinity clay, occasionally flooded	307.4	14.1%
81	Vertel clay, 3 to 5 percent slopes	3.4	0.2%
83	Wilson clay loam, 0 to 1 percent slopes	33.0	1.5%
84	Wilson clay loam, 1 to 3 percent slopes	1.8	0.1%
W	Water	83.8	3.9%
Totals for Area of Interest		**2,173.6**	**100.0%**

Soil Map—Denton County, Texas
(CAMELOT LANDFILL)

STATE OF TEXAS
NEVZAT TURAN
84059
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2-28-12

IIIF-D-11

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

USE OF THE UNIVERSAL SOIL LOSS EQUATION IN FINAL COVER/CONFIGURATION DESIGN

PROCEDURAL HANDBOOK

PERMITS SECTION
MUNICIPAL SOLID WASTE DIVISION

OCTOBER 1993

Table 1 Approximate Values of Factor K for USDA Textural Classes

Texture Class	Organic Matter Content		
	<0.5%	2%	4%
	K	K	K
Sand	0.05	0.03	0.02
Fine Sand	0.16	0.14	0.10
Very Fine Sand	0.42	0.36	0.28
Loamy Sand	0.12	0.10	0.08
Loamy Fine Sand	0.24	0.20	0.16
Loamy Very Fine Sand	0.44	0.38	0.30
Sandy Loam	0.27	0.24	0.19
Fine Sandy Loam	0.35	0.30	0.24
Very Fine Sandy Loam	0.47	0.41	0.33
Loam	0.38	0.32	0.29
Silt Loam	0.48	0.42	0.33
Silt	0.60	0.52	0.42
Sandy Clay Loam	0.27	0.25	0.21
Clay Loam	0.28	0.25	0.21
Silty Clay Loam	0.37	0.32	0.26
Sandy Clay	0.14	0.13	0.12
Silty Clay	0.25	0.23	0.19
Clay	0.13 - 0.29 K = 0.25		

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

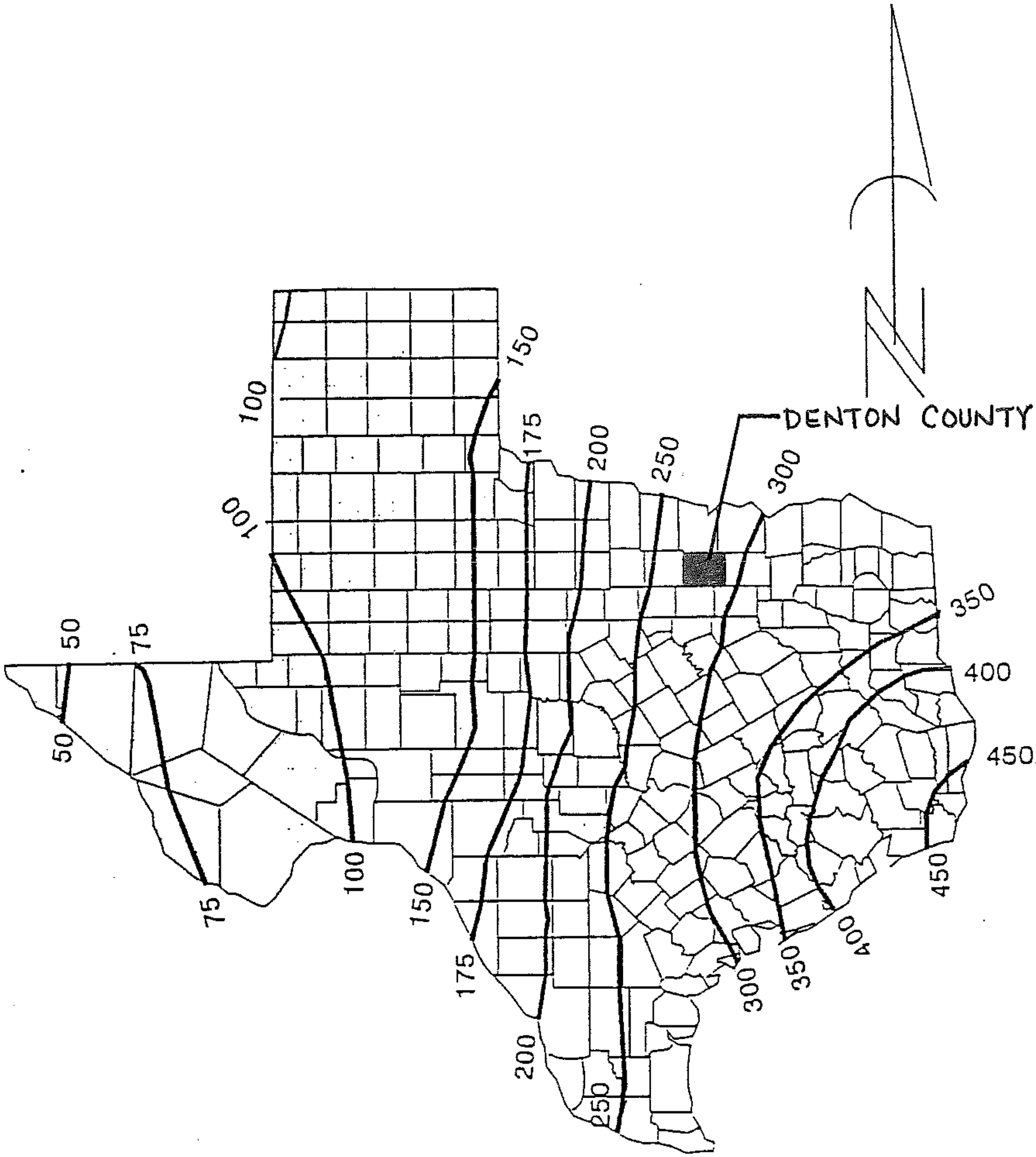

FIGURE 1. - AVERAGE ANNUAL VALUES OF THE RAINFALL EROSION INDEX

Table 2 Factor C for permanent pasture, range, and idle land[1]

Vegetative Canopy		Cover that contacts the soil surface					
Type and height[2]	Percent cover[3]	Percent ground cover					
		0	20	40	60	80	95+
No Appreciable Canopy		0.45	0.20	0.10	0.042	0.013	0.003
Tall weeds or short brush with average drop fall height of 20 in.	25	0.36	0.17	0.09	0.038	0.013	0.011
	50	0.26	0.13	0.07	0.035	0.012	0.003
	75	0.17	0.10	0.06	0.032	0.011	0.003

Extracted from:
United States Department of Agriculture, AGRICULTURE HANDBOOK NUMBER 537

[1] The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.

[2] Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

[3] Portions of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

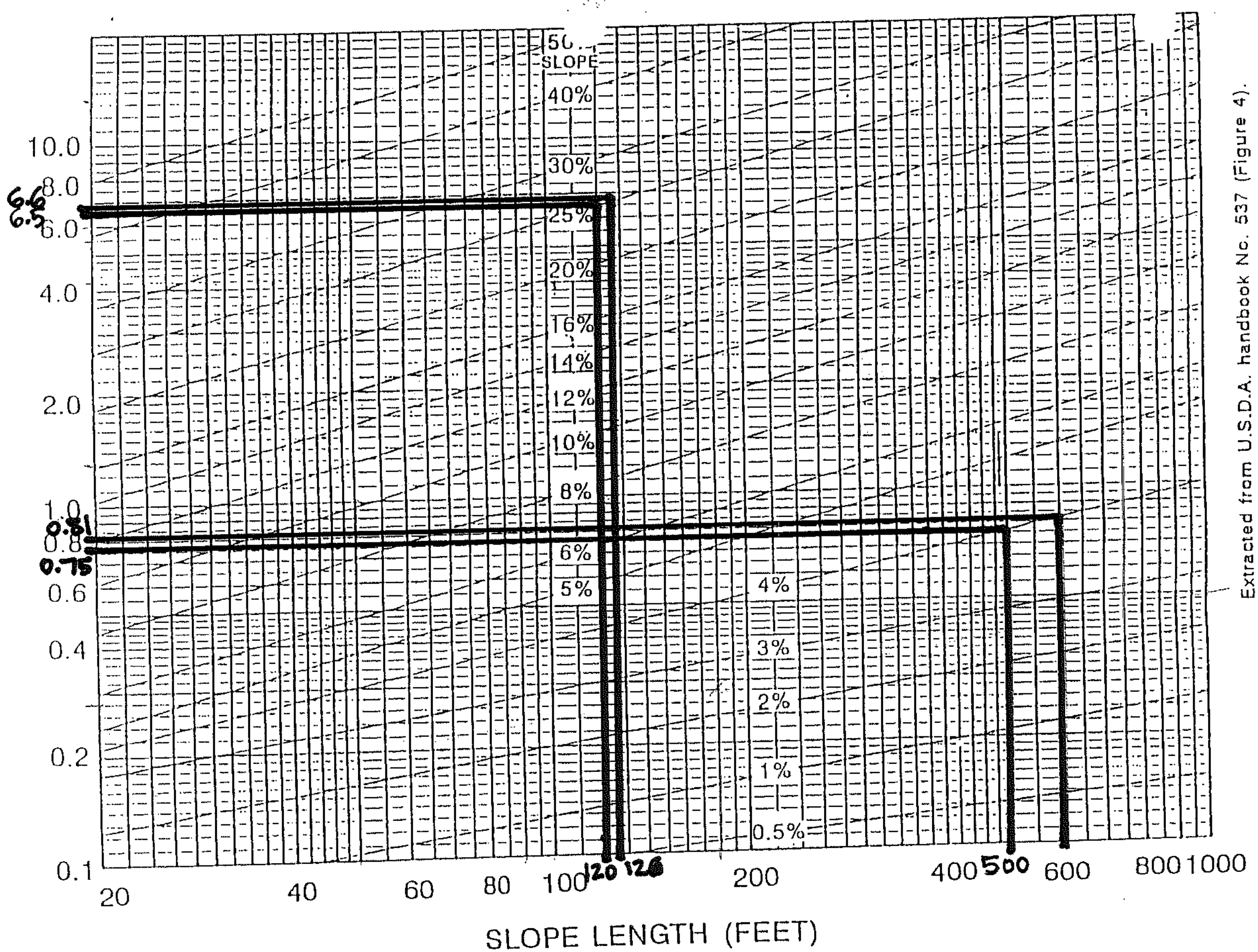

FIGURE 2.- Slope effect chart (topographic factor, LS). LS = (λ/72.6)‴ 65.41 sin² ()=4.56 sin ()+ 0.065) whereλ= slope lenght in feet ;()=angle of slope; and m = 0.2 for gradients <1 percent, 0.3 for 1 to 3 slopes; 0.4 for 3.5 to 4.5 percent slopes, and 0.5 for slopes of 5 percent or steeper.

Required: Determine the sheet flow velocity for the final cover system design and compare to the permissible non-erodible flow velocity.

Method:
1. Determine the flow using the Rational Method.
2. Calculate flow depth using Kinematic Wave procedures.
3. Compute flow velocity and compare to permissible non-erodibility velocity.

References:
1. Raudkivi, A.J., *Hydrology - An Advanced Introduction to Hydrological Processes and Modeling*, 1979.
2. Texas Department of Transportation, *Bridge Division Hydraulic Manual*, April 2002.
3. United States Soil Conservation Service, *TR-55 Hydrology for Small Watersheds*, December 1989.

Solution: Use the typical case scenarios from the USLE calculation to determine the expected sheet flow velocity.

Case 1. Typical top slope
slope = 0.04 ft/ft
length = 500 ft

Case 2. Longest top slope
slope = 0.04 ft/ft
length = 600 ft

Case 3. Typical side slope
slope = 0.25 ft/ft
length = 120 ft

Case 4. Longest side slope
slope = 0.25 ft/ft
length = 126 ft

Time of Concentration:

$$t_c = \frac{0.007(nL)^{0.8}}{(P_{2,24})^{0.5} S^{0.4}}$$

Where:
t_c = time of concentration (hr)
n = Manning's roughness coefficient
L = slope length
$P_{2,24}$ = 2-year, 24-hour rainfall depth (in)
S = slope (ft/ft)

United States
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Soil
Conservation
Service

Engineering
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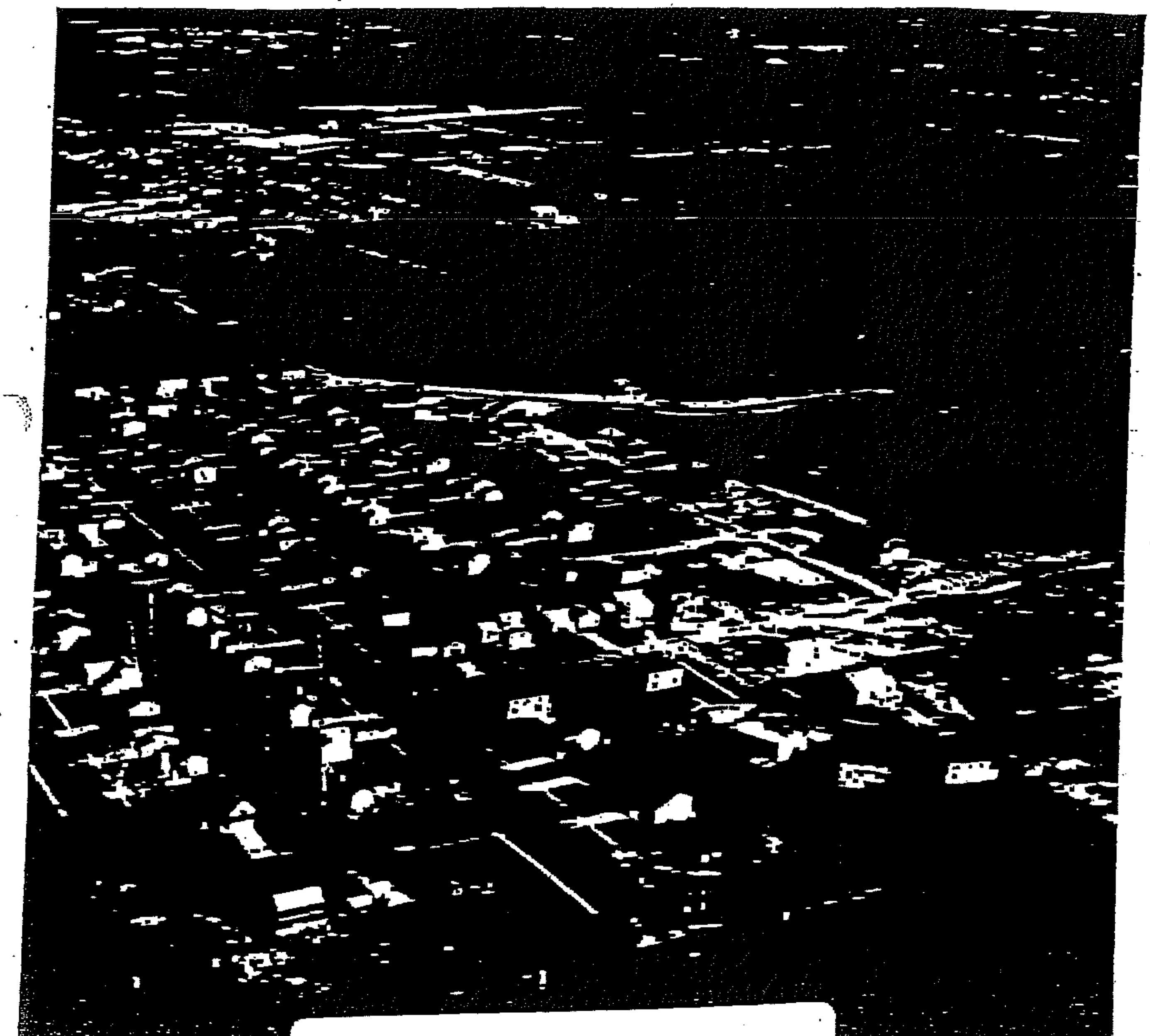
Technical
Release 55

June 1986

Urban Hydrology for Small Watersheds



Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

Factors affecting time of concentration and travel time

Surface roughness

One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development: the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns

In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope

Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time and time of concentration

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600\ V} \qquad \text{[Eq. 3-1]}$$

where

T_t = travel time (hr),
L = flow length (ft),
V = average velocity (ft/s), and
3600 = conversion factor from seconds to hours.

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t_1} + T_{t_2} + \dots T_{t_m} \qquad \text{[Eq. 3-2]}$$

where

T_c = time of concentration (hr) and
m = number of flow segments.

Determine $P_{2,24}$:

$$i = \frac{b}{(t_c + d)^e}$$

Where:	i =	rainfall intensity (in/hr)		
	b =	constant for Denton County	=	90
	d =	constant for Denton County	=	8.5
	e =	constant for Denton County	=	0.781
	t_d =	storm duration (min)	=	1440

i = 0.31 in/hr

$P_{2,24}$ = 7.34 in (Ref 2.)

Calculate t_c:

Case 1:

n =	0.24	
L =	500	
$P_{2,24}$ =	7.3	
S =	0.04	
t_c =	0.43	hr
	25.88	min

Case 2:

n =	0.24	
L =	600	
$P_{2,24}$ =	7.3	
S =	0.04	
t_c =	0.50	hr
	29.94	min

Case 3:

n =	0.24	
L =	120	
$P_{2,24}$ =	7.3	
S =	0.25	
t_c =	0.07	hr
	3.97	min

Case 4:

n =	0.24	
L =	126	
$P_{2,24}$ =	7.3	
S =	0.25	
t_c =	0.07	hr
	4.13	min

Insert TR-55 reference page 3

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}} \qquad \text{[Eq. 3-3]}$$

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1]The n values are a composite of information compiled by Engman (1986).

[2]Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

[3]When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1),
L = flow length (ft),
P_2 = 2-year, 24-hour rainfall (in), and
s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

METRIC UNITS: e is in inches, b is unitless, and d is in minutes

County name	2-year e	2-year b	2-year d	5-year e	5-year b	5-year d	10-year e	10-year b	10-year d	25-year e	25-year b	25-year d	50-year e	50-year b	50-year d	100-year e	100-year b	100-year d
Dawson	0.820	1118	10.0	0.818	1499	10.4	0.814	1727	10.4	0.807	1956	10.4	0.801	2184	10.4	0.798	2362	10.0
De Witt	0.810	1651	8.9	0.785	1905	8.7	0.758	1981	8.7	0.758	2286	8.7	0.747	2438	8.7	0.739	2591	8.9
Deaf Smith	0.847	1219	10.7	0.844	1524	9.3	0.794	1549	9.3	0.831	2083	9.3	0.837	2388	9.3	0.830	2718	10.7
Delta	0.788	1372	8.2	0.783	1727	9.1	0.775	1956	9.1	0.770	2261	9.1	0.759	2388	9.1	0.753	2540	8.2
Denton	0.769	1295	8.0	0.777	1651	8.5	0.779	1956	8.5	0.781	2286	8.5	0.780	2591	8.5	0.769	2718	8.0
Dickens	0.810	1143	9.4	0.807	1549	10.0	0.803	1803	10.0	0.808	2159	10.0	0.808	2438	10.0	0.809	2769	9.4
Dimmit	0.830	1524	9.6	0.806	1880	9.4	0.795	2083	9.4	0.783	2388	9.4	0.781	2667	9.4	0.779	2870	9.6
Donley	0.839	1321	11.0	0.832	1727	10.6	0.825	2007	10.6	0.836	2438	10.6	0.823	2616	10.6	0.845	3277	11.0
Duval	0.826	1778	8.8	0.802	2007	9.2	0.781	2134	9.2	0.772	2388	9.2	0.755	2489	9.2	0.750	2642	8.8
Eastland	0.780	1143	8.0	0.772	1473	7.8	0.771	1753	7.8	0.772	2057	7.8	0.775	2337	7.8	0.770	2565	8.0
Ector	0.812	991	9.5	0.821	1422	10.5	0.816	1651	10.5	0.789	1727	10.5	0.802	2083	10.5	0.800	2261	9.5
Edwards	0.790	1118	8.2	0.759	1372	7.5	0.759	1600	7.5	0.769	1930	7.5	0.776	2235	7.5	0.772	2540	8.2
El Paso	0.797	610	9.5	0.802	864	12.0	0.795	1067	12.0	0.843	1524	12.0	0.900	2286	12.0	0.825	1651	9.5
Ellis	0.798	1422	8.4	0.788	1803	8.8	0.777	2007	8.8	0.771	2311	8.8	0.766	2489	8.8	0.760	2667	8.4
Erath	0.780	1194	7.7	0.772	1549	8.1	0.770	1829	8.1	0.785	2261	8.1	0.772	2438	8.1	0.765	2616	7.7
Falls	0.801	1524	8.0	0.786	1829	8.5	0.771	2007	8.5	0.772	2362	8.5	0.750	2388	8.5	0.748	2591	8.0
Fannin	0.790	1372	8.3	0.778	1676	9.1	0.782	2007	9.1	0.782	2362	9.1	0.779	2515	9.1	0.762	2616	8.3
Fayette	0.805	1651	8.3	0.782	1854	8.2	0.758	1930	8.2	0.758	2235	8.2	0.743	2388	8.2	0.740	2540	8.3
Fisher	0.786	1041	8.6	0.779	1397	9.5	0.793	1778	9.5	0.790	2108	9.5	0.798	2438	9.5	0.788	2591	8.6
Floyd	0.829	1219	10.1	0.821	1600	10.0	0.890	1803	10.0	0.818	2159	10.0	0.813	2464	10.0	0.822	2794	10.1
Foard	0.810	1219	9.8	0.787	1524	9.5	0.806	1956	9.5	0.807	2311	9.5	0.817	2769	9.5	0.806	2946	9.8
Fort Bend	0.804	1778	7.9	0.760	1803	8.1	0.751	2032	8.1	0.729	2134	8.1	0.726	2311	8.1	0.710	2337	7.9
Franklin	0.780	1346	8.1	0.782	1753	8.8	0.765	1880	8.8	0.759	2134	8.8	0.751	2261	8.8	0.745	2413	8.1
Freestone	0.803	1575	8.5	0.795	1956	9.0	0.769	2032	9.0	0.775	2413	9.0	0.749	2388	9.0	0.745	2540	8.5
Frio	0.814	1549	9.3	0.789	1803	9.1	0.789	2083	9.1	0.772	2261	9.1	0.765	2438	9.1	0.769	2794	9.3
Gaines	0.820	1067	10.0	0.832	1473	10.0	0.805	1600	10.0	0.797	1778	10.0	0.807	2134	10.0	0.813	2413	10.0
Galveston	0.787	1702	7.8	0.739	1676	7.6	0.742	1981	7.6	0.727	2159	7.6	0.704	2235	7.6	0.690	2159	7.8
Garza	0.812	1118	9.4	0.811	1524	10.2	0.800	1702	10.2	0.810	2108	10.2	0.799	2235	10.2	0.800	2540	9.4
Gillespie	0.787	1245	8.5	0.766	1524	8.1	0.767	1803	8.1	0.765	2083	8.1	0.764	2388	8.1	0.765	2642	8.5
Glasscock	0.801	1016	9.1	0.796	1397	10.0	0.803	1676	10.0	0.789	1880	10.0	0.789	2108	10.0	0.784	2337	9.1
Goliad	0.812	1651	9.1	0.789	1905	8.7	0.758	1956	8.7	0.755	2261	8.7	0.746	2464	8.7	0.738	2565	9.1
Gonzales	0.801	1549	8.4	0.788	1880	8.6	0.763	1956	8.6	0.760	2261	8.6	0.747	2413	8.6	0.745	2642	8.4
Gray	0.845	1372	10.8	0.837	1778	10.8	0.836	2108	10.8	0.842	2515	10.8	0.841	2896	10.8	0.846	3175	10.8
Grayson	0.790	1321	8.3	0.778	1651	8.9	0.779	1981	8.9	0.790	2413	8.9	0.781	2642	8.9	0.769	2743	8.3
Gregg	0.783	1422	8.1	0.783	1803	8.6	0.750	1829	8.6	0.753	2134	8.6	0.740	2210	8.6	0.737	2388	8.1
Grimes	0.808	1727	8.0	0.784	1905	8.3	0.760	2057	8.3	0.744	2210	8.3	0.742	2413	8.3	0.721	2388	8.0
Guadalupe	0.796	1473	8.4	0.787	1829	8.7	0.772	1981	8.7	0.765	2261	8.7	0.750	2362	8.7	0.754	2667	8.4
Hale	0.834	1219	10.3	0.827	1549	9.9	0.815	1753	9.9	0.823	2134	9.9	0.812	2337	9.9	0.817	2642	10.3
Hall	0.829	1270	10.4	0.821	1676	10.3	0.815	1905	10.3	0.822	2337	10.3	0.819	2616	10.3	0.830	3200	10.4
Hamilton	0.779	1219	7.3	0.770	1575	8.3	0.761	1829	8.3	0.776	2261	8.3	0.766	2413	8.3	0.761	2616	7.3
Hansford	0.865	1448	10.4	0.846	1854	11.3	0.842	2134	11.3	0.862	2642	11.3	0.867	3150	11.3	0.839	2946	10.4
Hardeman	0.815	1245	10.0	0.794	1549	9.5	0.810	1981	9.5	0.816	2413	9.5	0.817	2794	9.5	0.810	3048	10.0
Hardin	0.788	1727	8.4	0.738	1651	7.5	0.740	1880	7.5	0.720	2032	7.5	0.718	2210	7.5	0.700	2210	8.4
Harris	0.800	1727	7.9	0.749	1778	7.7	0.753	2057	7.7	0.724	2057	7.7	0.728	2311	7.7	0.706	2311	7.9
Harrison	0.771	1346	8.0	0.773	1753	8.4	0.750	1778	8.4	0.747	2032	8.4	0.730	2083	8.4	0.732	2286	8.0
Hartley	0.858	1295	10.8	0.855	1702	10.2	0.814	1702	10.2	0.840	2159	10.2	0.863	2692	10.2	0.832	2718	10.8
Haskell	0.790	1143	8.9	0.779	1448	9.2	0.799	1880	9.2	0.787	2159	9.2	0.805	2616	9.2	0.788	2692	8.9
Hays	0.796	1422	8.2	0.783	1753	8.6	0.776	1981	8.6	0.765	2210	8.6	0.747	2286	8.6	0.755	2642	8.2
Hemphill	0.845	1422	10.6	0.851	1930	10.7	0.842	2210	10.7	0.843	2616	10.7	0.840	2921	10.7	0.847	3353	10.6
Henderson	0.800	1524	8.7	0.796	1956	9.0	0.770	2007	9.0	0.773	2362	9.0	0.752	2362	9.0	0.749	2591	8.7
Hidalgo	0.831	1880	9.6	0.795	2032	9.2	0.778	2210	9.2	0.771	2489	9.2	0.749	2515	9.2	0.740	2616	9.6
Hill	0.799	1448	8.2	0.790	1829	8.8	0.777	1981	8.8	0.773	2311	8.8	0.764	2489	8.8	0.759	2667	8.2
Hockley	0.832	1168	9.9	0.832	1524	10.0	0.807	1626	10.0	0.812	1981	10.0	0.810	2210	10.0	0.817	2565	9.9
Hood	0.782	1219	7.7	0.773	1600	8.3	0.773	1905	8.3	0.782	2286	8.3	0.773	2489	8.3	0.766	2667	7.7
Hopkins	0.786	1372	8.3	0.783	1778	9.1	0.775	1956	9.1	0.767	2235	9.1	0.754	2362	9.1	0.750	2540	8.3
Houston	0.797	1600	8.2	0.780	1854	8.3	0.757	1981	8.3	0.748	2184	8.3	0.740	2362	8.3	0.727	2388	8.2
Howard	0.805	1067	9.2	0.800	1422	10.1	0.802	1651	10.1	0.796	1930	10.1	0.791	2184	10.1	0.768	2413	9.2
Hudspeth	0.800	686	9.4	0.840	1118	11.4	0.827	1270	11.4	0.819	1524	11.4	0.856	1981	11.4	0.833	1956	9.4
Hunt	0.793	1397	8.4	0.785	1753	9.2	0.783	2032	9.2	0.776	2362	9.2	0.764	2515	9.2	0.758	2642	8.4
Hutchinson	0.860	1422	10.4	0.844	1778	11.0	0.837	2032	11.0	0.851	2540	11.0	0.863	3073	11.0	0.837	2921	10.4

CAMELOT LANDFILL
1339-351-11-02
SHEET FLOW VELOCITY

Calculate the design 25-year frequency for each condition:

$Q = CiA$

Where:
Q = flow rate (cfs)
C = runoff coefficient
i = rainfall intensity (in/hr)
A = drainage area (ac)

$i = b/(t_c+d)^e$

Where:
i = rainfall intensity (in/hr)
b = constant for Denton County = 90
d = constant for Denton County = 8.5
e = constant for Denton County = 0.781
t_c = time of concentration (min)

For a unit width of final cover, the flow lengths shown on sheet IIIF-D-7 for each case is used.

A=[Length (ft) x Width (ft)] / 43560 = acres

Case 1:

C =	0.7	
t_c =	25.88	min
i =	5.68	in/hr
Length:	500.00	ft
A	0.0115	ac
Q =	**0.046**	**cfs**

Case 2:

C =	0.7	
t_c =	29.94	min
i =	5.21	in/hr
Length:	600.00	ft
A	0.0138	ac
Q =	**0.050**	**cfs**

Case 3:

C =	0.7	
t_c =	3.97	min
i =	12.54	in/hr
Length:	120.00	ft
A	0.0028	ac
Q =	**0.024**	**cfs**

Case 4:

C =	0.7	
t_c =	4.13	min
i =	12.42	in/hr
Length:	126.00	ft
A	0.0029	ac
Q =	**0.025**	**cfs**

Approximate depth of flow:

Using Manning's Equation

$V = 1.49/n\ y^{0.67}\ S^{0.5}$

$Q = VA \quad \Rightarrow \quad V = Q/A$

$A = y \times 1$ (assuming unit width of flow)

substituting for V

$Q/y = 1.49/n\ y^{0.67}\ S^{0.5}$

$Q = 1.49/n\ y^{1.67}\ S^{0.5}$

solve for y

$y = (Qn/1.49\ S^{0.5})^{1/1.67}$

$y = (Qn/1.49S^{0.5})^{0.6}$

Case 1:

Q =	0.046	cfs
n =	0.24	
S =	0.04	ft/ft
y =	0.138	ft

Case 2:

Q =	0.050	cfs
n =	0.24	
S =	0.04	ft/ft
y =	0.146	ft

Case 3:

Q =	0.024	cfs
n =	0.24	
S =	0.25	ft/ft
y =	0.054	ft

Case 4:

Q =	0.025	cfs
n =	0.24	
S =	0.25	ft/ft
y =	0.056	ft

Determine sheet flow velocity:

V = Q/A (assume unit flow width for the flow area, A)

Case 1:

Q =	0.046	cfs
A =	0.138	sf
V =	0.33	ft/s

Case 2:

Q =	0.050	cfs
A =	0.146	sf
V =	0.34	ft/s

Case 3:

Q =	0.024	cfs
A =	0.054	sf
V =	0.45	ft/s

Case 4:

Q =	0.025	cfs
A =	0.056	sf
V =	0.45	ft/s

Permissible non-erodible velocity is 5.0 ft/s. Therefore, expected sheet flow velocity is acceptable on the final cover system top and side slopes.

Texas Department of Transportation

STANDARD SPECIFICATIONS FOR CONSTRUCTION AND MAINTENANCE OF HIGHWAYS, STREETS, AND BRIDGES

Adopted by the
Texas Department of Transportation

June 1, 2004

Add or reshape the mulch sod to meet the requirements of Section 162.3.B, "Finishing."

B. **Finishing.** Smooth and shape the area after planting to conform to the desired cross sections. Spread any excess soil uniformly over adjacent areas or dispose of the excess soil as directed.

C. **Straw or Hay Mulch.** Apply straw or hay mulch for "Spot Sodding" and "Mulch Sodding" uniformly over the area as shown on the plans. Apply straw mulch at 2 to 2-1/2 tons per acre. Apply hay mulch at 1-1/2 to 2 tons per acre. Use a tacking method over the mulched area.

162.4. Measurement. "Spot Sodding," "Block Sodding," and "Straw or Hay Mulch" will be measured by the square yard in its final position. "Mulch Sodding" will be measured by the square yard in its final position or by the cubic yard in vehicles as delivered to the planting site.

162.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Spot Sodding," "Block Sodding," "Straw or Hay Mulch," or "Mulch Sodding." This price is full compensation for securing a source, excavation, loading, hauling, placing, rolling, finishing, furnishing materials, equipment, labor, tools, supplies, and incidentals. Fertilizer will not be paid for directly but will be subsidiary to this Item.

Unless otherwise specified on the plans, water, except for that used for maintaining and preparing the sod before planting, will be measured and paid for in accordance with Item 168, "Vegetative Watering."

ITEM 164

SEEDING FOR EROSION CONTROL

164.1. Description. Provide and install temporary or permanent seeding for erosion control as shown on the plans or as directed.

164.2. Materials.

A. **Seed.** Provide seed from the previous season's crop meeting the requirements of the Texas Seed Law, including the testing and labeling for pure live seed (PLS = Purity x Germination). Furnish seed of the designated species, in labeled unopened bags or containers to the Engineer before planting. Use within 12 mo. From the date of the analysis. When Buffalograss is specified, use seed that is treated with KNO_3 (potassium nitrate) to overcome dormancy.

Use Tables 1 through 4 to determine the appropriate seed mix and rates as specified on the plans.

Table 1
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils: Species and Rates (lb. PLS/ac.)		Sandy Soils: Species and Rates (lb. PLS/ac.)	
1 (Paris) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.2	Bermudagrass	1.5
	Bermudagrass	1.8	Bahiagrass (Pensacola)	6.0
	Little Bluestem (Native)	1.7	Sand Lovegrass	0.6
	Illinois Bundleflower	1.0	Weeping Lovegrass (Ermelo)	0.8
			Partridge Pea	1.0
2 (Ft. Worth) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Sand Lovegrass	0.5
	Bermudagrass	0.9	Bermudagrass	1.8
	Little Bluestem (Native)	1.0	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Partridge Pearl	1.0
3 (Wichita Falls) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Bermudagrass	1.2
	Bermudagrass	0.9	Sand Dropseed	0.4
	Buffalograss (Texoka)	1.6	Sand Bluestem	2.4
	Western Wheatgrass	2.1	Sand Lovegrass	0.3
	Blue Grama (Hachita)	0.6	Weeping Lovegrass (Ermelo)	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
4 (Amarillo) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairieclover	0.5
5 (Lubbock) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
6 (Odessa) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.3	Blue Grama	0.8
	Blue Grama (Hachita)	0.8	Sand Dropseed	0.4
	Alkali Sacaton	0.4	Weeping Lovegrass (Ermelo)	0.6
	Galleta	2.1	Indian Ricegrass	3.0
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
7 (San Angelo) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Sideoats Grama (Haskell)	2.7
	Buffalograss (Texoka)	1.6	Weeping Lovegrass (Ermelo)	0.6
	Little Bluestem (Native)	1.7	Sand Dropseed	0.4
	Blue Grama (Hachita)	0.9	Purple Prairieclover	0.5
	Galleta	1.6		
	Illinois Bundleflower	1.0		
8 (Abilene) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Sand Bluestem	3.0
	Blue Grama (Hachita)	0.9	Weeping Lovegrass (Ermelo)	1.2
	Galleta	1.6	Sand Dropseed	0.5
	Buffalograss (Texoka)	1.6	Purple Prairieclover	0.5
	Little Bluestem (Native)	1.7		
	Illinois Bundleflower	1.0		
9 (Waco) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	2.4
	Sideoats Grama (Haskell)	3.6	Sand Dropseed	0.5
	Little Bluestem (Native)	2.0	Weeping Lovegrass (Ermelo)	0.8
	Illinois Bundleflower	1.0	Partridge Pea	1.0
10 (Tyler) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.8	Bermudagrass	1.8
	Bahiagrass (Pensacola)	9.0	Bahiagrass (Pensacola)	9.0
	Sideoats Grama (Haskell)	2.7	Weeping Lovegrass (Ermelo)	0.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.5
			Lance-Leaf Coreopsis	1.0

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils: Species and Rates (lb. PLS/ac.)		Sandy Soils: Species and Rates (lb. PLS/ac.)	
11 (Lufkin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.8	Bermudagrass	2.1
	Bahiagrass (Pensacola)	9.0	Bahiagrass (Pensacola)	9.0
	Sideoats Grama (Haskell)	2.7	Sand Lovegrass	0.5
	Illinois Bundleflower	1.0	Lance-Leaf Coreopsis	1.0
12 (Houston) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.1	Bermudagrass	2.4
	Sideoats Grama (Haskell)	3.2	Bahiagrass (Pensacola)	10.5
	Little Bluestem (Native)	1.4	Weeping Lovegrass (Ermelo)	0.5
	Illinois Bundleflower	1.0	Lance-Leaf Coreopsis	1.0
13 (Yoakum) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Bermudagrass	1.8	Bahiagrass (Pensacola)	6.0
	Little Bluestem (Native)	1.4	Sand Lovegrass	0.6
	Illinois Bundleflower	1.0	Weeping Lovegrass (Ermelo)	0.6
			Partridge Pea	1.0
14 (Austin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	0.9	Bermudagrass	2.4
	Sideoats Grama (Haskell)	2.7	Weeping Lovegrass (Ermelo)	0.8
	Little Bluestem (Native)	1.0	Sand Lovegrass	0.8
	Blue Grama (Hachita)	0.9	Partridge Pea	1.0
	Illinois Bundleflower	1.0		
15 (San Antonio) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	1.8
	Sideoats Grama (Haskell)	2.7	Lehmanns Lovegrass	0.6
	Little Bluestem (Native)	1.4	Sand Lovegrass	0.6
	Plains Bristlegrass	1.2	Buffelgrass (Common)	0.4
	Illinois Bundleflower	1.0	Partridge Pea	1.0
16 (Corpus Christi) Jan. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Bermudagrass	1.8
	Bermudagrass	1.8	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Lovegrass	0.6
	Plains Bristlegrass	1.2	Lehmanns Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
17 (Bryan) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.5	Bermudagrass	1.5
	Sideoats Grama (Haskell)	3.6	Bahiagrass (Pensacola)	7.5
	Little Bluestem (Native)	1.7	Weeping Lovegrass (Ermelo)	0.6
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
18 (Dallas) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	1.8
	Sideoats Grama (El Reno)	2.7	Weeping Lovegrass (Ermelo)	0.6
	Little Bluestem (Native)	2.0	Sand Lovegrass	0.6
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Partridge Pea	1.0
19 (Atlanta) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.5	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
20 (Beaumont) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.7	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.1	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
21 (Pharr) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Plains Bristlegrass	1.2	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Bermudagrass	1.2	Lehmanns Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
22 (Laredo) Jan. 15 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Bermudagrass	1.2	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Plains Bristlegrass	1.2	Lehmanns Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils — Species and Rates (lb. PLS/ac.)		Sandy Soils — Species and Rates (lb. PLS/ac.)	
23 (Brownwood) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Bermudagrass	1.8
	Bermudagrass	0.6	Weeping Lovegrass (Ermelo)	0.6
	Blue Grama (Hachita)	0.9	Sand Lovegrass	0.6
	Galleta	2.1	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
24 (El Paso) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Butte)	2.7	Sand Dropseed	0.4
	Blue Grama (Hachita)	0.9	Lehmanns Lovegrass	0.9
	Galleta	2.1	Blue Grama (Hachita)	1.0
	Alkali Sacaton	0.4	Indian Ricegrass	1.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
25 (Childress) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Weeping Lovegrass (Ermelo)	1.2
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.5
	Western Wheatgrass	2.1	Sand Lovegrass	0.8
	Galleta	1.6	Purple Prairieclover	0.5
	Illinois Bundleflower	1.0		

Table 2
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
1 (Paris) Feb. 1 – May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
2 (Ft. Worth) Feb. 1 – May 15	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Buffalograss (Texoka)	0.3 3.6 2.4 1.6	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Sand Dropseed	0.3 3.6 2.1 0.3
3 (Wichita Falls) Feb. 1 – May 15	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Buffalograss (Texoka)	0.3 4.5 1.8 1.6	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Sand Dropseed	0.3 3.6 1.8 0.4
4 (Amarillo) Feb. 15 – May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Sand Dropseed Buffalograss (Texoka)	0.3 2.7 0.9 0.4 1.6
5 (Lubbock) Feb. 15 – May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Sand Dropseed Buffalograss (Texoka)	0.3 2.7 0.9 0.4 1.6
6 (Odessa) Feb. 1 – May 15	Green Sprangletop Sideoats Grama (Haskell) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sideoats Grama (Haskell) Sand Dropseed Blue Grama (Hachita) Buffalograss (Texoka)	0.3 2.7 0.4 0.9 1.6
7 (San Angelo) Feb. 1 – May 1	Green Sprangletop Sideoats Grama (Haskell) Buffalograss (Texoka)	0.3 7.2 1.6	Green Sprangletop Sideoats Grama (Haskell) Sand Dropseed Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.2 0.3 0.9 1.6

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
8 (Abilene) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Sand Dropseed	0.3
	Blue Grama (Hachita)	1.2	Sideoats Grama (Haskell)	3.6
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	0.8
			Buffalograss (Texoka)	1.6
9 (Waco) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.8	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Sideoats Grama (Haskell)	4.5	Sand Dropseed	0.4
10 (Tyler) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
11 (Lufkin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
12 (Houston) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
13 (Yoakum) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
14 (Austin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	4.8
	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
15 (San Antonio) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
16 (Corpus Christi) Jan. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
17 (Bryan) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
18 (Dallas) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed	0.4
19 (Atlanta) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
20 (Beaumont) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
21 (Pharr) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed	0.4
22 (Laredo) Jan. 15 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	4.5	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	1.8	Sand Dropseed	0.4
23 (Brownwood) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Bermudagrass	1.2	Bermudagrass	3.6
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.4
24 (El Paso) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Butte)	3.6	Buffalograss (Texoka)	1.6
	Blue Grama (Hachita)	1.2	Sand Dropseed	0.4
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	1.8
25 (Childress) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sand Dropseed	0.4
	Blue Grama (Hachita)	1.2	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	1.8

Table 3
Temporary Cool Season Seeding

Districts	Dates	Seed Mix and Rates (lb./ac.)	
Paris (1), Amarillo (4), Lubbock (5), Dallas (18)	September 1 – November 30	Tall Fescue Western Wheatgrass Wheat (Red, Winter)	4.5 5.6 34
Odessa (6), San Angelo (7), El Paso (24)	September 1 – November 30	Western Wheatgrass Wheat (Red, Winter)	8.4 50
Waco (9), Tyler (10), Lufkin (11), Austin (14), San Antonio (15), Bryan (17), Atlanta (19)	September 1 – November 30	Tall Fescue Oats Wheat	4.5 24 34
Houston (12), Yoakum (13), Corpus Christi (16), Beaumont (20), Pharr (21), Laredo (22)	September 1 – November 30	Oats	72
Ft. Worth (2), Wichita Falls (3), Abilene (8), Brownwood (23), Childress (25)	September 1 – November 30	Tall Fescue Western Wheatgrass Cereal Rye	4.5 5.6 34

Table 4
Temporary Warm Season Seeding

Districts	Dates	Seed Mix and Rates (lb./ac.)	
All	May 1 – August 31	Foxtail Millet	34

B. Fertilizer. Use fertilizer in conformance with Article 166.2, "Materials."

C. Vegetative Watering. Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

D. Mulch.

1. **Straw or Hay Mulch.** Use straw or hay mulch in conformance with Article 162.2.E, "Mulch."

2. **Cellulose Fiber Mulch.** Use only cellulose fiber mulches that are on the approved list published in "Field Performance of Erosion Control Products," available from the Maintenance Division. Submit 1 full set of manufacturer's literature for the selected material. Keep mulch dry until applied. Do not use molded or rotted material.

E. Tacking Methods. Use a tacking agent applied in accordance with the manufacturer's recommendations or a crimping method on all straw or

APPENDIX IIIF-E

PERMITTED LANDFILL CONDITION
HYDROLOGIC CALCULATIONS

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

Includes pages IIIF-E-1 through IIIF-E-120

CONTENTS

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

PERMITTED CONDITION HYDROLOGIC CALCULATIONS

Appendix IIIF-E presents the hydrologic calculations for the updated permitted conditions summarized on the Sheet IIIF-E-16 and Sheet IIIF-E-17 drawings. The following summarizes the content of this appendix:

- Precipitation data are provided on page IIIF-E-3.
- Precipitation loss information is included on pages IIIF-E-4 through IIIF-E-9.
- Hydrograph development information is presented on IIIF-E-10 through IIIF-E-19.
- A comparison between the existing permitted, updated permitted, and proposed drainage conditions is presented in Section 4 of Appendix IIIF – Drainage Design Report.
- The HEC-1 output for the 25-year storm event for the updated permitted conditions is presented on IIIF-E-20 through IIIF-E-109.

HYPOTHETICAL STORM DATA

Hypothetical Storm Data

Precipitation data taken from TP-40 and Hydro 35 rainfall data.

Time	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr
25-Year Event	0.74	1.57	3.19	4.18	4.52	5.47	6.43	7.44
100-Year Event	0.88	1.87	4.30	5.45	5.75	6.80	8.30	9.45

TP-40 (*U.S. Department of Commerce, May 1961*) was used to identify precipitation values for storm durations ranging from 60 minutes to 24 hours.

Hydro 35 (*National Oceanic and Atmospheric Administration, June 1977*) was used to estimate precipitation for the 5 minute and 15 minute duration storm events.

PRECIPITATION LOSS DATA

Required: Determine the SCS curve numbers for both on-site and off-site drainage areas for use in the HEC-1 analysis.

References:

1. Dodson's and Associates, Inc., *ProHec-1 Plus Program Documentation*, 1995.
2. United States Department of Agriculture, National Resource Conservation Service, Web Soil Survey for Hill County, Texas (http://websoilsurvey.nrcs.usda.gov).
3. The Hydrologic Evaluation of Landfill Performance (HELP) Model - Engineering Documentation for version 3. EPA/600/R-94/168b, September 1994.

Note: Approximate non landfill areas within the permit boundary on SCS map (page IIIF-A-5).

Solution: Based on the soil survey information found in Ref. 2, hydrologic group D soils predominate the soils within the permit boundary drainage area (see pages IIIF-A-5 through IIIF-A-7).

Offsite areas O3, O4, and O5 and several onsite areas (CH2, CH3, CH4, CH4A, CH5, CH6, CH7A, CH7B, CH9, CH10, CH11, N1, N12, N13, N14, N15, N16, N17, N18, N19, S1, S2, S3, S4, and S5) were considered pasture land or range in fair condition. A curve number was selected using the table on page IIIF-E-6.

Use:	CN = 84

Curve numbers for offsite areas O1, O1A, and O2 were calculated using an area-weighted average of rural and urban land uses, including pasture or range in fair condition, 1/4 acre average residential lots, and industrial districts. The calculated composite curve numbers are shown below.

Use:	CN = 87	for area O1
Use:	CN = 85	for area O1A
Use:	CN = 85	for area O2

The final cover system was assumed to be in place and the erosion layer will control precipitation loss. A curve number that is corrected for the surface slope of the erosion layer may be computed first using the chart on page IIIF-E-7 to select an un-adjusted curve numbe Calculate the adjusted curve number using equation 34 from Ref. 3 (see page IIIF-E-7).

$$CN_{II} = 100 - (100 - CN_{II\,o}) * (L^{*\,2} / S^{*}) \wedge (CN_{II\,o}^{-0.81})$$

Use:	$CN_{II\,o} = 84$, $L^{*} = (500/500)$, $S^{*} = (.02/.04)$	for top dome surfaces
Use:	$CN_{II\,o} = 84$, $L^{*} = (120/500)$, $S^{*} = (.20/.04)$	for side slopes

Calculate:	CN = 84	for top dome surfaces
Calculate:	CN = 86	for side slopes

The pond areas are assumed to collect all precipitation for their areas:

Use:	CN = 100

TABLE 5.3 Values of SCS Curve Number for Rural Areas

Source: [McCuen, 1982]

Land Use Description	Hydrologic Soil Group A	B	C	D
Fallow:				
Straight Row	77	86	91	94
Row Crops:				
Straight Row, Poor Condition	72	81	88	91
Straight Row, Good Condition	67	78	85	89
Contoured, Poor Condition	70	79	84	88
Contoured, Good Condition	65	75	82	86
Contoured and Terraced, Poor Condition	66	74	80	82
Contoured and Terraced, Good Condition	62	71	78	81
Small Grain:				
Straight Row, Poor Condition	65	76	84	88
Straight Row, Good Condition	63	75	83	87
Contoured, Poor Condition	63	74	82	85
Contoured, Good Condition	61	73	81	84
Contoured and Terraced, Poor Condition	61	72	79	82
Contoured and Terraced, Good Condition	59	70	78	81
Close-Seeded Legumes or Rotation Meadow				
Straight Row, Poor Condition	66	77	85	89
Straight Row, Good Condition	58	72	81	85
Contoured, Poor Condition	64	75	83	85
Contoured, Good Condition	55	69	78	83
Contoured and Terraced, Poor Condition	63	73	80	83
Contoured and Terraced, Good Condition	51	67	76	80
Pasture or Range:				
Poor Condition	68	79	86	89
Fair Condition	49	69	79	84
Good Condition	39	61	74	80
Contoured, Poor Condition	47	67	81	88
Contoured, Fair Condition	25	59	75	83
Contoured, Good Condition	6	35	70	79
Meadow, Good Condition	30	58	71	78
Woods or Forest Land:				
Poor Condition	45	66	77	83
Fair Condition	36	60	73	79
Good Condition	25	55	70	77
Farmsteads:	59	74	82	86

Initial and Uniform Loss Rate

An initial loss in inches (*STRTL*) and a constant loss rate (*CNSTL*) in inches per hour are specified for this method. All rainfall is lost until the volume of initial loss is satisfied. After the initial loss is satisfied, rainfall is lost at the constant rate.

This section provides guidance in selecting the values used for the initial loss and uniform loss rate in two ways:

1. By consulting previous studies of actual rainfall events for a particular watershed or region.
2. By relating the parameters to the SCS Curve Number, which can be estimated using the information presented earlier in this chapter.

Previous studies by the U.S. Army Corps of Engineers or other public agencies may provide guidance on selecting appropriate values for the initial loss and uniform loss rate for a particular location. Tables 5.4 through 5.6 list the values of initial and loam, and clayey loam as specified by saturated hydraulic conductivity, capillary drive, porosity, and maximum relative saturation. Two levels of vegetation were described--a good stand of grass (bluegrass sod) and a poor stand of grass (clipped range). Slopes of 0.04, 0.10, 0.20, 0.35, and 0.50 ft/ft and slope lengths of 50, 100, 250, and 500 ft were used. Rainfalls of 1.1 inches, 1-hour duration and 2nd quartile Huff distribution and of 3.8 inches, 6-hour duration and balanced distribution were modeled.

The resulting regression equation used for adjusting the AMC-II curve number computed for default soils and vegetation placed at mild slopes, CN_{II_o}, is:

$$CN_{II} = 100 - (100 - CN_{II_o}) \cdot \left(\frac{L^{*2}}{S^{*}} \right)^{CN_{II_o}^{-0.81}} \qquad (34)$$

where

L^* = standardized dimensionless length, (L/500 ft)

S^* = standardized dimensionless slope, (S/0.04)

This same equation is used to adjust user-specified AMC-II curve numbers for surface slope conditions by substituting the user value for CN_{II_o} in Equation 34.

4.2.4 Adjustment of Curve Number for Frozen Soil

When the HELP program predicts frozen conditions to exist, the value of CN_{II} is increased, resulting in a higher calculated runoff. Knisel et al. (1985) found that this type of curve number adjustment in the CREAMS model resulted in improved predictions of annual runoff for several test watersheds. If the CN_{II} for unfrozen soil is less than or equal to 80, the CN_{II} for frozen soil conditions is set at 95. When the unfrozen soil CN_{II} is greater than 80, the CN_{II} is reset to be 98 on days when the program has determined the soil to be frozen. This adjustment results in an increase in CN_I and consequently a decrease in S_{mx} and S' (Equations 19, 26, and 30).

From Equations 19 and 21, it is apparent that as S' approaches zero, Q approaches P. In other words, as S' decreases, the calculated runoff becomes closer to being equal to the net rainfall which is most often, when frozen soil conditions exist, predominantly snowmelt. This will result in a decrease in infiltration under frozen soil conditions, which has been observed in numerous studies.

4.2.5 Summary of Daily Runoff Computation

The HELP model determines daily runoff by the following procedure:

where

CN_{II_o} = AMC-II curve number for mild slope (unadjusted for slope)

C_o = regression constant for a given level of vegetation

C_1 = regression constant for a given level of vegetation

C_2 = regression constant for a given level of vegetation

IR = infiltration correlation parameter for given soil type

The relationship between CN_{II_o}, the vegetative cover and default soil texture is shown graphically in Figure 8. Table 7 gives values of C_o, C_1 *and* C_2 for the five types of vegetative cover built into the HELP program.

4.2.3 Adjustment of Curve Number for Surface Slope

A regression equation was developed to adjust the AMC-II curve number for surface slope conditions. The regression was developed based on kinematic wave theory where

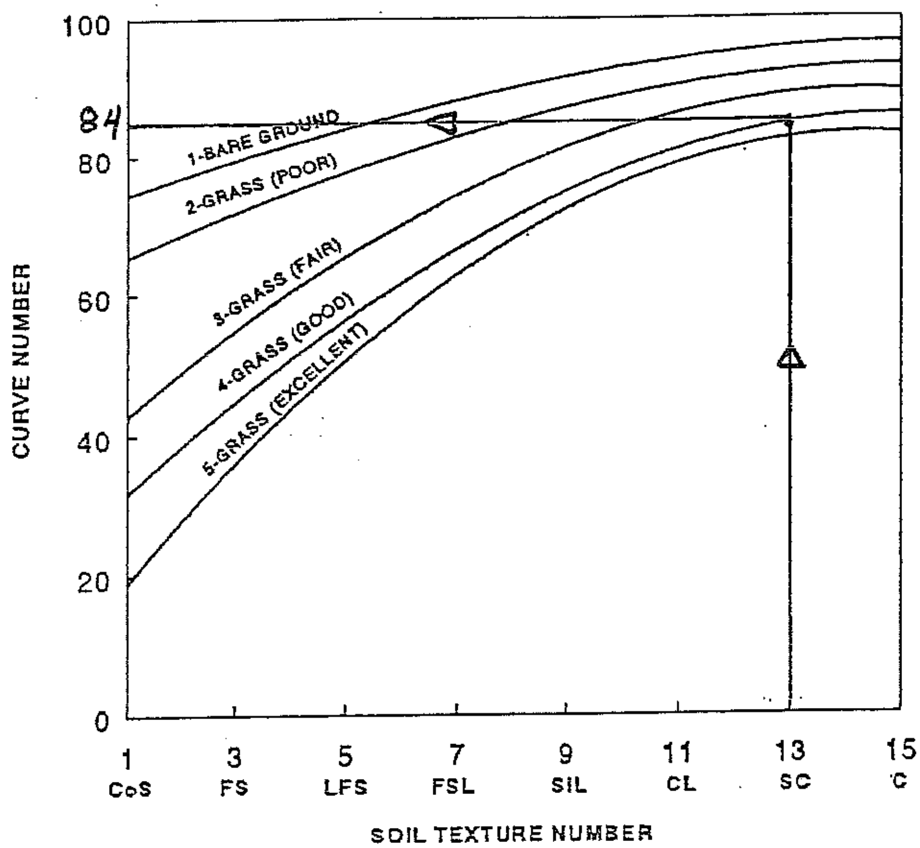


Figure 8. Relation between SCS Curve Number and Default Soil Texture Number for Various Levels of Vegetation

TABLE 7. CONSTANTS FOR USE IN EQUATION 32

Vegetative Cover	C_0	C_1	C_2
Bare Ground	96.77	-20.80	-54.94
Poor Grass	93.51	-24.85	-71.92
Fair Grass	90.09	-23.73	-158.4
Good Grass	86.72	-43.38	-151.2
Excellent Grass	83.83	-26.91	-229.4

the travel time of runoff from the top of a slope to the bottom of the slope is computed as follows:

$$t_{run} = \frac{1.5}{(i - I)^{1/3}} \left(\frac{L^2}{S}\right)^{1/3} \left(\frac{1.49}{n}\right)^{-2/3} \tag{33}$$

where

t_{run} = runoff travel time (time of concentration), minutes

i = steady-state rainfall intensity (rate), inches/hour

I = steady-state infiltration rate, inches/hour

L = slope length, feet

S = surface slope, dimensionless

n = Manning's roughness coefficient, dimensionless

A decrease in travel time results in less infiltration because less time is available for infiltration to occur.

Using the KINEROS kinematic runoff and erosion model (Woolhiser, Smith, and Goodrich, 1990), hundreds of runoff estimates were generated using different combinations of soil texture class, level of vegetation, slope, slope length, and rainfall depth, duration and temporal distribution. Using these estimates, the curve number that would yield the estimated runoff was calculated from the rainfall depth and the runoff estimate. These curve numbers were regressed with the slope length, surface slope and the curve number that would be generated for the soil texture and level of vegetation placed at a mild slope. The four soil textures used included loamy sand, sandy loam,

HYDROGRAPH DEVELOPMENT INFORMATION

HYDROGRAPH DEVELOPMENT INFORMATION

Landfill Areas

Direct runoff methods (i.e., kinematic wave) have been used for the landfill final cover areas. The kinematic wave method has been used to model the four percent slope top dome areas before flow is intercepted by top dome swales. The kinematic wave method is a physically based method using slope, surface roughness, catchment lengths and areas. This method does not consider attenuation for flood wave; as a consequence, this method provides for a conservative analysis. The following typical parameters for the direct runoff method have been developed for the landfill areas consistent with the parameters used in the currently approved hydrologic analysis (HEC-1 output file included in pages IIIF-E-20 through IIIF-E-109.

Kinematic wave parameters for overland flow:

Slope: Varies from 0.02 to 0.20 ft/ft landfill slopes

N: 0.35 Manning's friction coefficient for sheet flow

L: Represents a typical distance between swales for overland flow.

Percentage of drainage area represented by this element is 100 percent.

Muskingum-Cunge routing is used along with the kinematic wave method to estimate hydrographs at the outfall of each separate drainage area analyzed using the direct runoff method.

Muskingum-Cunge routing data for swale:

- Swale length (ft): Typical swale lengths for each drainage area were used.
- Swale bottom slope (ft/ft): 0.005 ft/ft
- Swale roughness coefficient: 0.03
- Swale type: A trapezoidal channel was used with no bottom width to simulate a triangular channel.

Muskingum-Cunge routing data for channels:

- Channel length (ft): The length of the channel section.

- Channel slope (ft/ft): Varies from 0.001 to 0.011.
- Channel roughness coefficient: 0.03 for grass lined.
- Channel type: A trapezoidal channel was used with varying bottom width and 3:1 side slopes.

Non-Landfill Final Cover Areas

Hydrographs for a portion of the non-landfill final cover areas within the permit boundary (e.g., pond areas) and all off-site areas were developed using the Snyder unit hydrograph method. Espey "10-Minute" method has been used to estimate Snyder parameters. Snyder parameter estimations are provided on the pages IIIF-E-14 and IIIF-E-15.

As discussed in Section 2 of Appendix IIIF, hydrographs for the areas outside of the permit boundary (O1, O1A, O2, O3, O4, and O5), and larger areas inside the permit boundary (S1, S2, S3, S4, S5, N1, N12, N13, N14, N15, 16, N17, N18, and N19) were developed using the Snyder unit hydrograph method. The percent imperviousness ranges from 2 percent to 23 percent for the non-landfill on-site and off-site areas, which represents the majority of the watersheds as undeveloped. Pond areas are assumed to be 100 percent impervious, and areas with significant channel surface or paved surfaces were assigned higher percentages of impervious area, as shown on IIIF-E-14.

Drainage Areas

The drainage areas used for this analysis are shown on Sheet IIIF-E-16 and Sheet IIIF-E-17 The routing scheme for the updated permitted condition is shown in the HEC-1 output file presented on pages IIIF-E-20 through IIIF-E-109.

ESPEY 10-MINUTE METHOD PARAMETERS

Prep By: CRM
Date: 2/21/2012

Chkd By: RCE
Date: 2-28-12

CAMELOT LANDFILL
1339-351-11-02-01
UNIT HYDROGRAPH DATA
UPDATED PERMITTED CONDITION

Snyder's Hydrograph Coefficients (Espey's 10 Minute Method)

Updated Permitted Conditions

Area No.	Area (acres)	Max. Flow Length (L) (ft)	S (ft/ft)	I (%)	Manning "n"	Φ[1]	T_r[2] (min)	T_{lag}[3] (min)	T_{lag} (hr)	Area[4] (sq mi)	q_p[5] (cfs/sq mi)	C_p[6]
O1	87.47	3,580	0.0101	23	0.04	0.80	25.7	23.2	0.39	0.1367	1059.5	0.64
O1A	23.42	2,285	0.0132	4	0.04	0.85	32.7	30.2	0.50	0.0366	864.1	0.68
O2	1008.38	14,770	0.0050	18	0.04	0.81	45.3	42.8	0.71	1.5756	524.7	0.58
O3	16.18	835	0.0611	2	0.04	0.86	20.4	17.9	0.30	0.0253	1452.4	0.68
O4	86.04	3,840	0.0180	10	0.04	0.84	28.4	25.9	0.43	0.1344	954.1	0.64
O5	116.47	2,140	0.0121	2	0.04	0.86	38.0	35.5	0.59	0.1820	690.4	0.64
S1	10.40	908	0.0022	2	0.04	0.86	47.7	45.2	0.75	0.0163	595.4	0.70
S2	31.53	1,538	0.0040	2	0.04	0.86	46.4	43.9	0.73	0.0493	586.8	0.67
S3	20.21	1,076	0.0019	2	0.04	0.86	51.8	49.3	0.82	0.0316	531.3	0.68
S4	57.41	2,475	0.0024	2	0.04	0.86	58.7	56.2	0.94	0.0897	445.7	0.65
S5	0.67	165	0.0363	2	0.04	0.86	16.0	13.5	0.23	0.0010	2137.5	0.75
N1	11.26	880	0.0273	2	0.04	0.86	25.3	22.8	0.38	0.0176	1172.1	0.70
N12	7.96	700	0.0214	2	0.04	0.86	25.5	23.0	0.38	0.0124	1179.0	0.71
N13	18.73	1,368	0.0117	2	0.04	0.86	34.6	32.1	0.53	0.0293	821.8	0.69
N14	26.06	861	0.0279	2	0.04	0.86	25.0	22.5	0.38	0.0407	1146.5	0.67
N15	19.93	1,078	0.0148	2	0.04	0.86	30.8	28.3	0.47	0.0311	926.1	0.68
N16	2.72	351	0.0627	2	0.04	0.86	16.6	14.1	0.24	0.0042	1943.8	0.71
N17	4.32	60	0.1000	2	0.04	0.86	9.8	7.3	0.12	0.0068	3339.4	0.64

[1] Conveyance efficiency coefficient from Dodson & Associates Inc., *ProHec-1 Program Documentation*, 1995, pages 6-19 and 6-20.
[2] $T_r = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\Phi^{1.57})$
[3] $T_{lag} = T_r - \Delta t/2$
[4] From area summary sheet
[5] $q_p = 31600(A^{-0.04})(T_r^{-1.07})$
[6] $C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$

T_r = surface runoff to unit hydrograph peak (min)
L = distance along main channel from study point to watershed boundary (ft)
S = main channel slope (ft/ft)
I = impervious cover within the watershed (%)
T_{lag} = watershed lag time (min)
Δt = computation interval (minutes)
q_p = unit hydrograph peak discharge (cfs/sq mi)
C_p = Snyder's peaking coefficient

Snyder Unit Hydrograph uses lag time (T_{lag}) and peaking coefficient accounting for flood wave and watershed storage conditions.

Drainage area "O1" is used in this example.

Estimated Watershed specific parameters

A =	87.47	acres	watershed area
L =	3580	feet	maximum flow length with this watershed
S =	0.0101	feet/feet	watershed slope
I =	23	percent (%)	watershed imperviousness
n =	0.04		Manning's coefficient

Calculate Tr: time beginning of surface runoff to the unit hydrograph peak in minutes

$T_r = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\Phi^{1.57})$

Estimate : conveyance efficiency coefficient
See figure 6.12 on page IIIF-E-18 for estimating
Φ = for 23 percent impervious cover and n = 0.04

$\Phi = 0.8$

$T_r = 3.1(3580^{0.23})(.0101^{-0.25})(23^{-0.18})(0.8^{1.57})$

$T_r = 25.7$ min

Calculate T_{lag}: watershed lag time

$T_{lag} = Tr - (\Delta t/2)$ Δt is calculation interval, and 5 minutes is used in the HEC - 1 modeling in this project

$T_{lag} = 23.2$ minutes

$T_{lag} = 0.39$ hours

A= A/640

A= 0.1367 square miles

Calculate q_p: peak discharge of unit hydrograph per unit area (cfs/sq. mi).

$q_p = 31600(A^{-0.04})(T_r^{-1.07})$

$q_p = 31600(0.1367^{-0.04})(25.7^{-1.07})$

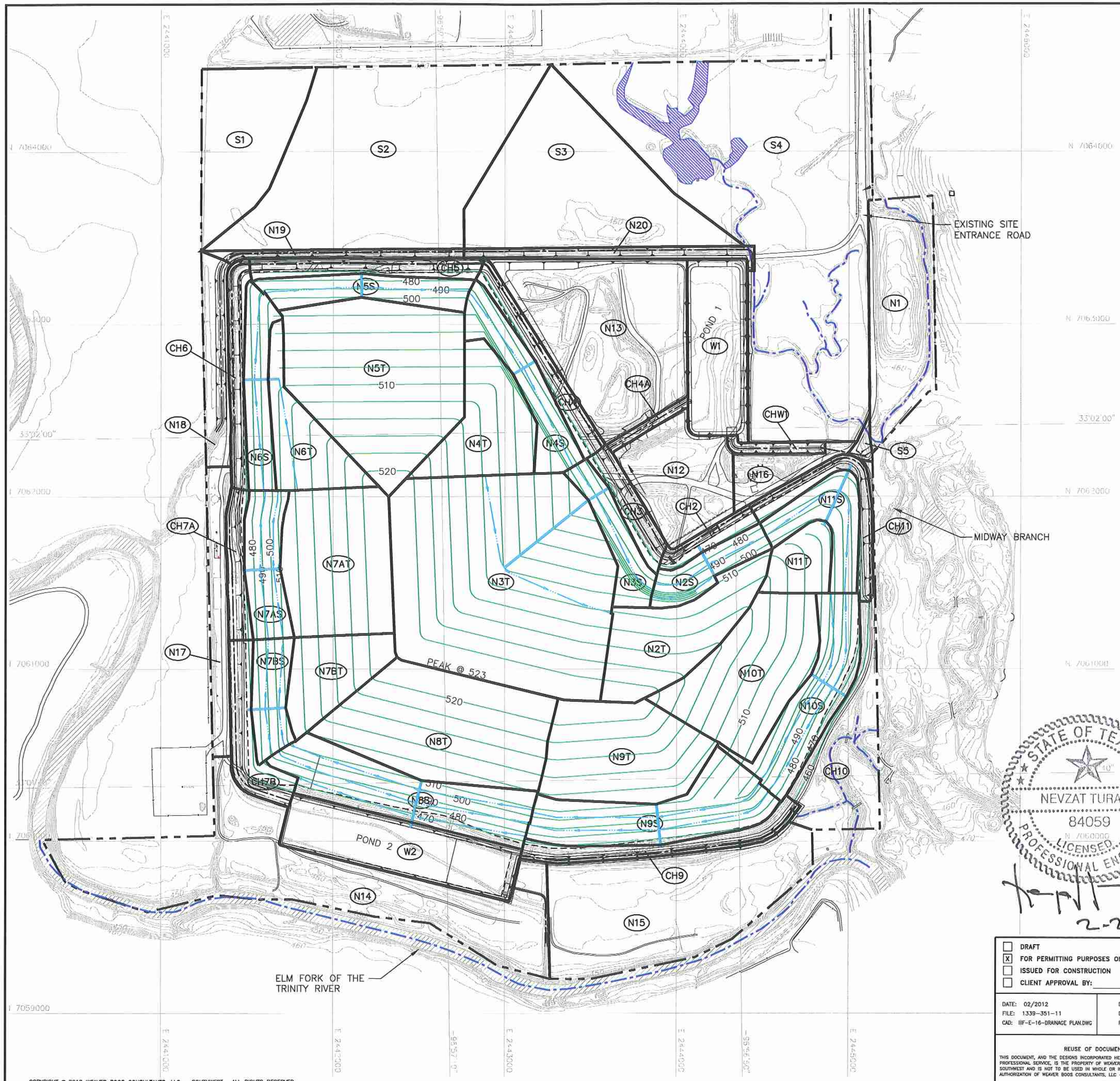
$q_p = 1059.5$ cfs/sq. mi

Calculate Peaking coefficient C_p:

$C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$

$C_p = 49.375(0.1367^{-0.04})(25.7^{-1.07})(0.39)$

$C_p = 0.64$



LEGEND

- PERMIT BOUNDARY
- AUTHORIZED LIMIT OF WASTE
- STATE PLANE COORDINATE SYSTEM
- GEODETIC COORDINATE SYSTEM
- 600 — PERMITTED FINAL COVER CONTOUR
- 500 — EXISTING CONTOUR (SEE NOTE 1)
- PERMITTED DRAINAGE SWALE
- PERMITTED LETDOWN STRUCTURE
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 3)
- USACE JURISDICTIONAL WETLANDS
- DRAINAGE AREA BOUNDARY
- (S3) DRAINAGE AREA DESIGNATION

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.
3. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.
4. REFER TO DRAWING IIIF-E-17 FOR OFFSITE DRAINAGE AREAS.

DRAINAGE AREA NO.	AREA (ACRES)	DRAINAGE AREA NO.	AREA (ACRES)	DRAINAGE AREA NO.	AREA (ACRES)
S1	10.40	N7AS	4.36	N18	4.12
S2	31.53	N7BT	5.45	N19	1.82
S3	20.21	N7BS	3.34	N20	2.62
S4	57.41	N8T	16.52	CH2	1.56
S5	0.67	N8S	10.27	CH3	2.39
N1	11.26	N9T	11.35	CH4	3.11
N2T	9.05	N9S	9.50	CH4A	0.68
N2S	3.16	N10T	11.93	CH5	3.26
N3T	34.01	N10S	7.39	CH6	2.95
N3S	3.47	N11T	3.03	CH7A	2.30
N4T	7.45	N11S	4.40	CH7B	3.66
N4S	5.05	N12	7.96	CH9	3.48
N5T	20.18	N13	18.73	CH10	8.41
N5S	4.50	N14	26.06	CH11	2.97
N6T	5.48	N15	19.93	CHW1	0.89
N6S	4.10	N16	2.72	W1	8.30
N7AT	12.08	N17	4.32	W2	9.83
TOTAL OF ALL DRAINAGE AREAS LISTED = 469.62 ACRES					

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

2-28-12

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY:

PREPARED FOR

CITY OF FARMERS BRANCH

MAJOR PERMIT AMENDMENT UPDATED PERMITTED CONDITION DRAINAGE AREA PLAN

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-E-16-DRAINAGE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

REVISIONS		
NO.	DATE	DESCRIPTION

REUSE OF DOCUMENTS

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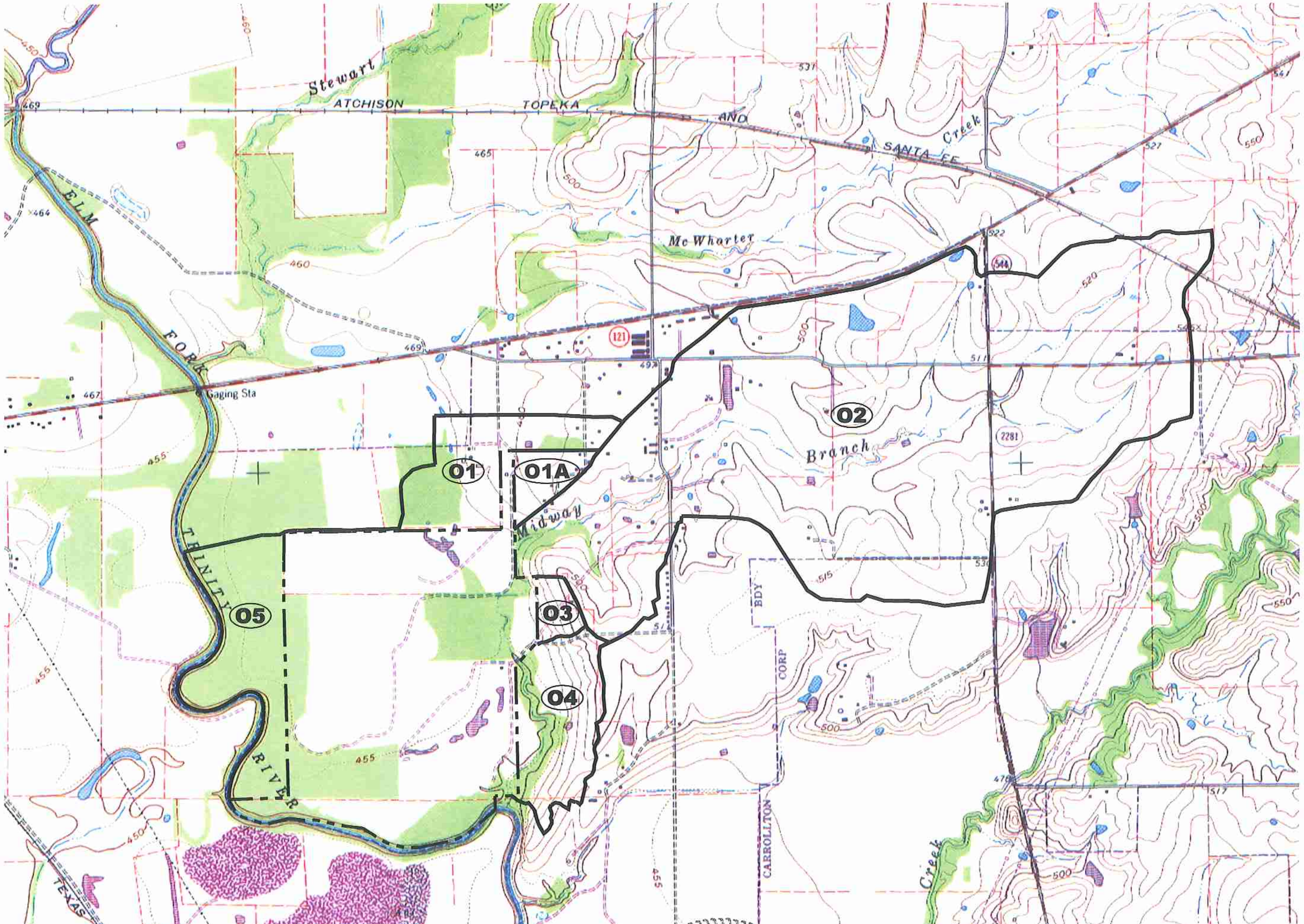
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

SHEET IIIF-E-16

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-E\IIIF-E-16-EXISTING PERMITTED.dwg, jwilson, 1:2



N

0 1000 2000
SCALE IN FEET

LEGEND

PERMIT BOUNDARY

DRAINAGE AREA BOUNDARY

(02) DRAINAGE AREA LABEL

DRAINAGE AREA NO.	AREA (ACRES)
01	87.5
01A	23.4
02	1,008.4
03	16.2
04	86.0
05	116.5
PB	462.6
TOTAL	1,807.6

ROAD CLASSIFICATION

Heavy-duty .... Light-duty ....

Medium-duty .... Unimproved dirt ....

Interstate Route U.S. Route State Route

LEWISVILLE EAST, TEX.
SW/4 FRISCO 15' QUADRANGLE
N3300—W9652.5/7.5
1960
PHOTOREVISED 1968
AMS 6650 III SW—SERIES V882

NOTES:

1. DRAINAGE AREA DELINEATION WITHIN THE PERMIT BOUNDARY IS SHOWN ON DRAWING IIIF-E-16.
2. TOPOGRAPHY REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (LEWISVILLE EAST, TX, PHOTO REVISED 1981).

STATE OF TEXAS
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84059
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2-28-12

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☐ CLIENT APPROVAL BY:

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-E-17 OFFSITE DRAINAGE.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
UPDATED PERMITTED
OFFSITE DRAINAGE AREAS

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735-9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

SHEET IIIF-E-17

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-E\IIIF-E-17 OFFSITE DRAINAGE.dwg, jwilson, 1:2

compute the value of Snyder's peaking coefficient C_p for use in HEC-1 analyses. First, the watershed lag time T_L is determined by subtracting one-half of the computation interval from the time to rise ($T_L = T_r - \Delta t/2$). Then, C_p may be computed by substituting the known values of T_L and q_p into Snyder's equation for peak unit hydrograph flow rate and solving for C_p.

$$C_p = \frac{q_p \times T_L}{640} \quad 6.30$$

Espey "10-Minute" Method for Estimating Snyder Parameters

In another study, Espey [1977] derived the following equation for computing the time from the beginning of surface runoff to the unit hydrograph peak:

$$T_r = 3.10\, L^{0.23} S^{-0.25} I^{-0.18} \Phi^{1.57} \quad 6.31$$

in which:

T_r = time from beginning of surface runoff to unit hydrograph peak (minutes)

L = total distance along main channel from study point to watershed boundary (feet)

S = main channel slope between the reference point and a point 0.2L downstream from the upstream watershed boundary (feet per foot)

I = impervious cover within the watershed (percent)

Φ = description of conveyance efficiency of the watershed drainage system.

The conveyance efficiency coefficient Φ is determined using the relationships illustrated on Figure 6.12.

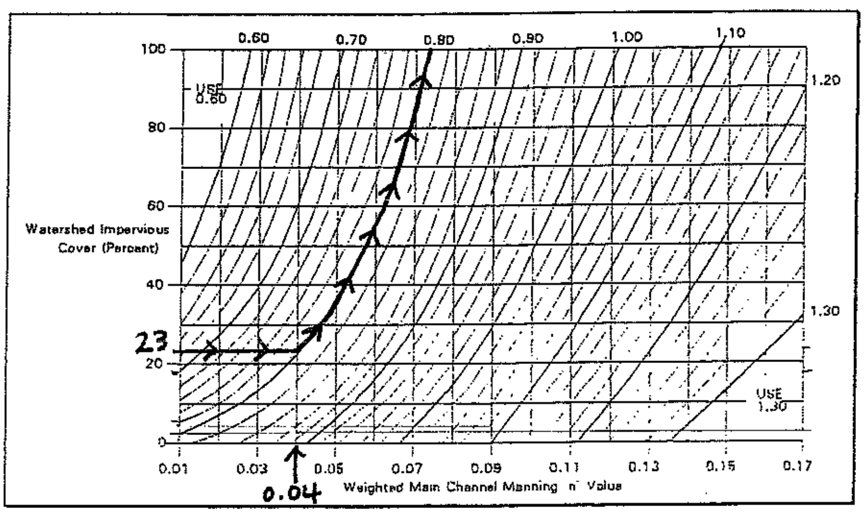

FIGURE 6.12 Determination of Conveyance Efficiency Coefficient Φ

This equation was derived from records for 41 watersheds in Texas, Tennessee, Mississippi, Pennsylvania, North Carolina, Colorado, Kentucky, and Indiana. The range in the watershed characteristics used to develop the equations for urban areas were:

Area : From 0.0128 square miles to 15.00 square miles

L : From 555 feet to 35,600 feet

S: From 0.0005 ft. per ft. to 0.0295 ft. per ft.

I: From 2% to 100%

Φ: From 0.60 to 1.30

Again, note that the time to rise T_r is not the same as the watershed lag time T_p. The difference between the two is that T_r is defined as the time from the beginning of effective rainfall to the peak of the unit hydrograph, while T_L is the time from the centroid of the effective rainfall to the peak of the unit hydrograph. For the purposes of HEC-1 analyses, however, T_L may be determined simply by subtracting one-half the computation time interval from the computed value of T_r ($T_R - \Delta t/2$).

The relationship developed by Espey to compute the peak flow rate of the unit hydrograph is as follows:

6.32 $$Q_u = 31600 \quad A^{0.96} T_r^{-1.07}$$

in which:

Q_u = unit hydrograph peak discharge (cfs)

A = drainage area (square miles)

T_r = time of rise from beginning of surface runoff to unit hydrograph peak (minutes)

Riverside County Method for Estimating Snyder Parameters

Three watershed lag equations have been derived for use in rural areas of Riverside County, California by the Riverside County Flood Control and Water Conservation District [Anonymous, 1963]. These equations differ slightly from those developed at the Tulsa District of the U.S. Army Corps of Engineers in that lag is defined as the time from the beginning of rainfall to the point on the unit hydrograph corresponding to one-half of the total runoff volume.

Each equation is applicable to a different topographic region:

6.33 $$T_L = 1.20\left(\frac{L \times L_{ca}}{\sqrt{S}}\right)^{0.38}$$ (Mountain Areas)

6.34 $$T_L = 0.72\left(\frac{L \times L_{ca}}{\sqrt{S}}\right)^{0.38}$$ (Foothill Areas)

6.35 $$T_L = 0.38\left(\frac{L \times L_{ca}}{\sqrt{S}}\right)^{0.38}$$ (Valley Areas)

in which:

T_L = watershed lag in hours

L = watershed length in miles

L_{ca} = length to centroid in miles

S = watershed slope in feet per mile.

The sizes of the watersheds studied in developing these equations ranged from 2.3 square miles to 645 square miles.

IIIF-E-19

HEC-1 OUTPUT – UPDATED PERMITTED 25-YEAR, 24-HOUR STORM EVENT

```
1****************************************                               ****************************************
 *                                      *                               *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                               *   U.S. ARMY CORPS OF ENGINEERS       *
 *             JUN   1998               *                               *   HYDROLOGIC ENGINEERING CENTER      *
 *           VERSION 4.1                *                               *         609 SECOND STREET            *
 *                                      *                               *      DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   13JUN11  TIME  13:37:12  *                               *         (916) 756-1104               *
 *                                      *                               *                                      *
****************************************                               ****************************************


                    X     X  XXXXXXX   XXXXX          X
                    X     X  X        X     X        XX
                    X     X  X        X               X
                    XXXXXXX  XXXX     X        XXXXX  X
                    X     X  X        X               X
                    X     X  X        X     X         X
                    X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                         HEC-1 INPUT                                                     PAGE  1

         LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                   *DIAGRAM
           1       ID         CAMELOT LANDFILL
           2       ID         MAJOR PERMIT AMENDMENT APPLICATION
           3       ID         UPDATED PERMITTED CONDITION
           4       ID         25-YEAR, 24-HOUR STORM EVENT
           5       IT       5       0    2400     416       0       0
           6       IO       3       0       0
                   *      NORTHEAST AREA

           7       KK      O1
           8       KM        OFFSITE AREA O1
           9       KO       0       0       0       7      21
          10       BA   .1367
          11       PH       4                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44
          12       LS               87
          13       US     .39     .64
                   *

          14       KK     O1A
          15       KM        OFFSITE AREA O1A
          16       KO       0       0       0       7      21
          17       BA   .0366
          18       LS               85
          19       US     .50     .68
                   *

          20       KK      O2
          21       KM        OFFSITE AREA O2
          22       KO       0       0       0       7      21
          23       BA  1.5756
          24       LS               85
          25       US     .71     .58
                   *

          26       KK      S4
          27       KM        RUNOFF AREA S4
          28       KO       0       0       0       7      21
          29       BA   .0897
          30       LS               84
          31       US     .94     .65
                   *

          32       KK     CS4
          33       KM  COMBINE AREAS PRIOR TO POND P1 OUTLET
          34       KO       0       0       0       7      21
          35       HC       3
                   *

          36       KK      N1
          37       KM        RUNOFF AREA N1
          38       KO       0       0       0       7      21
          39       BA   .0176
          40       LS               84
          41       US     .38     .70
                   *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 42           KK      O3
 43           KM        OFFSITE AREA O3
 44           KO       0       0       0       7      21
 45           BA   .0253
 46           LS               84
 47           US     .30     .68
              *

 48           KK   C1MWY
 49           KM  COMBINE AREAS N1, O1, O2, O3, AND S4
 50           KO       0       0       0       7      21
 51           HC       3
              *

 52           KK      S3
 53           KM        RUNOFF AREA S3
 54           KO       0       0       0       7      21
 55           BA   .0316
 56           LS               84
 57           US     .82     .68
              *

 58           KK     N20
 59           KM  RUNOFF AREA N20
 60           KO       0       0       0       7      21
 61           BA   .0041
 62           LS               84
 63           UK   31.95    .188     .35     100
 64           RD  1832.1   .0018     .03             TRAP       6       3     YES
              *

 65           KK   C2MWY
 66           KM  COMBINE AREAS O1, O2, O3, N1, S4, S3, AND N20
 67           KO       0       0       0       7      21
 68           HC       2
              *
              *       NORTH CENTRAL AREA OF LANDFILL TO POND 1 (UPPER POND)
              *

 69           KK    N11T
 70           KM  RUNOFF AREA N11T
 71           KO       0       0       0       7      21
 72           BA   .0047
 73           LS               84
 74           UK  415.07     .02     .35     100
 75           RD  427.05    .003     .03             TRAP       0       4      NO
              *

 76           KK    N11S
 77           KM  RUNOFF AREA N11S
 78           KO       0       0       0       7      21
 79           BA   .0069
 80           LS               86
 81           UK   73.21     .20     .35     100
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 82           RD  733.86    .007     .03             TRAP       0       4      NO
              *

 83           KK    CN11
 84           KM  COMBINE N11 AREAS
 85           KO       0       0       0       7      21
 86           HC       2
              *

 87           KK    CH11
 88           KM  RUNOFF AREA CH11
 89           KO       0       0       0       7      21
 90           BA   .0046
 91           LS               84
 92           UK   84.04     .33     .35     100
 93           RD    1487    .001     .03             TRAP      10       3     YES
              *

 94           KK     N2T
 95           KM  RUNOFF AREA N2T
 96           KO       0       0       0       7      21
 97           BA   .0141
 98           LS               84
 99           UK  553.17     .02     .35     100
100           RD  644.44    .003     .03             TRAP       0       4      NO
              *

101           KK     N2S
102           KM  RUNOFF AREA N2S
103           KO       0       0       0       7      21
```

```
     104          BA   .0049
     105          LS             86
     106          UK   80.24    .20     .35     100
     107          RD  379.06    .01     .03             TRAP      0       4      NO
                  *

     108          KK     CN2
     109          KM  COMBINE N2 AREAS
     110          KO       0      0       0       7      21
     111          HC       2
                  *

     112          KK    CCH2
     113          KM  COMBINE AREAS UPSTREAM OF CH2
     114          KO       0      0       0       7      21
     115          HC       2
                  *

     116          KK     CH2
     117          KM  RUNOFF AREA CH2
     118          KO       0      0       0       7      21
     119          BA   .0024
     120          LS             84
     121          UK  102.63    .18     .35     100
     122          RD  576.18   .001     .03             TRAP     10       3     YES
                  *
1                                       HEC-1 INPUT                                               PAGE  4

    LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


     123          KK     N12
     124          KM  RUNOFF AREA N12
     125          KO       0      0       0       7      21
     126          BA   .0124
     127          LS             84
     128          US     .38    .71
                  *

     129          KK     N3T
     130          KM  RUNOFF AREA N3T
     131          KO       0      0       0       7      21
     132          BA   .0531
     133          LS             84
     134          UK  512.17    .02     .35     100
     135          RD  691.59   .003     .03             TRAP      0       4      NO
                  *

     136          KK     N3S
     137          KM  RUNOFF AREA N3S
     138          KO       0      0       0       7      21
     139          BA   .0054
     140          LS             86
     141          UK   89.87    .20     .35     100
     142          RD  581.49   .003     .03             TRAP      0       4      NO
                  *

     143          KK     CN3
     144          KM  COMBINE N3S, N3T, N12
     145          KO       0      0       0       7      21
     146          HC       3
                  *

     147          KK    CCH3
     148          KM  COMBINE AREAS N11, N2, N12, N3 AT CH3
     149          KO       0      0       0       7      21
     150          HC       2
                  *

     151          KK     CH3
     152          KM  RUNOFF AREA CH3
     153          KO       0      0       0       7      21
     154          BA   .0037
     155          LS             84
     156          UK  152.72   .275     .35     100
     157          RD  697.69   .001     .03             TRAP     20       3     YES
                  *

     158          KK     N4T
     159          KM  RUNOFF AREA N4T
     160          KO       0      0       0       7      21
     161          BA   .0116
     162          LS             84
     163          UK  746.35    .02     .35     100
     164          RD  608.13    .01     .03             TRAP      0       4      NO
                  *
1                                       HEC-1 INPUT                                               PAGE  5

    LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

     165          KK     N4S
     166          KM  RUNOFF AREA N4S
```

```
 167          KO      0       0       0       7      21
 168          BA   .0079
 169          LS              86
 170          UK   77.51     .20     .35     100
 171          RD  640.53    .003     .03            TRAP       0       4      NO
              *

 172          KK     CN4
 173          KM  COMBINE N4 AREAS
 174          KO      0       0       0       7      21
 175          HC      2
              *

 176          KK     CH4
 177          KM  RUNOFF AREA CH4
 178          KO      0       0       0       7      21
 179          BA   .0049
 180          LS              84
 181          UK  100.82    .198     .35     100
 182          RD  1278.5    .005     .03            TRAP      10       4     YES
              *

 183          KK  C1CH4A
 184          KM  COMBINE AREAS N11, N2, N3, N4 AT CHANNEL CH4A
 185          KO      0       0       0       7      21
 186          HC      2
              *

 187          KK    CH4A
 188          KM  RUNOFF AREA CH4A
 189          KO      0       0       0       7      21
 190          BA   .0011
 191          LS              84
 192          UK   40.38     .33     .35     100
 193          RD  519.75   .0035     .03            TRAP      20       3     YES
              *

 194          KK     N13
 195          KM  RUNOFF AREA N13
 196          KO      0       0       0       7      21
 197          BA   .0293
 198          LS              84
 199          US     .53     .69
              *

 200          KK      W1
 201          KM  RUNOFF AREA W1 (POND 1)
 202          KO      0       0       0       7      21
 203          BA   .0130
 204          LS             100
 205          UD      0
              *
1                                            HEC-1 INPUT                                             PAGE  6

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 206          KK  PND1IN
 207          KM  COMBINE ALL FLOWS INTO POND 1
 208          KO      0       0       0       7      21
 209          HC      3
              *

 210          KK  PND1OUT
 211          KM  ROUTE THROUGH UPPER DET. POND (POND 1) 3-42" AT 451
 212          KO      0       0       0       7      21
 213          RS      1    ELEV   455.2
 214          SA      0  7.7727  7.9131  8.0441  8.1759
 215          SE   455.2   455.5     456   456.5     457
 216          SS     456      25     2.6     1.5
 217          SL  452.77 19.6350      .8      .5
              *

 218          KK     N16
 219          KM  RUNOFF AREA N16
 220          KO      0       0       0       7      21
 221          BA   .0042
 222          LS              84
 223          US     .24     .71
              *

 224          KK    CHW1
 225          KM  RUNOFF AREA CHW1
 226          KO      0       0       0       7      21
 227          BA   .0014
 228          LS              84
 229          UK   41.87     .33     .35     100
 230          RD  551.13    .001     .03            TRAP      20       3     YES
              *

 231          KK   MIDRD
 232          KM          COMBINE ALL FLOWS U/S OF ENTRANCE ROAD
 233          KO      0       0       0       7      21
```

```
 234          HC       3
              *

 235          KK      S5
 236          KM  RUNOFF AREA S5
 237          KO       0       0       0       7      21
 238          BA   .0010
 239          LS               84
 240          US     .23     .75
              *

 241          KK     CS5
 242          KM        COMBINE ALL FLOWS U/S OF ENTRANCE ROAD WITH S5
 243          KO       0       0       0       7      21
 244          HC       2
              *
1                                     HEC-1 INPUT                                          PAGE  7

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 245          KK      O4
 246          KM        OFFSITE AREA O4
 247          KO       0       0       0       7      21
 248          BA   .1344
 249          LS               84
 250          US     .43     .64
              *

 251          KK   C4MWY
 252          KM          COMBINE ALL FLOWS UPSTREAM OF N10
 253          KO       0       0       0       7      21
 254          HC       2
              *      EAST AND SOUTHSIDE TO MIDWAY BRANCH

 255          KK    N10T
 256          KM  RUNOFF AREA N10T
 257          KO       0       0       0       7      21
 258          BA   .0186
 259          LS               84
 260          UK  733.01     .02     .35     100
 261          RK  618.87    .002     .03             TRAP       0       4      NO
              *

 262          KK    N10S
 263          KM  RUNOFF AREA N10S
 264          KO       0       0       0       7      21
 265          BA   .0115
 266          LS               86
 267          UK   99.77     .20     .35     100
 268          RK  717.21    .013     .03             TRAP       0       4      NO
              *

 269          KK    CN10
 270          KM  COMBINE N10 AREAS
 271          KO       0       0       0       7      21
 272          HC       2
              *

 273          KK    CH10
 274          KM  RUNOFF AREA CH10
 275          KO       0       0       0       7      21
 276          BA   .0131
 277          LS               84
 278          UK   88.40    .015     .35     100
 279          RD  1453.8    .011     .03             TRAP      10       3     YES
              *

 280          KK  CABELM
 281          KM  COMBINE AREAS UPSTREAM OF ELM FORK
 282          KO       0       0       0       7      21
 283          HC       2
              *      SOUTHEAST CORNER INTO POND 2
1                                     HEC-1 INPUT                                          PAGE  8

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 284          KK     N9T
 285          KM  RUNOFF AREA N9T
 286          KO       0       0       0       7      21
 287          BA   .0177
 288          LS               84
 289          UK  566.18     .02     .35     100
 290          RK  696.09    .003     .03             TRAP       0       4      NO
              *

 291          KK     N9S
 292          KM  RUNOFF AREA N9S
 293          KO       0       0       0       7      21
 294          BA   .0148
 295          LS               86
 296          UK   83.55      .2     .35     100
```

```
297            RK  791.65    .014     .03            TRAP       0       4      NO
               *

298            KK     CN9
299            KM  COMBINE N9 AREAS
300            KO       0       0       0       7      21
301            HC       2
               *

302            KK     CH9
303            KM  RUNOFF AREA CH9
304            KO       0       0       0       7      21
305            BA   .0054
306            LS              84
307            UK   84.85    .157     .35     100
308            RD  1689.3    .001     .03            TRAP      10       3     YES
               *      NORTHWEST CORNER TO POND 2

309            KK     N5T
310            KM  RUNOFF AREA N5T
311            KO       0       0       0       7      21
312            BA   .0315
313            LS              84
314            UK  1133.6     .02     .35     100
315            RK  154.15    .002     .03            TRAP       0       4      NO
               *

316            KK     N5S
317            KM  RUNOFF AREA N5S
318            KO       0       0       0       7      21
319            BA    .007
320            LS              86
321            UK  126.10    .140     .35     100
322            RK   628.8     .01     .03            TRAP       0       4      NO
               *
1                                    HEC-1 INPUT                                                PAGE  9

LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


323            KK    `CN5
324            KM  COMBINE N5 AREAS
325            KO       0       0       0       7      21
326            HC       2
               *

327            KK     CH5
328            KM  RUNOFF AREA CH5
329            KO       0       0       0       7      21
330            BA   .0051
331            LS              84
332            UK   100.8    .198     .35     100
333            RD  1358.6    .001     .03            TRAP      10       3     YES
               *

334            KK     N6T
335            KM  RUNOFF AREA N6T
336            KO       0       0       0       7      21
337            BA   .0086
338            LS              84
339            UK  476.08     .02     .35     100
340            RK  652.91    .005     .03            TRAP       0       4      NO
               *

341            KK     N6S
342            KM  RUNOFF AREA N6S
343            KO       0       0       0       7      21
344            BA   .0064
345            LS              86
346            UK   85.77     .20     .35     100
347            RK  641.29    .005     .03            TRAP       0       4      NO
               *

348            KK     CN6
349            KM  COMBINE N6 AREAS
350            KO       0       0       0       7      21
351            HC       2
               *

352            KK    CCH6
353            KM  COMBINE AREAS N5 AND N6 AT CH6
354            KO       0       0       0       7      21
355            HC       2
               *

356            KK     CH6
357            KM  RUNOFF AREA CH6
358            KO       0       0       0       7      21
359            BA   .0046
360            LS              84
361            UK  101.19     .17     .35     100
362            RD  1371.2    .001     .03            TRAP      20       3     YES
               *
```

```
LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 363           KK    N7AT
 364           KM  RUNOFF AREA N7AT
 365           KO       0         0       0       7      21
 366           BA   .0189
 367           LS                84
 368           UK  582.87       .02     .35     100
 369           RK  408.17      .003     .03            TRAP       0       4      NO
               *

 370           KK    N7AS
 371           KM  RUNOFF AREA N7AS
 372           KO       0         0       0       7      21
 373           BA   .0068
 374           LS                86
 375           UK   91.73       .20     .35     100
 376           RK  467.36      .011     .03            TRAP       0       4      NO
               *

 377           KK    CN7A
 378           KM  COMBINE N7A AREAS
 379           KO       0         0       0       7      21
 380           HC       2
               *

 381           KK   CCH7A
 382           KM  COMBINE AREAS N5, N6, N7A AT CH7A
 383           KO       0         0       0       7      21
 384           HC       2
               *

 385           KK    CH7A
 386           KM  RUNOFF AREA CH7A
 387           KO       0         0       0       7      21
 388           BA   .0036
 389           LS                84
 390           UK   78.31      .203     .35     100
 391           RD  885.29      .001     .03            TRAP      40       3     YES
               *

 392           KK    N7BT
 393           KM  RUNOFF AREA N7BT
 394           KO       0         0       0       7      21
 395           BA   .0085
 396           LS                84
 397           UK  562.87       .02     .35     100
 398           RK  410.19      .003     .03            TRAP       0       4      NO
               *

 399           KK    N7BS
 400           KM  RUNOFF AREA N7BS
 401           KO       0         0       0       7      21
 402           BA   .0052
 403           LS                86
 404           UK   86.46       .20     .35     100
```



```
LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 405           RK  405.33      .014     .03            TRAP       0       4      NO
               *

 406           KK    CN7B
 407           KM  COMBINE N7B AREAS
 408           KO       0         0       0       7      21
 409           HC       2
               *

 410           KK   CCH7B
 411           KM  COMBINE AREAS N5, N6, N7A, N7B AT CH7B
 412           KO       0         0       0       7      21
 413           HC       2
               *

 414           KK    CH7B
 415           KM  RUNOFF AREA CH7A
 416           KO       0         0       0       7      21
 417           BA   .0057
 418           LS                84
 419           UK  109.04      .177     .35     100
 420           RD    1127      .001     .03            TRAP      40       3     YES
               *

 421           KK     N8T
 422           KM  RUNOFF AREA N8T
 423           KO       0         0       0       7      21
 424           BA   .0258
 425           LS                84
 426           UK  551.92       .02     .35     100
```

```
 427          RK  667.70    .003     .03            TRAP       0        4       NO
              *

 428          KK     N8S
 429          KM  RUNOFF AREA N8S
 430          KO       0       0       0       7      21
 431          BA   .0160
 432          LS              86
 433          UK   91.71     .20     .35     100
 434          RK  924.50    .018     .03            TRAP       0        4       NO
              *

 435          KK     CN8
 436          KM  COMBINE N8 AREAS
 437          KO       0       0       0       7      21
 438          HC       2
              *

 439          KK    C2W2
 440          KM  COMBINE AREAS N5-N9 INTO POND 2
 441          KO       0       0       0       7      21
 442          HC       3
              *
1                                        HEC-1 INPUT                                                  PAGE 12

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 443          KK      W2
 444          KM  RUNOFF WITHIN POND 2
 445          KO       0       0       0       7      21
 446          BA   .0154
 447          LS             100
 448          UD       0
              *

 449          KK  PND2IN
 450          KM  COMBINE AREAS INTO POND 2
 451          KO       0       0       0       7      21
 452          HC       2
              *

 453          KK  PD2OUT
 454          KM  ROUTE THROUGH POND W2
 455          KO       0       0       0       7      21
 456          RS       1    ELEV     454
 457          SA       0  4.4466  6.7860  8.2567  8.3782  8.5005  8.6236  8.8721  9.1240
 458          SE     454   454.5     455   455.5     456   456.5     457     458     459
 459          SS     458      25     2.6     1.5
 460          SL     456 28.2743      .8      .5
              *

 461          KK     N14
 462          KM         RUNOFF AREA N14
 463          KO       0       0       0       7      21
 464          BA   .0407
 465          LS              84
 466          US     .38     .67
              *

 467          KK     N15
 468          KM  RUNOFF AREA N15
 469          KO       0       0       0       7      21
 470          BA   .0311
 471          LS              84
 472          US     .47     .68
              *

 473          KK   C1N14
 474          KM  COMBINE AREAS N14, N15 & POND 2
 475          KO       0       0       0       7      21
 476          HC       3
              *

 477          KK      S2
 478          KM         RUNOFF AREA S2
 479          KO       0       0       0       7      21
 480          BA   .0493
 481          LS              84
 482          US     .73     .67
              *
1                                        HEC-1 INPUT                                                  PAGE 13

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 483          KK     N19
 484          KM  RUNOFF AREA N19
 485          KO       0       0       0       7      21
 486          BA   .0028
 487          LS              84
 488          UK   43.65     .33     .35     100
 489          RD    1305   .0016     .03            TRAP      10        3      YES
```

```
                 *

490              KK     N18
491              KM  RUNOFF AREA N18
492              KO      0         0         0         7        21
493              BA   .0064
494              LS                84
495              UK   41.18       .33       .35      100
496              RD  1123.4    .0016       .03                 TRAP       15        3       YES
                 *

497              KK      O5
498              KM        OFFSITE AREA O5
499              KO      0         0         0         7        21
500              BA   .1820
501              LS                84
502              US     .59       .64
                 *

503              KK      S1
504              KM        RUNOFF AREA S1
505              KO      0         0         0         7        21
506              BA   .0163
507              LS                84
508              US     .75       .70
                 *

509              KK     N17
510              KM        RUNOFF AREA N17
511              KO      0         0         0         7        21
512              BA   .0068
513              LS                84
514              US     .12       .64
                 *

515              KK    C107
516              KM  COMBINE AREAS S1, O6, AND N17-19
517              KO      0         0         0         7        21
518              HC      4
                 *
519              ZZ
1
            SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   7          O1
              .
              .
  14          .          O1A
              .           .
              .           .
  20          .           .            O2
              .           .            .
              .           .            .
  26          .           .            .           S4
              .           .            .           .
              .           .            .           .
  32          .          CS4.......................
              .           .
              .           .
  36          .           .            N1
              .           .            .
              .           .            .
  42          .           .            .           O3
              .           .            .           .
              .           .            .           .
  48          .        C1MWY.......................
              .           .
              .           .
  52          .           .            S3
              .           .            V
              .           .            V
  58          .           .           N20 ***
              .           .            .
              .           .            .
  65          .        C2MWY...........
              .           .
              .           .
  69          .           .           N11T
              .           .            .
              .           .            .
  76          .           .            .         N11S
              .           .            .           .
              .           .            .           .
  83          .           .           CN11...........
              .           .            V
              .           .            V
  87          .           .           CH11 ***
              .           .            .
              .           .            .
```

```
  94           .           .           .        N2T
               .           .           .           .
               .           .           .           .
 101           .           .           .           .        N2S
               .           .           .           .           .
               .           .           .           .           .
 108           .           .           .        CN2.............
               .           .           .           .
               .           .           .           .
 112           .           .       CCH2.............
               .           .           V
               .           .           V
 116           .           .        CH2 ***
               .           .           .
               .           .           .
 123           .           .           .        N12
               .           .           .           .
               .           .           .           .
 129           .           .           .           .        N3T
               .           .           .           .           .
               .           .           .           .           .
 136           .           .           .           .           .        N3S
               .           .           .           .           .           .
               .           .           .           .           .           .
 143           .           .           .        CN3.........................
               .           .           .           .
               .           .           .           .
 147           .           .       CCH3.............
               .           .           V
               .           .           V
 151           .           .        CH3 ***
               .           .           .
               .           .           .
 158           .           .           .        N4T
               .           .           .           .
               .           .           .           .
 165           .           .           .           .        N4S
               .           .           .           .           .
               .           .           .           .           .
 172           .           .           .        CN4.............
               .           .           .           V
               .           .           .           V
 176           .           .           .        CH4 ***
               .           .           .           .
               .           .           .           .
 183           .           .     C1CH4A.............
               .           .           V
               .           .           V
 187           .           .       CH4A ***
               .           .           .
               .           .           .
 194           .           .           .        N13
               .           .           .           .
               .           .           .           .
 200           .           .           .           .         W1
               .           .           .           .           .
               .           .           .           .           .
 206           .           .     PND1IN.........................
               .           .           V
               .           .           V
 210           .           .     PND1OU
               .           .           .
               .           .           .
 218           .           .           .        N16
               .           .           .           V
               .           .           .           V
 224           .           .           .       CHW1 ***
               .           .           .           .
               .           .           .           .
 231           .      MIDRD.........................
               .           .
               .           .
 235           .           .         S5
               .           .           .
               .           .           .
 241           .        CS5.............
               .           .
               .           .
 245           .           .         O4
               .           .           .
               .           .           .
 251           .      C4MWY.............
               .           .
               .           .
 255           .           .       N10T
               .           .           .
               .           .           .
 262           .           .           .       N10S
               .           .           .           .
               .           .           .           .
 269           .           .       CN10.............
               .           .           V
               .           .           V
```

```
273           .           .        CH10 ***
              .           .           .
              .           .           .
280           .      CABELM............
              .           .
              .           .
284           .           .         N9T
              .           .           .
              .           .           .
291           .           .           .         N9S
              .           .           .           .
              .           .           .           .
298           .           .         CN9............
              .           .           V
              .           .           V
302           .           .         CH9 ***
              .           .           .
              .           .           .
309           .           .           .         N5T
              .           .           .           .
              .           .           .           .
316           .           .           .           .         N5S
              .           .           .           .           .
              .           .           .           .           .
323           .           .           .         CN5............
              .           .           .           V
              .           .           .           V
327           .           .           .         CH5 ***
              .           .           .           .
              .           .           .           .
334           .           .           .           .         N6T
              .           .           .           .           .
              .           .           .           .           .
341           .           .           .           .           .         N6S
              .           .           .           .           .           .
              .           .           .           .           .           .
348           .           .           .           .         CN6............
              .           .           .           .           .
              .           .           .           .           .
352           .           .           .        CCH6............
              .           .           .           V
              .           .           .           V
356           .           .           .         CH6 ***
              .           .           .           .
              .           .           .           .
363           .           .           .           .        N7AT
              .           .           .           .           .
              .           .           .           .           .
370           .           .           .           .           .        N7AS
              .           .           .           .           .           .
              .           .           .           .           .           .
377           .           .           .           .        CN7A............
              .           .           .           .           .
              .           .           .           .           .
381           .           .           .       CCH7A............
              .           .           .           V
              .           .           .           V
385           .           .           .        CH7A ***
              .           .           .           .
              .           .           .           .
392           .           .           .           .        N7BT
              .           .           .           .           .
              .           .           .           .           .
399           .           .           .           .           .        N7BS
              .           .           .           .           .           .
              .           .           .           .           .           .
406           .           .           .           .        CN7B............
              .           .           .           .           .
              .           .           .           .           .
410           .           .           .       CCH7B............
              .           .           .           V
              .           .           .           V
414           .           .           .        CH7B ***
              .           .           .           .
              .           .           .           .
421           .           .           .           .         N8T
              .           .           .           .           .
              .           .           .           .           .
428           .           .           .           .           .         N8S
              .           .           .           .           .           .
              .           .           .           .           .           .
435           .           .           .           .         CN8............
              .           .           .           .           .
              .           .           .           .           .
439           .           .        C2W2........................
              .           .           .
              .           .           .
443           .           .           .          W2
              .           .           .           .
              .           .           .           .
449           .           .      PND2IN............
              .           .           V
              .           .           V
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453           .           .      PD2OUT
              .           .           .
              .           .           .
461           .           .           .           N14
              .           .           .            .
              .           .           .            .
467           .           .           .            .           N15
              .           .           .            .            .
              .           .           .            .            .
473           .           .        C1N14.......................
              .           .           .
              .           .           .
477           .           .           .            S2
              .           .           .            V
              .           .           .            V
483           .           .           .           N19 ***
              .           .           .            V
              .           .           .            V
490           .           .           .           N18 ***
              .           .           .            .
              .           .           .            .
497           .           .           .            .           O5
              .           .           .            .            .
              .           .           .            .            .
503           .           .           .            .            .           S1
              .           .           .            .            .            .
              .           .           .            .            .            .
509           .           .           .            .            .            .           N17
              .           .           .            .            .            .            .
              .           .           .            .            .            .            .
515           .           .           .          C107.................................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                                           ***************************************
*                                         *                                           *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)     *                                           *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998                 *                                           *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                  *                                           *         609 SECOND STREET           *
*                                         *                                           *      DAVIS, CALIFORNIA 95616        *
*  RUN DATE   13JUN11   TIME  13:37:12    *                                           *          (916) 756-1104             *
*                                         *                                           *                                     *
*****************************************                                            ***************************************


                               CAMELOT LANDFILL
                               MAJOR PERMIT AMENDMENT APPLICATION
                               UPDATED PERMITTED CONDITION
                               25-YEAR, 24-HOUR STORM EVENT

  6 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         416  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1035  ENDING TIME
                      ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   34.58 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  7 KK    *       O1   *
          *            *
          **************
                             OFFSITE AREA O1

  9 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
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                  QSCAL          0.  HYDROGRAPH PLOT SCALE
                  IPNCH          7   PUNCH COMPUTED HYDROGRAPH
                   IOUT         21   SAVE HYDROGRAPH ON THIS UNIT
                  ISAV1          1   FIRST ORDINATE PUNCHED OR SAVED
                  ISAV2        416   LAST ORDINATE PUNCHED OR SAVED
                 TIMINT       .083   TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 10 BA          SUBBASIN CHARACTERISTICS
                  TAREA        .14   SUBBASIN AREA

                PRECIPITATION DATA

 11 PH                           DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR   3-HR    6-HR   12-HR  24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18   4.52    5.47    6.43   7.44     .00     .00     .00     .00

                                              STORM AREA =      .14

 12 LS          SCS LOSS RATE
                  STRTL        .30   INITIAL ABSTRACTION
                 CRVNBR      87.00   CURVE NUMBER
                  RTIMP        .00   PERCENT IMPERVIOUS AREA

 13 US          SNYDER UNITGRAPH
                     TP        .39   LAG
                     CP        .64   PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                           ***

                                                UNIT HYDROGRAPH PARAMETERS
                                           CLARK   TC=   .45 HR,      R=   .34 HR
                                          SNYDER   TP=   .39 HR,     CP=   .65

                                                        UNIT HYDROGRAPH
                                                   25 END-OF-PERIOD ORDINATES
               13.      46.      89.     127.     144.     135.     110.      86.      67.      53.
               41.      32.      25.      20.      15.      12.       9.       7.       6.       5.
                4.       3.       2.       2.       1.

      ***           ***          ***            ***            ***

                     HYDROGRAPH AT STATION        O1

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.53, TOTAL EXCESS =     5.90

  PEAK FLOW     TIME                     MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR      34.58-HR

+   (CFS)       (HR)
                         (CFS)
+     298.     12.42                70.         22.         15.          15.
                      (INCHES)    4.730       5.877       5.877        5.877
                       (AC-FT)      34.         43.         43.          43.

                     CUMULATIVE AREA =     .14 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  14 KK     *     O1A    *
            *            *
            **************
                             OFFSITE AREA O1A

  16 KO          OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  17 BA          SUBBASIN CHARACTERISTICS
                    TAREA        .04  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
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                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =       .04

 18 LS          SCS LOSS RATE
                      STRTL          .35  INITIAL ABSTRACTION
                     CRVNBR        85.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 19 US          SNYDER UNITGRAPH
                         TP          .50  LAG
                         CP          .68  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                             ***

                                                    UNIT HYDROGRAPH PARAMETERS
                                              CLARK   TC=    .58 HR,        R=   .39 HR
                                             SNYDER   TP=    .50 HR,       CP=   .67

                                                         UNIT HYDROGRAPH
                                                    29 END-OF-PERIOD ORDINATES
                   2.          8.         15.        23.        29.        32.        32.        28.        22.        18.
                  15.         12.          9.         8.         6.         5.         4.         3.         3.         2.
                   2.          1.          1.         1.         1.         1.         0.         0.         0.

       ***            ***            ***            ***            ***

                           HYDROGRAPH AT STATION        O1A

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.77, TOTAL EXCESS =     5.67

   PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
                                         6-HR          24-HR         72-HR        34.58-HR

 +   (CFS)        (HR)
                               (CFS)
 +      70.      12.58                    18.             6.            4.             4.
                             (INCHES)    4.570          5.648         5.648          5.648
                              (AC-FT)       9.            11.           11.            11.

                           CUMULATIVE AREA =      .04 SQ MI


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            *            *
 20 KK      *       O2   *
            *            *
            **************
                                OFFSITE AREA O2

 22 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 23 BA          SUBBASIN CHARACTERISTICS
                      TAREA         1.58  SUBBASIN AREA

                PRECIPITATION DATA

 11 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =      1.58

 24 LS          SCS LOSS RATE
                      STRTL          .35  INITIAL ABSTRACTION
                     CRVNBR        85.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 25 US          SNYDER UNITGRAPH
                         TP          .71  LAG
                         CP          .58  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED
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                                                     ***

                                           UNIT HYDROGRAPH PARAMETERS
                                     CLARK    TC=   .79 HR,       R=   .76 HR
                                    SNYDER    TP=   .71 HR,      CP=   .58

                                                UNIT HYDROGRAPH
                                           54 END-OF-PERIOD ORDINATES
           31.       115.      232.      367.      512.      648.      752.      817.      841.      808.
          733.       657.      589.      528.      473.      424.      380.      341.      306.      274.
          246.       220.      197.      177.      159.      142.      127.      114.      102.       92.
           82.        74.       66.       59.       53.       48.       43.       38.       34.       31.
           28.        25.       22.       20.       18.       16.       14.       13.       11.       10.
            9.         8.        7.        7.

  ***            ***             ***             ***             ***

                  HYDROGRAPH AT STATION       O2

   TOTAL RAINFALL =    7.42, TOTAL LOSS =    1.77, TOTAL EXCESS =    5.66

 PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                     6-HR         24-HR        72-HR      34.58-HR
+   (CFS)      (HR)
                             (CFS)
+   2171.     12.75                  767.          239.         166.         166.
                          (INCHES)  4.524         5.632        5.632        5.632
                           (AC-FT)   380.          473.         473.         473.

                         CUMULATIVE AREA =    1.58 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  26 KK       *      S4    *
              *            *
              **************
                               RUNOFF AREA S4

  28 KO            OUTPUT CONTROL VARIABLES
                         IPRNT          3  PRINT CONTROL
                         IPLOT          0  PLOT CONTROL
                         QSCAL         0.  HYDROGRAPH PLOT SCALE
                         IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                          IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT       .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

  29 BA            SUBBASIN CHARACTERISTICS
                         TAREA        .09  SUBBASIN AREA

                   PRECIPITATION DATA

  11 PH                                DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......    ............... TP-40 ..............    ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY    4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00      .00     .00     .00

                                                  STORM AREA =       .09

  30 LS            SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  31 US            SNYDER UNITGRAPH
                           TP         .94  LAG
                           CP         .65  PEAKING COEFFICIENT

                   SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                     ***

                                           UNIT HYDROGRAPH PARAMETERS
                                     CLARK    TC=  1.04 HR,       R=   .82 HR
                                    SNYDER    TP=   .93 HR,      CP=   .65

                                                UNIT HYDROGRAPH
                                           59 END-OF-PERIOD ORDINATES
            1.         4.        8.       13.       18.       24.       29.       34.       37.       40.
           41.        41.       39.       35.       32.       29.       26.       24.       21.       19.
           17.        16.       14.       13.       12.       10.        9.        8.        8.        7.
            6.         6.        5.        5.        4.        4.        3.        3.        3.        2.
```

```
             2.        2.        2.        2.        1.        1.        1.        1.        1.        1.
             1.        1.        1.        1.        1.        0.        0.        0.        0.

      ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION        S4

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      34.58-HR
+  (CFS)        (HR)
                             (CFS)
+     113.     13.00                    43.          13.          9.           9.
                           (INCHES)    4.456        5.532        5.532       5.532
                            (AC-FT)     21.          26.          26.          26.

                         CUMULATIVE AREA =      .09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
   32 KK    *      CS4   *
            *            *
            **************
                          COMBINE AREAS PRIOR TO POND P1 OUTLET

   34 KO         OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


   35 HC         HYDROGRAPH COMBINATION
                       ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION       CS4

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      34.58-HR
+  (CFS)        (HR)
                             (CFS)
+    2337.     12.75                   828.         258.         179.         179.
                           (INCHES)    4.521        5.627        5.627       5.627
                            (AC-FT)    410.         511.         511.         511.

                         CUMULATIVE AREA =     1.70 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
   36 KK    *       N1   *
            *            *
            **************
                               RUNOFF AREA N1

   38 KO         OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS

               SUBBASIN RUNOFF DATA

   39 BA         SUBBASIN CHARACTERISTICS
                       TAREA        .02  SUBBASIN AREA

                 PRECIPITATION DATA
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```
 11 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                              STORM AREA =      .02

 40 LS        SCS LOSS RATE
                  STRTL         .38  INITIAL ABSTRACTION
                 CRVNBR       84.00  CURVE NUMBER
                  RTIMP         .00  PERCENT IMPERVIOUS AREA

 41 US        SNYDER UNITGRAPH
                    TP          .38  LAG
                    CP          .70  PEAKING COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                         ***

                                               UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .46 HR,        R=   .28 HR
                                        SNYDER   TP=   .38 HR,       CP=   .70

                                                    UNIT HYDROGRAPH
                                               21 END-OF-PERIOD ORDINATES
              2.         7.        13.        18.        21.        19.        15.        11.         8.         6.
              4.         3.         2.         2.         1.         1.         1.         1.         0.         0.
              0.

    ***             ***            ***             ***             ***

                  HYDROGRAPH AT STATION        N1

  TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR        72-HR     34.58-HR
+  (CFS)      (HR)
                     (CFS)
+      39.    12.42                  9.           3.           2.           2.
                   (INCHES)      4.495        5.535        5.535        5.535
                    (AC-FT)         4.           5.           5.           5.

                  CUMULATIVE AREA =      .02 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 42 KK     *        O3  *
           *            *
           **************
                          OFFSITE AREA O3

 44 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 45 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .03  SUBBASIN AREA

              PRECIPITATION DATA

 11 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                              STORM AREA =      .03

 46 LS        SCS LOSS RATE
                  STRTL         .38  INITIAL ABSTRACTION
                 CRVNBR       84.00  CURVE NUMBER
                  RTIMP         .00  PERCENT IMPERVIOUS AREA

 47 US        SNYDER UNITGRAPH
                    TP          .30  LAG
                    CP          .68  PEAKING COEFFICIENT
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                   SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                              ***

                                                                   UNIT HYDROGRAPH PARAMETERS
                                                             CLARK   TC=    .35 HR,        R=   .23 HR
                                                            SNYDER   TP=    .30 HR,       CP=   .68

                                                                        UNIT HYDROGRAPH
                                                                   18 END-OF-PERIOD ORDINATES
                   5.        17.        30.        36.        32.        23.        16.        11.        8.        5.
                   4.         3.         2.         1.         1.         1.         0.         0.

      ***             ***             ***             ***             ***

                              HYDROGRAPH AT STATION        O3

        TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

     PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                          6-HR          24-HR          72-HR       34.58-HR
 +    (CFS)        (HR)
                              (CFS)
 +       62.      12.33                    12.            4.             3.             3.
                            (INCHES)     4.500          5.539          5.539          5.539
                             (AC-FT)        6.            7.             7.             7.

                             CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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               *            *
    48 KK      *     C1MWY  *
               *            *
               **************
                              COMBINE AREAS N1, O1, O2, O3, AND S4

    50 KO          OUTPUT CONTROL VARIABLES
                         IPRNT            3   PRINT CONTROL
                         IPLOT            0   PLOT CONTROL
                         QSCAL           0.   HYDROGRAPH PLOT SCALE
                         IPNCH            7   PUNCH COMPUTED HYDROGRAPH
                          IOUT           21   SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1            1   FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2          416   LAST ORDINATE PUNCHED OR SAVED
                        TIMINT         .083   TIME INTERVAL IN HOURS


    51 HC          HYDROGRAPH COMBINATION
                         ICOMP            3   NUMBER OF HYDROGRAPHS TO COMBINE

                                                                              ***

      ***             ***             ***             ***             ***

                              HYDROGRAPH AT STATION     C1MWY

     PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                          6-HR          24-HR          72-HR       34.58-HR
 +    (CFS)        (HR)
                              (CFS)
 +     2396.      12.75                   848.          264.           183.           183.
                            (INCHES)     4.520          5.625          5.625          5.625
                             (AC-FT)      421.          523.           523.           523.

                             CUMULATIVE AREA =     1.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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               *            *
    52 KK      *        S3  *
               *            *
               **************
                                   RUNOFF AREA S3

    54 KO          OUTPUT CONTROL VARIABLES
                         IPRNT            3   PRINT CONTROL
                         IPLOT            0   PLOT CONTROL
                         QSCAL           0.   HYDROGRAPH PLOT SCALE
                         IPNCH            7   PUNCH COMPUTED HYDROGRAPH
                          IOUT           21   SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1            1   FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2          416   LAST ORDINATE PUNCHED OR SAVED
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              TIMINT        .083  TIME INTERVAL IN HOURS

         SUBBASIN RUNOFF DATA

 55 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .03  SUBBASIN AREA

                PRECIPITATION DATA

 11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                     STORM AREA =       .03

 56 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 57 US          SNYDER UNITGRAPH
                         TP          .82  LAG
                         CP          .68  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                              ***

                                                    UNIT HYDROGRAPH PARAMETERS
                                                 CLARK   TC=   .94 HR,        R=   .65 HR
                                                SNYDER   TP=   .82 HR,       CP=   .68

                                                         UNIT HYDROGRAPH
                                                    48 END-OF-PERIOD ORDINATES
             1.         2.         4.         6.         9.        12.        14.        16.        17.        17.
            17.        16.        14.        12.        11.         9.         8.         7.         6.         6.
             5.         4.         4.         3.         3.         3.         2.         2.         2.         2.
             1.         1.         1.         1.         1.         1.         1.         1.         0.         0.
             0.         0.         0.         0.         0.         0.         0.         0.

     ***            ***            ***            ***            ***

                 HYDROGRAPH AT STATION        S3

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                               MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                            (CFS)
+      45.     12.83                     15.           5.           3.           3.
                          (INCHES)     4.472        5.533        5.533        5.533
                           (AC-FT)        8.           9.           9.           9.

                          CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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           *            *
 58 KK     *      N20   *
           *            *
           **************
                      RUNOFF AREA N20

 60 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS

         SUBBASIN RUNOFF DATA

 61 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .00  SUBBASIN AREA

                PRECIPITATION DATA

 11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00
```

```
                                        STORM AREA =       .00

   62 LS          SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   63 UK            OVERLAND-FLOW ELEMENT NO. 1
                            L         32.  OVERLAND FLOW LENGTH
                            S       .1880  SLOPE
                            N        .350  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   64 RD            MAIN CHANNEL
                            L       1832.  CHANNEL LENGTH
                            S       .0018  SLOPE
                            N        .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .00  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD        6.00  BOTTOM WIDTH OR DIAMETER
                            Z        3.00  SIDE SLOPE
                       RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                            COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                   COMPUTATION TIME STEP
                   ELEMENT    ALPHA     M        DT        DX      PEAK    TIME TO    VOLUME    MAXIMUM
                                                                            PEAK                CELERITY
                                                (MIN)     (FT)    (CFS)    (MIN)      (IN)      (FPS)

                  PLANE1       1.85    1.67       .42      6.39    20.57   724.93      5.56       .33
                  MAIN          .70    1.38      5.00    610.70    46.52   780.00      5.53      2.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9325E+01  EXCESS= .1215E+01 OUTFLOW= .1052E+02 BASIN STORAGE= .2178E-02 PERCENT ERROR=     .1

                                 INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          .70    1.38      5.00              46.52   780.00      5.53

     ***            ***          ***          ***          ***

                        HYDROGRAPH AT STATION       N20

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+      47.      13.00                 17.          5.          4.           4.
                        (INCHES)    4.468       5.527       5.527        5.527
                         (AC-FT)       9.         11.         11.          11.

                        CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   65 KK      *   C2MWY    *
              *            *
              **************
                         COMBINE AREAS O1, O2, O3, N1, S4, S3, AND N20

   67 KO          OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                        IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT         .083  TIME INTERVAL IN HOURS


   68 HC          HYDROGRAPH COMBINATION
                       ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***            ***          ***          ***          ***

                        HYDROGRAPH AT STATION    C2MWY
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  PEAK FLOW     TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                            (CFS)
+    2437.     12.75                    865.         269.        187.         187.
                          (INCHES)     4.519        5.623       5.623        5.623
                           (AC-FT)      429.         534.        534.         534.

                          CUMULATIVE AREA =     1.78 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  69 KK      *     N11T   *
             *            *
             **************
                          RUNOFF AREA N11T

  71 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  72 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

  11 PH                              DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                    STORM AREA =       .00

  73 LS           SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                      CRVNBR        84.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  74 UK             OVERLAND-FLOW ELEMENT NO. 1
                           L         415.  OVERLAND FLOW LENGTH
                           S        .0200  SLOPE
                           N         .350  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  75 RD             MAIN CHANNEL
                           L         427.  CHANNEL LENGTH
                           S        .0030  SLOPE
                           N         .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA          .00  CONTRIBUTING AREA
                       SHAPE         TRAP  CHANNEL SHAPE
                          WD          .00  BOTTOM WIDTH OR DIAMETER
                           Z         4.00  SIDE SLOPE
                      RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
                     ELEMENT     ALPHA       M         DT         DX        PEAK     TIME TO      VOLUME    MAXIMUM
                                                                                      PEAK                  CELERITY
                                                     (MIN)       (FT)      (CFS)     (MIN)        (IN)       (FPS)

                    PLANE1         .60      1.67       4.05      83.01      12.12    734.95        5.54        .35
                    MAIN          1.06      1.33       3.26     213.52      11.91    733.23        5.53       2.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1393E+01 OUTFLOW= .1385E+01 BASIN STORAGE= .1876E-02 PERCENT ERROR=     .4

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.06      1.33       5.00                 11.86    735.00        5.53
      ***              ***              ***              ***              ***
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                                    HYDROGRAPH AT STATION     N11T

      TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

    PEAK FLOW      TIME                               MAXIMUM AVERAGE FLOW
                                             6-HR        24-HR        72-HR      34.58-HR
+    (CFS)        (HR)
                                 (CFS)
+       12.      12.25                        2.           1.           0.            0.
                              (INCHES)    4.492        5.521        5.528         5.528
                               (AC-FT)       1.           1.           1.            1.

                             CUMULATIVE AREA =      .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

                  **************
                  *            *
       76 KK      *     N11S   *
                  *            *
                  **************
                                  RUNOFF AREA N11S

       78 KO           OUTPUT CONTROL VARIABLES
                              IPRNT           3  PRINT CONTROL
                              IPLOT           0  PLOT CONTROL
                              QSCAL          0.  HYDROGRAPH PLOT SCALE
                              IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                               IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                              ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                              ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                             TIMINT        .083  TIME INTERVAL IN HOURS


                     SUBBASIN RUNOFF DATA

       79 BA           SUBBASIN CHARACTERISTICS
                              TAREA         .01  SUBBASIN AREA

                       PRECIPITATION DATA

       11 PH                                  DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                       ..... HYDRO-35 ......    .............. TP-40 ..............     ........... TP-49 ...........
                       5-MIN  15-MIN  60-MIN     2-HR     3-HR     6-HR    12-HR    24-HR    2-DAY    4-DAY    7-DAY  10-DAY
                         .74    1.57    3.19     4.18     4.52     5.47     6.43     7.44      .00      .00      .00     .00

                                                           STORM AREA =        .01

       80 LS           SCS LOSS RATE
                             STRTL          .33  INITIAL ABSTRACTION
                            CRVNBR        86.00  CURVE NUMBER
                             RTIMP          .00  PERCENT IMPERVIOUS AREA

                       KINEMATIC WAVE
       81 UK             OVERLAND-FLOW ELEMENT NO. 1
                                 L          73.  OVERLAND FLOW LENGTH
                                 S        .2000  SLOPE
                                 N         .350  ROUGHNESS COEFFICIENT
                                PA        100.0  PERCENT OF SUBBASIN
                             DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                       MUSKINGUM-CUNGE
       82 RD             MAIN CHANNEL
                                 L         734.  CHANNEL LENGTH
                                 S        .0070  SLOPE
                                 N         .030  CHANNEL ROUGHNESS COEFFICIENT
                                CA          .01  CONTRIBUTING AREA
                             SHAPE         TRAP  CHANNEL SHAPE
                                WD          .00  BOTTOM WIDTH OR DIAMETER
                                 Z         4.00  SIDE SLOPE
                            RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                               ***
                                     COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                            COMPUTATION TIME STEP
                         ELEMENT     ALPHA        M         DT         DX        PEAK     TIME TO      VOLUME     MAXIMUM
                                                                                          PEAK                    CELERITY
                                                          (MIN)       (FT)       (CFS)     (MIN)        (IN)        (FPS)

                        PLANE1        1.90      1.67        .65      14.64       35.28    724.53        5.79         .48
                        MAIN          1.62      1.33       3.12     366.93       34.59    724.20        5.65        3.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2130E+01 OUTFLOW= .2077E+01 BASIN STORAGE= .4285E-03 PERCENT ERROR=   2.5

                                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                        MAIN          1.62      1.33       5.00                  32.23    725.00        5.64
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     ***              ***              ***              ***              ***

                                 HYDROGRAPH AT STATION      N11S

        TOTAL RAINFALL =      7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

    PEAK FLOW       TIME                                  MAXIMUM AVERAGE FLOW
                                              6-HR          24-HR          72-HR        34.58-HR
+    (CFS)          (HR)
                                  (CFS)
+       32.        12.08                      3.             1.             1.              1.
                               (INCHES)     4.623          5.639          5.639           5.639
                                (AC-FT)       2.             2.             2.              2.

                                 CUMULATIVE AREA =       .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
   83 KK      *    CN11    *
              *            *
              **************
                           COMBINE N11 AREAS

   85 KO           OUTPUT CONTROL VARIABLES
                         IPRNT             3  PRINT CONTROL
                         IPLOT             0  PLOT CONTROL
                         QSCAL            0.  HYDROGRAPH PLOT SCALE
                         IPNCH             7  PUNCH COMPUTED HYDROGRAPH
                          IOUT            21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1             1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2           416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT          .083  TIME INTERVAL IN HOURS


   86 HC           HYDROGRAPH COMBINATION
                         ICOMP             2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                              ***

     ***              ***              ***              ***              ***

                                 HYDROGRAPH AT STATION      CN11

    PEAK FLOW       TIME                                  MAXIMUM AVERAGE FLOW
                                              6-HR          24-HR          72-HR        34.58-HR
+    (CFS)          (HR)
                                  (CFS)
+       41.        12.08                      6.             2.             1.              1.
                               (INCHES)     4.559          5.589          5.594           5.594
                                (AC-FT)       3.             3.             3.              3.

                                 CUMULATIVE AREA =       .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
   87 KK      *    CH11    *
              *            *
              **************
                           RUNOFF AREA CH11

   89 KO           OUTPUT CONTROL VARIABLES
                         IPRNT             3  PRINT CONTROL
                         IPLOT             0  PLOT CONTROL
                         QSCAL            0.  HYDROGRAPH PLOT SCALE
                         IPNCH             7  PUNCH COMPUTED HYDROGRAPH
                          IOUT            21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1             1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2           416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT          .083  TIME INTERVAL IN HOURS

                 SUBBASIN RUNOFF DATA

   90 BA           SUBBASIN CHARACTERISTICS
                         TAREA           .00  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
```

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                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .00

   91 LS          SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   92 UK            OVERLAND-FLOW ELEMENT NO. 1
                            L         84.  OVERLAND FLOW LENGTH
                            S       .3300  SLOPE
                            N        .350  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   93 RD            MAIN CHANNEL
                            L       1487.  CHANNEL LENGTH
                            S       .0010  SLOPE
                            N        .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .00  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD       10.00  BOTTOM WIDTH OR DIAMETER
                            Z        3.00  SIDE SLOPE
                       RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                            ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA        M        DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                 PEAK                 CELERITY
                                                   (MIN)      (FT)     (CFS)    (MIN)        (IN)      (FPS)

                   PLANE1       2.45      1.67       .49     16.81     22.92    724.87       5.56        .58
                   MAIN          .44      1.42      5.00    743.50     40.46    735.00       5.42       2.19

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3461E+01  EXCESS= .1364E+01 OUTFLOW= .4683E+01 BASIN STORAGE= .2406E-02 PERCENT ERROR=   2.9

                                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN           .44      1.42      5.00               40.46    735.00       5.42

     ***              ***            ***            ***            ***

                            HYDROGRAPH AT STATION      CH11

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+     40.      12.25                 8.          2.          2.          2.
                        (INCHES)   4.475       5.417       5.421       5.421
                         (AC-FT)      4.          5.          5.          5.

                        CUMULATIVE AREA =      .02 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
   94 KK     *      N2T   *
             *            *
             **************
                            RUNOFF AREA N2T

   96 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   97 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA
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 11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............  ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =       .01

 98 LS          SCS LOSS RATE
                     STRTL         .38  INITIAL ABSTRACTION
                    CRVNBR       84.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 99 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        553.  OVERLAND FLOW LENGTH
                         S       .0200  SLOPE
                         N        .350  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
100 RD            MAIN CHANNEL
                         L        644.  CHANNEL LENGTH
                         S       .0030  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        4.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                         ***
                             COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                    COMPUTATION TIME STEP
                  ELEMENT    ALPHA       M         DT        DX        PEAK    TIME TO    VOLUME    MAXIMUM
                                                                                PEAK                 CELERITY
                                                  (MIN)      (FT)      (CFS)    (MIN)      (IN)      (FPS)

                 PLANE1        .60      1.67       4.23     92.19      32.17    737.61      5.54        .37
                 MAIN         1.06      1.33       3.86    322.22      31.70    737.41      5.49       2.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4180E+01 OUTFLOW= .4128E+01 BASIN STORAGE= .7392E-02 PERCENT ERROR=    1.1

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN         1.06      1.33       5.00                31.34    735.00      5.49

      ***           ***          ***             ***             ***

                         HYDROGRAPH AT STATION       N2T

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                       6-HR          24-HR         72-HR       34.58-HR
+    (CFS)       (HR)
                            (CFS)
+      31.      12.25                    7.            2.            1.            1.
                          (INCHES)    4.483         5.486         5.492         5.492
                           (AC-FT)       3.            4.            4.            4.

                         CUMULATIVE AREA =      .01 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
101 KK      *      N2S   *
            *            *
            **************
                         RUNOFF AREA N2S

103 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

104 BA          SUBBASIN CHARACTERISTICS
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                TAREA          .00  SUBBASIN AREA

            PRECIPITATION DATA

 11 PH                          DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
            ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
            5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
              .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                           STORM AREA =       .00

105 LS      SCS LOSS RATE
                 STRTL         .33  INITIAL ABSTRACTION
                CRVNBR       86.00  CURVE NUMBER
                 RTIMP         .00  PERCENT IMPERVIOUS AREA

            KINEMATIC WAVE
106 UK        OVERLAND-FLOW ELEMENT NO. 1
                     L         80.  OVERLAND FLOW LENGTH
                     S       .2000  SLOPE
                     N        .350  ROUGHNESS COEFFICIENT
                    PA       100.0  PERCENT OF SUBBASIN
                 DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
            MUSKINGUM-CUNGE
107 RD        MAIN CHANNEL
                     L        379.  CHANNEL LENGTH
                     S       .0100  SLOPE
                     N        .030  CHANNEL ROUGHNESS COEFFICIENT
                    CA         .00  CONTRIBUTING AREA
                 SHAPE        TRAP  CHANNEL SHAPE
                    WD         .00  BOTTOM WIDTH OR DIAMETER
                     Z        4.00  SIDE SLOPE
                RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                   ***

       *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1


                             COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                  COMPUTATION TIME STEP
             ELEMENT    ALPHA       M          DT       DX       PEAK    TIME TO    VOLUME   MAXIMUM
                                                                           PEAK               CELERITY
                                             (MIN)     (FT)     (CFS)     (MIN)      (IN)      (FPS)

            PLANE1       1.90     1.67         .56     16.05     24.97    724.49     5.79        .49
            MAIN         1.93     1.33        1.54    189.53     24.45    723.94     5.68       4.11

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1513E+01 OUTFLOW= .1483E+01 BASIN STORAGE= .2001E-03 PERCENT ERROR=   2.0

                                 INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


            MAIN         1.93     1.33        5.00               23.72    725.00     5.69

     ***         ***         ***          ***          ***

                 HYDROGRAPH AT STATION        N2S

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.65, TOTAL EXCESS =     5.79

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+       24.    12.08                 2.          1.          1.           1.
                        (INCHES)  4.647       5.686       5.687        5.687
                         (AC-FT)     1.          1.          1.           1.

                 CUMULATIVE AREA =     .00 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

         **************
         *            *
108 KK   *      CN2   *
         *            *
         **************
                  COMBINE N2 AREAS

110 KO        OUTPUT CONTROL VARIABLES
                 IPRNT           3  PRINT CONTROL
                 IPLOT           0  PLOT CONTROL
                 QSCAL          0.  HYDROGRAPH PLOT SCALE
                 IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                  IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
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                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


  111 HC        HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                            ***

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION      CN2

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      34.58-HR
+   (CFS)        (HR)
                             (CFS)
+     47.       12.08                    9.          3.          2.          2.
                           (INCHES)    4.513       5.535       5.542       5.542
                            (AC-FT)      5.          6.          6.          6.

                          CUMULATIVE AREA =      .02 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  112 KK      *     CCH2   *
              *            *
              **************
                          COMBINE AREAS UPSTREAM OF CH2

  114 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


  115 HC        HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                            ***

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION      CCH2

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      34.58-HR
+   (CFS)        (HR)
                             (CFS)
+     82.       12.17                   17.          5.          4.          4.
                           (INCHES)    4.494       5.481       5.486       5.486
                            (AC-FT)      8.         10.         10.         10.

                          CUMULATIVE AREA =      .04 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  116 KK      *      CH2   *
              *            *
              **************
                          RUNOFF AREA CH2

  118 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA
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 119 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .00  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                STORM AREA =      .00

 120 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 121 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        103.  OVERLAND FLOW LENGTH
                           S       .1800  SLOPE
                           N        .350  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 122 RD            MAIN CHANNEL
                           L        576.  CHANNEL LENGTH
                           S       .0010  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                         ***
                                      COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                              COMPUTATION TIME STEP
                   ELEMENT     ALPHA       M          DT        DX        PEAK     TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                 CELERITY
                                                     (MIN)      (FT)      (CFS)     (MIN)       (IN)      (FPS)

                 PLANE1        1.81       1.67        .80      20.53      11.58    724.49       5.56       .51
                 MAIN           .44       1.42       3.94     576.18      84.60    733.28       5.48      2.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1030E+02  EXCESS= .7115E+00 OUTFLOW= .1099E+02 BASIN STORAGE= .1160E-02 PERCENT ERROR=      .2

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN           .44       1.42       5.00                 84.05    735.00       5.48

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       CH2

   TOTAL RAINFALL =      7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                               MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR       34.58-HR
+    (CFS)       (HR)
                             (CFS)
+       84.      12.25                   18.           6.           4.           4.
                           (INCHES)   4.495        5.477        5.482        5.482
                            (AC-FT)      9.          11.          11.          11.

                          CUMULATIVE AREA =      .04 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 123 KK     *     N12    *
            *            *
            **************
                          RUNOFF AREA N12

 125 KO          OUTPUT CONTROL VARIABLES
                     IPRNT             3  PRINT CONTROL
                     IPLOT             0  PLOT CONTROL
                     QSCAL            0.  HYDROGRAPH PLOT SCALE
                     IPNCH             7  PUNCH COMPUTED HYDROGRAPH
                      IOUT            21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1             1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2           416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT          .083  TIME INTERVAL IN HOURS
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              SUBBASIN RUNOFF DATA

 126 BA         SUBBASIN CHARACTERISTICS
                      TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =       .01

 127 LS         SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 128 US         SNYDER UNITGRAPH
                         TP          .38  LAG
                         CP          .71  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                         ***

                                                         UNIT HYDROGRAPH PARAMETERS
                                                   CLARK   TC=    .46 HR,        R=   .27 HR
                                                  SNYDER   TP=    .38 HR,       CP=   .70

                                                              UNIT HYDROGRAPH
                                                         21 END-OF-PERIOD ORDINATES
                1.         5.         9.        13.        15.        13.        10.         8.         6.         4.
                3.         2.         2.         1.         1.         1.         0.         0.         0.         0.
                0.

     ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION         N12

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                      6-HR          24-HR         72-HR       34.58-HR
+   (CFS)        (HR)
                              (CFS)
+      28.      12.42                   6.            2.            1.            1.
                           (INCHES)   4.498         5.538         5.538         5.538
                            (AC-FT)      3.            4.            4.            4.

                         CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

           **************
           *            *
 129 KK    *      N3T   *
           *            *
           **************
                         RUNOFF AREA N3T

 131 KO         OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS

              SUBBASIN RUNOFF DATA

 132 BA         SUBBASIN CHARACTERISTICS
                      TAREA          .05  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =       .05

 133 LS         SCS LOSS RATE
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                 STRTL          .38  INITIAL ABSTRACTION
                CRVNBR        84.00  CURVE NUMBER
                 RTIMP          .00  PERCENT IMPERVIOUS AREA

             KINEMATIC WAVE
 134 UK        OVERLAND-FLOW ELEMENT NO. 1
                     L         512.  OVERLAND FLOW LENGTH
                     S        .0200  SLOPE
                     N         .350  ROUGHNESS COEFFICIENT
                    PA        100.0  PERCENT OF SUBBASIN
                 DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
             MUSKINGUM-CUNGE
 135 RD        MAIN CHANNEL
                     L         692.  CHANNEL LENGTH
                     S        .0030  SLOPE
                     N         .030  CHANNEL ROUGHNESS COEFFICIENT
                    CA          .05  CONTRIBUTING AREA
                 SHAPE         TRAP  CHANNEL SHAPE
                    WD          .00  BOTTOM WIDTH OR DIAMETER
                     Z         4.00  SIDE SLOPE
                RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                         ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
               ELEMENT    ALPHA       M        DT        DX        PEAK     TIME TO     VOLUME     MAXIMUM
                                                                             PEAK                  CELERITY
                                             (MIN)      (FT)      (CFS)     (MIN)       (IN)       (FPS)

              PLANE1        .60      1.67      4.73    102.43    124.46    733.59       5.54         .36
              MAIN         1.06      1.33      2.95    691.59    122.61    737.11       5.07        3.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1574E+02 OUTFLOW= .1436E+02 BASIN STORAGE= .2430E-01 PERCENT ERROR=   8.6

                                    INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


              MAIN         1.06      1.33      5.00              122.18    735.00       5.07

     ***          ***          ***            ***            ***

                  HYDROGRAPH AT STATION        N3T

    TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                         6-HR        24-HR        72-HR      34.58-HR
+   (CFS)        (HR)
                               (CFS)
+     122.      12.25                     25.          7.           5.           5.
                            (INCHES)    4.309        5.069        5.073        5.073
                             (AC-FT)      12.          14.          14.          14.

                         CUMULATIVE AREA =      .05 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 136 KK   *     N3S    *
          *            *
          **************
                        RUNOFF AREA N3S

 138 KO        OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE
                     IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                      IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT         .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 139 BA        SUBBASIN CHARACTERISTICS
                     TAREA          .01  SUBBASIN AREA

               PRECIPITATION DATA

 11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00
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                                                  STORM AREA =      .01

 140 LS          SCS LOSS RATE
                      STRTL          .33  INITIAL ABSTRACTION
                     CRVNBR        86.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 141 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L          90.  OVERLAND FLOW LENGTH
                          S        .2000  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 142 RD            MAIN CHANNEL
                          L         581.  CHANNEL LENGTH
                          S        .0030  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         4.00  SIDE SLOPE
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                            ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                ELEMENT    ALPHA        M         DT        DX        PEAK    TIME TO      VOLUME    MAXIMUM
                                                                               PEAK                  CELERITY
                                                 (MIN)      (FT)     (CFS)    (MIN)        (IN)       (FPS)

                PLANE1      1.90      1.67        .60      17.97     27.38    724.55       5.79       .51
                MAIN        1.06      1.33       3.63     290.74     25.94    725.04       5.73      2.67

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1667E+01 OUTFLOW= .1650E+01 BASIN STORAGE= .4547E-03 PERCENT ERROR=   1.0

                                             INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                MAIN        1.06      1.33       5.00                25.88    725.00       5.78

     ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION        N3S

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =      5.79

  PEAK FLOW      TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      34.58-HR
 +    (CFS)       (HR)
                            (CFS)
 +        26.     12.08                3.           1.          1.          1.
                          (INCHES)   4.711       5.775       5.775       5.775
                           (AC-FT)      1.          2.          2.          2.

                          CUMULATIVE AREA =      .01 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 143 KK     *      CN3   *
            *            *
            **************
                          COMBINE N3S, N3T, N12

 145 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS


 146 HC          HYDROGRAPH COMBINATION
                      ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                            ***

     ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION        CN3
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  PEAK FLOW     TIME                                 MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                            (CFS)
+     156.     12.25                      33.          10.          7.          7.
                         (INCHES)       4.368        5.203       5.208       5.208
                          (AC-FT)         17.          20.         20.         20.

                          CUMULATIVE AREA =       .07 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  147 KK    *     CCH3   *
            *            *
            **************
                          COMBINE AREAS N11, N2, N12, N3 AT CH3

  149 KO         OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  150 HC         HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                         ***

      ***              ***              ***              ***              ***

                         HYDROGRAPH AT STATION      CCH3

  PEAK FLOW     TIME                                 MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                            (CFS)
+     240.     12.25                      51.          15.         11.         11.
                         (INCHES)       4.412        5.298       5.303       5.303
                          (AC-FT)         26.          31.         31.         31.

                          CUMULATIVE AREA =       .11 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  151 KK    *      CH3   *
            *            *
            **************
                          RUNOFF AREA CH3

  153 KO         OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  154 BA         SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   11 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                        STORM AREA =      .00

  155 LS         SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
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                CRVNBR        84.00  CURVE NUMBER
                 RTIMP          .00  PERCENT IMPERVIOUS AREA

           KINEMATIC WAVE
 156 UK     OVERLAND-FLOW ELEMENT NO. 1
                     L        153.  OVERLAND FLOW LENGTH
                     S       .2750  SLOPE
                     N        .350  ROUGHNESS COEFFICIENT
                    PA       100.0  PERCENT OF SUBBASIN
                 DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
           MUSKINGUM-CUNGE
 157 RD     MAIN CHANNEL
                     L        698.  CHANNEL LENGTH
                     S       .0010  SLOPE
                     N        .030  CHANNEL ROUGHNESS COEFFICIENT
                    CA         .00  CONTRIBUTING AREA
                 SHAPE        TRAP  CHANNEL SHAPE
                    WD       20.00  BOTTOM WIDTH OR DIAMETER
                     Z        3.00  SIDE SLOPE
                RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                     ***
                         COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                COMPUTATION TIME STEP
            ELEMENT    ALPHA      M         DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                        PEAK                CELERITY
                                          (MIN)      (FT)      (CFS)    (MIN)      (IN)      (FPS)

           PLANE1      2.23     1.67       .90      30.54     17.58    725.17      5.56       .67
           MAIN         .30     1.48      3.74     697.69    238.09    737.52      5.30      3.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3069E+02  EXCESS= .1097E+01 OUTFLOW= .3170E+02 BASIN STORAGE= .3574E-02 PERCENT ERROR=     .2

                                INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

           MAIN         .30     1.48      5.00               237.19    740.00      5.30

    ***          ***          ***          ***          ***

                  HYDROGRAPH AT STATION        CH3

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                   MAXIMUM AVERAGE FLOW
                                6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                       (CFS)
+     237.     12.33             53.         16.         11.         11.
                     (INCHES)   4.407       5.294       5.299       5.299
                      (AC-FT)     26.         32.         32.         32.

                  CUMULATIVE AREA =      .11 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

        **************
        *            *
 158 KK *      N4T   *
        *            *
        **************
                 RUNOFF AREA N4T

 160 KO      OUTPUT CONTROL VARIABLES
                 IPRNT            3  PRINT CONTROL
                 IPLOT            0  PLOT CONTROL
                 QSCAL           0.  HYDROGRAPH PLOT SCALE
                 IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                  IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                 ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                 ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                TIMINT         .083  TIME INTERVAL IN HOURS

          SUBBASIN RUNOFF DATA

 161 BA      SUBBASIN CHARACTERISTICS
                 TAREA          .01  SUBBASIN AREA

             PRECIPITATION DATA

  11 PH                           DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
             ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
             5-MIN  15-MIN  60-MIN   2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               .74    1.57    3.19   4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                             STORM AREA =      .01
```

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 162 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 163 UK           OVERLAND-FLOW ELEMENT NO. 1
                          L         746.  OVERLAND FLOW LENGTH
                          S        .0200  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 164 RD           MAIN CHANNEL
                          L         608.  CHANNEL LENGTH
                          S        .0100  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         4.00  SIDE SLOPE
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                            ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                   ELEMENT    ALPHA        M          DT         DX        PEAK     TIME TO     VOLUME     MAXIMUM
                                                                                     PEAK                  CELERITY
                                                     (MIN)       (FT)      (CFS)     (MIN)       (IN)       (FPS)

                 PLANE1         .60       1.67        4.67     106.62      22.94     743.34      5.54        .39
                 MAIN          1.93       1.33        2.52     304.07      22.88     740.50      5.47       4.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3439E+01 OUTFLOW= .3387E+01 BASIN STORAGE= .8891E-02 PERCENT ERROR=   1.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN          1.93       1.33        5.00                 22.84     740.00      5.47

      ***            ***            ***             ***             ***

                        HYDROGRAPH AT STATION        N4T

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR        72-HR      34.58-HR
+    (CFS)       (HR)
                        (CFS)
+      23.      12.33                   6.           2.           1.           1.
                       (INCHES)      4.467        5.466        5.474        5.474
                        (AC-FT)         3.           3.           3.           3.

                       CUMULATIVE AREA =       .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 165 KK     *     N4S    *
            *            *
            **************
                       RUNOFF AREA N4S

 167 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS

               SUBBASIN RUNOFF DATA

 168 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .01  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
```

```
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                       STORM AREA =       .01

 169 LS        SCS LOSS RATE
                  STRTL         .33  INITIAL ABSTRACTION
                 CRVNBR       86.00  CURVE NUMBER
                  RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 170 UK          OVERLAND-FLOW ELEMENT NO. 1
                      L         78.  OVERLAND FLOW LENGTH
                      S       .2000  SLOPE
                      N        .350  ROUGHNESS COEFFICIENT
                     PA       100.0  PERCENT OF SUBBASIN
                  DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 171 RD          MAIN CHANNEL
                      L        641.  CHANNEL LENGTH
                      S       .0030  SLOPE
                      N        .030  CHANNEL ROUGHNESS COEFFICIENT
                     CA         .01  CONTRIBUTING AREA
                  SHAPE        TRAP  CHANNEL SHAPE
                     WD         .00  BOTTOM WIDTH OR DIAMETER
                      Z        4.00  SIDE SLOPE
                 RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                CELERITY
                                                (MIN)     (FT)     (CFS)     (MIN)       (IN)      (FPS)

               PLANE1        1.90      1.67       .57     15.50     40.56    724.99      5.79        .48
               MAIN          1.06      1.33      3.62    320.27     35.90    723.22      5.68       2.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2439E+01 OUTFLOW= .2392E+01 BASIN STORAGE= .5147E-03 PERCENT ERROR=   1.9

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

               MAIN          1.06      1.33      5.00               33.64    725.00      5.65

     ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION       N4S

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                         (CFS)
+     34.      12.08                  4.          1.          1.          1.
                       (INCHES)   4.607       5.649       5.649       5.649
                        (AC-FT)      2.          2.          2.          2.

                     CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 172 KK   *      CN4   *
          *            *
          **************
                      COMBINE N4 AREAS

 174 KO        OUTPUT CONTROL VARIABLES
                  IPRNT           3  PRINT CONTROL
                  IPLOT           0  PLOT CONTROL
                  QSCAL          0.  HYDROGRAPH PLOT SCALE
                  IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                   IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                  ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                  ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                 TIMINT        .083  TIME INTERVAL IN HOURS


 175 HC        HYDROGRAPH COMBINATION
                  ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***            ***            ***            ***            ***
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                         HYDROGRAPH AT STATION      CN4

   PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      34.58-HR
+   (CFS)         (HR)
                              (CFS)
+       50.       12.08                   9.           3.           2.            2.
                            (INCHES)    4.500        5.536        5.545         5.545
                             (AC-FT)       5.           6.           6.            6.

                          CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 176 KK       *     CH4    *
              *            *
              **************
                          RUNOFF AREA CH4

 178 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 179 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                              DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =        .00

 180 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 181 UK            OVERLAND-FLOW ELEMENT NO. 1
                            L       101.  OVERLAND FLOW LENGTH
                            S      .1980  SLOPE
                            N       .350  ROUGHNESS COEFFICIENT
                           PA      100.0  PERCENT OF SUBBASIN
                        DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 182 RD            MAIN CHANNEL
                            L      1279.  CHANNEL LENGTH
                            S      .0050  SLOPE
                            N       .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA        .00  CONTRIBUTING AREA
                        SHAPE       TRAP  CHANNEL SHAPE
                           WD      10.00  BOTTOM WIDTH OR DIAMETER
                            Z       4.00  SIDE SLOPE
                       RUPSTQ        YES  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                   ELEMENT     ALPHA        M          DT          DX        PEAK     TIME TO     VOLUME    MAXIMUM
                                                                                       PEAK                 CELERITY
                                                     (MIN)        (FT)      (CFS)     (MIN)        (IN)      (FPS)

                  PLANE1        1.89      1.67         .69       20.16      23.91    724.62        5.56        .52
                  MAIN           .97      1.40        5.00      639.25      62.27    730.00        5.53       3.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5767E+01  EXCESS= .1453E+01 OUTFLOW= .7200E+01 BASIN STORAGE= .1358E-02 PERCENT ERROR=     .3


                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN           .97      1.40        5.00                  62.27    730.00        5.53

     ***             ***             ***             ***             ***
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                         HYDROGRAPH AT STATION      CH4

     TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

   PEAK FLOW       TIME                              MAXIMUM AVERAGE FLOW
                                            6-HR        24-HR       72-HR      34.58-HR
 +   (CFS)         (HR)
                                 (CFS)
 +      62.       12.17                       12.          4.          3.          3.
                               (INCHES)     4.503       5.526       5.533       5.533
                                (AC-FT)        6.          7.          7.          7.

                             CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
   183 KK     *   C1CH4A   *
              *            *
              **************
                               COMBINE AREAS N11, N2, N3, N4 AT CHANNEL CH4A

   185 KO           OUTPUT CONTROL VARIABLES
                          IPRNT           3  PRINT CONTROL
                          IPLOT           0  PLOT CONTROL
                          QSCAL          0.  HYDROGRAPH PLOT SCALE
                          IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                           IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT        .083  TIME INTERVAL IN HOURS


   186 HC           HYDROGRAPH COMBINATION
                          ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                        ***

       ***             ***             ***              ***              ***

                          HYDROGRAPH AT STATION   C1CH4A

   PEAK FLOW       TIME                              MAXIMUM AVERAGE FLOW
                                            6-HR        24-HR       72-HR      34.58-HR
 +   (CFS)         (HR)
                                 (CFS)
 +     288.       12.25                       65.         20.         14.         14.
                               (INCHES)     4.424       5.335       5.340       5.340
                                (AC-FT)       32.         39.         39.         39.

                             CUMULATIVE AREA =      .14 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
   187 KK     *    CH4A    *
              *            *
              **************
                               RUNOFF AREA CH4A

   189 KO           OUTPUT CONTROL VARIABLES
                          IPRNT           3  PRINT CONTROL
                          IPLOT           0  PLOT CONTROL
                          QSCAL          0.  HYDROGRAPH PLOT SCALE
                          IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                           IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                          ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                          ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                         TIMINT        .083  TIME INTERVAL IN HOURS

                 SUBBASIN RUNOFF DATA

   190 BA           SUBBASIN CHARACTERISTICS
                          TAREA         .00  SUBBASIN AREA

                    PRECIPITATION DATA

    11 PH                                   DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                    ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                    5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                      .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00
```

```
                                                     STORM AREA =       .00

191 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
192 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L          40.  OVERLAND FLOW LENGTH
                          S        .3300  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
193 RD            MAIN CHANNEL
                          L         520.  CHANNEL LENGTH
                          S        .0035  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .00  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD        20.00  BOTTOM WIDTH OR DIAMETER
                          Z         3.00  SIDE SLOPE
                     RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                               ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                 ELEMENT     ALPHA        M           DT         DX        PEAK      TIME TO     VOLUME     MAXIMUM
                                                                                       PEAK                 CELERITY
                                                    (MIN)       (FT)       (CFS)      (MIN)       (IN)       (FPS)

                 PLANE1       2.45       1.67         .34        8.08        5.52     724.98       5.56         .43
                 MAIN          .57       1.48        1.73      519.75      287.49     737.40       5.34        5.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3891E+02  EXCESS= .3261E+00 OUTFLOW= .3920E+02 BASIN STORAGE= .2158E-02 PERCENT ERROR=    .1

                                             INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN              .57       1.48        5.00                  286.30     735.00       5.34

      ***             ***             ***            ***            ***

                               HYDROGRAPH AT STATION     CH4A

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW       TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR          24-HR         72-HR       34.58-HR
+   (CFS)         (HR)
                              (CFS)
+     286.       12.25                    66.           20.           14.           14.
                            (INCHES)    4.424         5.334         5.339         5.339
                             (AC-FT)      32.           39.           39.           39.

                            CUMULATIVE AREA =     .14 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  194 KK   *     N13    *
           *            *
           **************
                         RUNOFF AREA N13

  196 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  197 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .03  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
```

```
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =       .03

198 LS           SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

199 US           SNYDER UNITGRAPH
                           TP         .53  LAG
                           CP         .69  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                             ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                              CLARK    TC=    .64 HR,        R=   .39 HR
                                             SNYDER    TP=    .53 HR,       CP=   .69

                                                         UNIT HYDROGRAPH
                                                   30 END-OF-PERIOD ORDINATES
                   1.         5.        10.        16.        21.        24.        25.        23.        20.        16.
                  13.        10.         8.         7.         5.         4.         4.         3.         2.         2.
                   2.         1.         1.         1.         1.         1.         0.         0.         0.         0.

      ***            ***            ***            ***            ***

                                   HYDROGRAPH AT STATION        N13

       TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

    PEAK FLOW      TIME                           MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR        72-HR       34.58-HR

 +    (CFS)        (HR)
                                  (CFS)
 +       55.      12.58                    14.           4.           3.           3.
                               (INCHES)  4.490        5.535        5.535        5.535
                                (AC-FT)     7.           9.           9.           9.

                                 CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
200 KK      *      W1    *
            *            *
            **************
                      RUNOFF AREA W1 (POND 1)

202 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

203 BA            SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =       .01

204 LS            SCS LOSS RATE
                        STRTL         .00  INITIAL ABSTRACTION
                       CRVNBR      100.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

205 UD            SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .00  LAG

                                                             ***
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                                          UNIT HYDROGRAPH
                                       5 END-OF-PERIOD ORDINATES
          75.        21.         4.          1.          0.

     ***            ***           ***             ***             ***

                      HYDROGRAPH AT STATION        W1

   TOTAL RAINFALL =     7.44, TOTAL LOSS =      .00, TOTAL EXCESS =     7.44

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                           (CFS)
+      67.      12.08                   8.          3.           2.           2.
                         (INCHES)     5.468       7.437        7.440        7.440
                          (AC-FT)       4.          5.           5.           5.

                       CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
  206 KK      *   PND1IN   *
              *            *
              **************
                       COMBINE ALL FLOWS INTO POND 1

  208 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


  209 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                ***

     ***            ***           ***             ***             ***

                      HYDROGRAPH AT STATION   PND1IN

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                           (CFS)
+     352.      12.25                  87.         27.          19.          19.
                         (INCHES)     4.493       5.496        5.522        5.522
                          (AC-FT)      43.         53.          53.          53.

                       CUMULATIVE AREA =      .18 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
  210 KK      *   PND1OU   *     T
              *            *
              **************
                       ROUTE THROUGH UPPER DET. POND (POND 1) 3-42" AT 451

  212 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


               HYDROGRAPH ROUTING DATA

  213 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC      455.20  INITIAL CONDITION
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                    X          .00 WORKING R AND D COEFFICIENT

214 SA              AREA         .0       7.8       7.9       8.0       8.2

215 SE         ELEVATION    455.20    455.50    456.00    456.50    457.00

217 SL         LOW-LEVEL OUTLET
                     ELEVL      452.77  ELEVATION AT CENTER OF OUTLET
                     CAREA       19.64  CROSS-SECTIONAL AREA
                      COQL         .80  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

216 SS         SPILLWAY
                      CREL      456.00  SPILLWAY CREST ELEVATION
                     SPWID       25.00  SPILLWAY WIDTH
                      COQW        2.60  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

                                                          ***

                                                 COMPUTED STORAGE-ELEVATION DATA

           STORAGE       .00        .78      4.70      8.69     12.74
         ELEVATION    455.20     455.50    456.00    456.50    457.00

                                                 COMPUTED OUTFLOW-ELEVATION DATA

           OUTFLOW       .00     199.32    202.35    205.47    208.68    212.00    215.43    218.97    222.63    226.41
         ELEVATION    455.20     455.27    455.35    455.43    455.51    455.60    455.69    455.79    455.89    456.00

           OUTFLOW    237.55     242.13    247.75    254.50    262.48    271.78    282.50    294.73    308.57    324.10
         ELEVATION    456.18     456.24    456.30    456.38    456.46    456.55    456.65    456.76    456.88    457.00


                                            COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

           STORAGE       .00        .01       .10       .35       .78       .89      1.57      2.29      3.05      3.85
           OUTFLOW    196.38     199.32    202.35    205.47    208.15    208.68    212.00    215.43    218.97    222.63
         ELEVATION    455.20     455.27    455.35    455.43    455.50    455.51    455.60    455.69    455.79    455.89

           STORAGE      4.70       6.12      6.59      7.12      7.72      8.38      8.69      9.12      9.92     10.79
           OUTFLOW    226.41     237.55    242.13    247.75    254.50    262.48    266.29    271.78    282.50    294.73
         ELEVATION    456.00     456.18    456.24    456.30    456.38    456.46    456.50    456.55    456.65    456.76

           STORAGE     11.73      12.74
           OUTFLOW    308.57     324.10
         ELEVATION    456.88     457.00

    ***           ***           ***           ***           ***

                         HYDROGRAPH AT STATION    PND10U

 PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                            (CFS)
+     229.     12.75                  202.         198.         197.         197.
                         (INCHES)   10.427       40.858       58.751       58.751
                          (AC-FT)     100.         392.         564.         564.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR        72-HR      34.58-HR
+  (AC-FT)      (HR)
        5.     12.75                    0.           0.           0.          -1.

 PEAK STAGE     TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR        72-HR      34.58-HR
+   (FEET)      (HR)
    456.04     12.75                455.34       455.24       455.23       455.23

                         CUMULATIVE AREA =      .18 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 218 KK      *     N16    *
             *            *
             **************
                          RUNOFF AREA N16

 220 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
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              TIMINT        .083  TIME INTERVAL IN HOURS

          SUBBASIN RUNOFF DATA

 221 BA         SUBBASIN CHARACTERISTICS
                     TAREA          .00  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =       .00

 222 LS         SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 223 US         SNYDER UNITGRAPH
                         TP          .24  LAG
                         CP          .71  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                ***

                                                    UNIT HYDROGRAPH PARAMETERS
                                              CLARK   TC=    .31 HR,       R=    .14 HR
                                             SNYDER   TP=    .24 HR,      CP=    .70

                                                         UNIT HYDROGRAPH
                                                    11 END-OF-PERIOD ORDINATES
                1.        5.        8.        8.        5.        3.        1.        1.        0.        0.
                0.

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION       N16

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+      12.     12.25                       2.           1.           0.           0.
                        (INCHES)        4.498        5.534        5.534        5.534
                         (AC-FT)           1.           1.           1.           1.

                      CUMULATIVE AREA =      .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

           **************
           *            *
  224 KK   *    CHW1    *
           *            *
           **************
                  RUNOFF AREA CHW1

  226 KO        OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS

          SUBBASIN RUNOFF DATA

  227 BA        SUBBASIN CHARACTERISTICS
                     TAREA          .00  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =       .00
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228 LS          SCS LOSS RATE
                   STRTL          .38  INITIAL ABSTRACTION
                  CRVNBR        84.00  CURVE NUMBER
                   RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
229 UK            OVERLAND-FLOW ELEMENT NO. 1
                       L          42.  OVERLAND FLOW LENGTH
                       S        .3300  SLOPE
                       N         .350  ROUGHNESS COEFFICIENT
                      PA        100.0  PERCENT OF SUBBASIN
                   DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
230 RD            MAIN CHANNEL
                       L         551.  CHANNEL LENGTH
                       S        .0010  SLOPE
                       N         .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA          .00  CONTRIBUTING AREA
                   SHAPE         TRAP  CHANNEL SHAPE
                      WD        20.00  BOTTOM WIDTH OR DIAMETER
                       Z         3.00  SIDE SLOPE
                  RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                         COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                COMPUTATION TIME STEP
                ELEMENT    ALPHA       M        DT       DX      PEAK    TIME TO    VOLUME    MAXIMUM
                                                                          PEAK                CELERITY
                                              (MIN)     (FT)    (CFS)    (MIN)      (IN)      (FPS)

                PLANE1      2.45      1.67      .39     8.37     7.02    724.78     5.56       .44
                MAIN         .30      1.48     5.00   275.57    13.02    740.00     5.49      1.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1240E+01  EXCESS= .4150E+00 OUTFLOW= .1639E+01 BASIN STORAGE= .1476E-02 PERCENT ERROR=     .9

                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN         .30      1.48     5.00            13.02    740.00     5.49

      ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION     CHW1

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR         24-HR        72-HR       34.58-HR
+   (CFS)       (HR)
                           (CFS)
+      13.      12.33                 3.            1.           1.           1.
                         (INCHES)   4.490        5.487        5.487        5.487
                          (AC-FT)      1.           2.           2.           2.

                    CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
231 KK      *    MIDRD   *
            *            *
            **************
                         COMBINE ALL FLOWS U/S OF ENTRANCE ROAD

233 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


234 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE
                                                ***

      ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION     MIDRD

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR         24-HR        72-HR       34.58-HR
```

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+   (CFS)       (HR)
                          (CFS)
+    2673.      12.75                1070.        468.        385.        385.
                        (INCHES)     5.060       8.849      10.487      10.487
                         (AC-FT)      531.        928.       1100.       1100.

                       CUMULATIVE AREA =    1.97 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 235 KK       *      S5    *
              *            *
              **************
                     RUNOFF AREA S5

 237 KO         OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 238 BA         SUBBASIN CHARACTERISTICS
                      TAREA        .00  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                              STORM AREA =       .00

 239 LS         SCS LOSS RATE
                      STRTL        .38  INITIAL ABSTRACTION
                     CRVNBR      84.00  CURVE NUMBER
                      RTIMP        .00  PERCENT IMPERVIOUS AREA

 240 US         SNYDER UNITGRAPH
                         TP        .23  LAG
                         CP        .75  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                         UNIT HYDROGRAPH PARAMETERS
                                   CLARK    TC=    .30 HR,        R=    .12 HR
                                  SNYDER    TP=    .23 HR,       CP=    .74

                                              UNIT HYDROGRAPH
                                         10 END-OF-PERIOD ORDINATES
                0.          1.          2.          2.          1.          1.          0.          0.          0.          0.

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION       S5

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW       TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR       72-HR     34.58-HR
+   (CFS)        (HR)
                          (CFS)
+       3.      12.25                   0.          0.          0.          0.
                        (INCHES)     4.499       5.535       5.535       5.535
                         (AC-FT)        0.          0.          0.          0.

                       CUMULATIVE AREA =     .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 241 KK       *     CS5    *
              *            *
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              **************
                                 COMBINE ALL FLOWS U/S OF ENTRANCE ROAD WITH S5

  243 KO          OUTPUT CONTROL VARIABLES
                        IPRNT              3  PRINT CONTROL
                        IPLOT              0  PLOT CONTROL
                        QSCAL             0.  HYDROGRAPH PLOT SCALE
                        IPNCH              7  PUNCH COMPUTED HYDROGRAPH
                         IOUT             21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1              1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2            416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT           .083  TIME INTERVAL IN HOURS


  244 HC          HYDROGRAPH COMBINATION
                        ICOMP              2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                    ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION        CS5

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                           (CFS)
+    2674.     12.75                   1070.        468.        385.        385.
                         (INCHES)     5.059        8.847      10.484      10.484
                          (AC-FT)      531.         928.       1100.       1100.

                          CUMULATIVE AREA =     1.97 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  245 KK      *      O4    *
              *            *
              **************
                                 OFFSITE AREA O4

  247 KO          OUTPUT CONTROL VARIABLES
                        IPRNT              3  PRINT CONTROL
                        IPLOT              0  PLOT CONTROL
                        QSCAL             0.  HYDROGRAPH PLOT SCALE
                        IPNCH              7  PUNCH COMPUTED HYDROGRAPH
                         IOUT             21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1              1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2            416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT           .083  TIME INTERVAL IN HOURS


                  SUBBASIN RUNOFF DATA

  248 BA          SUBBASIN CHARACTERISTICS
                        TAREA            .13  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                      STORM AREA =       .13

  249 LS          SCS LOSS RATE
                        STRTL            .38  INITIAL ABSTRACTION
                       CRVNBR          84.00  CURVE NUMBER
                        RTIMP            .00  PERCENT IMPERVIOUS AREA

  250 US          SNYDER UNITGRAPH
                           TP            .43  LAG
                           CP            .64  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                    ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=    .51 HR,        R=    .36 HR
                                            SNYDER   TP=    .43 HR,       CP=    .64

                                                         UNIT HYDROGRAPH
                                                   27 END-OF-PERIOD ORDINATES
                 10.        36.        71.       105.       126.       131.       115.        92.        73.        58.
                 46.        37.        29.        23.        18.        15.        12.         9.         7.         6.
                  5.         4.         3.         2.         2.         1.         1.
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     ***              ***              ***              ***              ***

                         HYDROGRAPH AT STATION       O4

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                           MAXIMUM AVERAGE FLOW
                                           6-HR         24-HR        72-HR      34.58-HR
+   (CFS)        (HR)
                              (CFS)
+      269.      12.50                     65.           20.          14.           14.
                             (INCHES)    4.491         5.534        5.534         5.534
                             (AC-FT)       32.           40.          40.           40.

                             CUMULATIVE AREA =     .13 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  251 KK     *    C4MWY   *
             *            *
             **************
                                   COMBINE ALL FLOWS UPSTREAM OF N10

  253 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


  254 HC          HYDROGRAPH COMBINATION
                        ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                     ***

     ***              ***              ***              ***              ***

                         HYDROGRAPH AT STATION    C4MWY

  PEAK FLOW      TIME                           MAXIMUM AVERAGE FLOW
                                           6-HR         24-HR        72-HR      34.58-HR
+   (CFS)        (HR)
                              (CFS)
+     2887.      12.75                   1135.          488.         399.          399.
                             (INCHES)    5.022         8.635       10.168        10.168
                             (AC-FT)      563.          968.        1140.         1140.

                             CUMULATIVE AREA =    2.10 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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             *            *
  255 KK     *     N10T   *
             *            *
             **************
                            RUNOFF AREA N10T

  257 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS

               SUBBASIN RUNOFF DATA

  258 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .02  SUBBASIN AREA

                PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
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              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                        STORM AREA =       .02

 259 LS       SCS LOSS RATE
                   STRTL         .38  INITIAL ABSTRACTION
                  CRVNBR       84.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
 260 UK         OVERLAND-FLOW ELEMENT NO. 1
                       L        733.  OVERLAND FLOW LENGTH
                       S       .0200  SLOPE
                       N        .350  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                   DXMIN           5  MINIMUM NUMBER OF DX INTERVALS

              KINEMATIC WAVE
 261 RK         MAIN CHANNEL
                       L        619.  CHANNEL LENGTH
                       S       .0020  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .02  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        4.00  SIDE SLOPE
                  NDXMIN           2  MINIMUM NUMBER OF DX INTERVALS
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                               COMPUTED KINEMATIC PARAMETERS
                                    VARIABLE TIME STEP
                                  (DT SHOWN IS A MINIMUM)

               ELEMENT    ALPHA       M          DT         DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                 CELERITY
                                                (MIN)      (FT)      (CFS)    (MIN)       (IN)      (FPS)

              PLANE1        .60      1.67        4.49     104.72     37.16    741.60      5.54       .39
              MAIN          .87      1.33        1.23     206.29     36.95    741.58      5.53      3.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5514E+01 OUTFLOW= .5490E+01 BASIN STORAGE= .1379E-01 PERCENT ERROR=     .2

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

              MAIN          .87      1.33        5.00                36.82    745.00      5.55

     ***        ***        ***        ***        ***

                    HYDROGRAPH AT STATION     N10T

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+     37.      12.42                 9.          3.          2.          2.
                      (INCHES)    4.484       5.535       5.546       5.546
                       (AC-FT)       4.          5.          6.          6.

                     CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
 262 KK     *    N10S    *
            *            *
            **************
                     RUNOFF AREA N10S

 264 KO       OUTPUT CONTROL VARIABLES
                   IPRNT           3  PRINT CONTROL
                   IPLOT           0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE
                   IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA
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265 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

 11 PH                          DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                          STORM AREA =      .01

266 LS          SCS LOSS RATE
                     STRTL          .33  INITIAL ABSTRACTION
                    CRVNBR        86.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
267 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L         100.  OVERLAND FLOW LENGTH
                         S        .2000  SLOPE
                         N         .350  ROUGHNESS COEFFICIENT
                        PA        100.0  PERCENT OF SUBBASIN
                     DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

                KINEMATIC WAVE
268 RK            MAIN CHANNEL
                         L         717.  CHANNEL LENGTH
                         S        .0130  SLOPE
                         N         .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA          .01  CONTRIBUTING AREA
                     SHAPE         TRAP  CHANNEL SHAPE
                        WD          .00  BOTTOM WIDTH OR DIAMETER
                         Z         4.00  SIDE SLOPE
                    NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
                    RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                            ***
                              COMPUTED KINEMATIC PARAMETERS
                                   VARIABLE TIME STEP
                                  (DT SHOWN IS A MINIMUM)

                  ELEMENT    ALPHA       M         DT         DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                PEAK                 CELERITY
                                                  (MIN)      (FT)      (CFS)    (MIN)       (IN)      (FPS)

                 PLANE1       1.90     1.67        .79      19.95      57.51    724.48      5.79        .53
                 MAIN         2.21     1.33        .62     239.07      55.67    725.10      5.79       7.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3551E+01 OUTFLOW= .3550E+01 BASIN STORAGE= .1045E-03 PERCENT ERROR=     .0

                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN         2.21     1.33       5.00                 55.40    725.00      5.79

     ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION       N10S

  TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR      34.58-HR
+   (CFS)      (HR)
                       (CFS)
+      55.     12.08                6.          2.          1.           1.
                     (INCHES)    4.686       5.794       5.795        5.795
                      (AC-FT)       3.          4.          4.           4.

                     CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 269 KK     *    CN10    *
            *            *
            **************
                       COMBINE N10 AREAS

 271 KO         OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
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                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


 272 HC        HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                              ***

     ***          ***         ***          ***          ***

                   HYDROGRAPH AT STATION     CN10

  PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                         (CFS)
+     78.      12.08                15.          5.          3.          3.
                       (INCHES)    4.539       5.629       5.641       5.641
                        (AC-FT)       7.          9.          9.          9.

                    CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
 273 KK       *     CH10   *
              *            *
              **************
                       RUNOFF AREA CH10

 275 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 276 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .01  SUBBASIN AREA

               PRECIPITATION DATA

  11 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                             STORM AREA =       .01


 277 LS        SCS LOSS RATE
                   STRTL         .38  INITIAL ABSTRACTION
                  CRVNBR       84.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 278 UK          OVERLAND-FLOW ELEMENT NO. 1
                       L         88.  OVERLAND FLOW LENGTH
                       S       .0150  SLOPE
                       N        .350  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                   DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 279 RD          MAIN CHANNEL
                       L       1454.  CHANNEL LENGTH
                       S       .0110  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD       10.00  BOTTOM WIDTH OR DIAMETER
                       Z        3.00  SIDE SLOPE
                  RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                              ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
                ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                              PEAK              CELERITY
                                               (MIN)      (FT)     (CFS)     (MIN)      (IN)      (FPS)

                PLANE1       .52     1.67       1.45     17.68     51.95    725.99      5.56        .21
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              MAIN           1.45      1.42       3.89    726.90    120.07    728.17      5.59      6.22

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9055E+01  EXCESS= .3884E+01 OUTFLOW= .1288E+02 BASIN STORAGE= .2546E-02 PERCENT ERROR=    .4

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

              MAIN           1.45      1.42       5.00              114.78    730.00      5.59

     ***          ***           ***          ***            ***

                         HYDROGRAPH AT STATION    CH10

    TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                         (CFS)
+     115.     12.17                21.           6.          5.           5.
                       (INCHES)    4.522       5.577       5.586       5.586
                        (AC-FT)      10.          13.         13.         13.

                        CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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            *            *
  280 KK    *   CABELM   *
            *            *
            **************
                          COMBINE AREAS UPSTREAM OF ELM FORK

  282 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


  283 HC          HYDROGRAPH COMBINATION
                        ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                ***

     ***          ***           ***          ***            ***

                         HYDROGRAPH AT STATION   CABELM

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                         (CFS)
+    2933.     12.75              1156.         494.        403.         403.
                       (INCHES)    5.012       8.574      10.075      10.075
                        (AC-FT)     573.         981.       1152.       1152.

                        CUMULATIVE AREA =     2.14 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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            *            *
  284 KK    *      N9T   *
            *            *
            **************
                          RUNOFF AREA N9T

  286 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS
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               SUBBASIN RUNOFF DATA

 287 BA          SUBBASIN CHARACTERISTICS
                       TAREA          .02  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =       .02

 288 LS          SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                      CRVNBR        84.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 289 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         566.  OVERLAND FLOW LENGTH
                           S        .0200  SLOPE
                           N         .350  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

                 KINEMATIC WAVE
 290 RK            MAIN CHANNEL
                           L         696.  CHANNEL LENGTH
                           S        .0030  SLOPE
                           N         .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA          .02  CONTRIBUTING AREA
                       SHAPE         TRAP  CHANNEL SHAPE
                          WD          .00  BOTTOM WIDTH OR DIAMETER
                           Z         4.00  SIDE SLOPE
                      NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
                      RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                           ***
                                        COMPUTED KINEMATIC PARAMETERS
                                              VARIABLE TIME STEP
                                            (DT SHOWN IS A MINIMUM)

                   ELEMENT    ALPHA       M         DT         DX        PEAK    TIME TO    VOLUME    MAXIMUM
                                                                                   PEAK                CELERITY
                                                  (MIN)       (FT)      (CFS)     (MIN)      (IN)      (FPS)

                  PLANE1         .60      1.67      4.26      94.36      40.09    734.99      5.54       .37
                  MAIN          1.06      1.33      1.05     232.03      39.81    739.00      5.54      3.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5247E+01 OUTFLOW= .5229E+01 BASIN STORAGE= .8873E-02 PERCENT ERROR=     .2

                                             INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          1.06      1.33      5.00                 39.58    740.00      5.54

      ***             ***            ***            ***            ***

                         HYDROGRAPH AT STATION      N9T

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                         6-HR        24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                            (CFS)
+      40.     12.33                       9.           3.           2.           2.
                          (INCHES)      4.481        5.528        5.537        5.537
                           (AC-FT)         4.           5.           5.           5.

                          CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

               **************
               *            *
  291 KK       *     N9S    *
               *            *
               **************
                          RUNOFF AREA N9S

  293 KO          OUTPUT CONTROL VARIABLES
                        IPRNT          3  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
```

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                    QSCAL           0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS

             SUBBASIN RUNOFF DATA

 294 BA       SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA

              PRECIPITATION DATA

  11 PH                        DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                              STORM AREA =      .01

 295 LS       SCS LOSS RATE
                   STRTL          .33  INITIAL ABSTRACTION
                  CRVNBR        86.00  CURVE NUMBER
                   RTIMP          .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
 296 UK         OVERLAND-FLOW ELEMENT NO. 1
                       L          84.  OVERLAND FLOW LENGTH
                       S        .2000  SLOPE
                       N         .350  ROUGHNESS COEFFICIENT
                      PA        100.0  PERCENT OF SUBBASIN
                   DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

              KINEMATIC WAVE
 297 RK         MAIN CHANNEL
                       L         792.  CHANNEL LENGTH
                       S        .0140  SLOPE
                       N         .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA          .01  CONTRIBUTING AREA
                   SHAPE         TRAP  CHANNEL SHAPE
                      WD          .00  BOTTOM WIDTH OR DIAMETER
                       Z         4.00  SIDE SLOPE
                  NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
                  RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                               COMPUTED KINEMATIC PARAMETERS
                                    VARIABLE TIME STEP
                                   (DT SHOWN IS A MINIMUM)

                ELEMENT    ALPHA       M        DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                           PEAK                 CELERITY
                                              (MIN)      (FT)     (CFS)   (MIN)       (IN)      (FPS)

               PLANE1       1.90      1.67       .71     16.71     74.98    724.42      5.79       .50
               MAIN         2.29      1.33       .57    263.88     73.17    725.45      5.79      7.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4570E+01 OUTFLOW= .4568E+01 BASIN STORAGE= .1143E-03 PERCENT ERROR=     .0

                                  INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

               MAIN         2.29      1.33      5.00                72.83    725.00      5.80

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       N9S

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)      (HR)
                           (CFS)
+       73.     12.08                  7.          2.          2.          2.
                         (INCHES)  4.693       5.801       5.801       5.801
                          (AC-FT)     4.          5.          5.          5.

                        CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  298 KK     *      CN9   *
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          *              *
          **************
                    COMBINE N9 AREAS

 300 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS


 301 HC          HYDROGRAPH COMBINATION
                      ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION       CN9

  PEAK FLOW      TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      34.58-HR

 +   (CFS)       (HR)
                           (CFS)
 +       99.     12.08                   16.           5.           3.           3.
                         (INCHES)      4.559        5.649        5.657        5.657
                          (AC-FT)         8.          10.          10.          10.

                    CUMULATIVE AREA =      .03 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 302 KK   *     CH9    *
          *            *
          **************
                    RUNOFF AREA CH9

 304 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 305 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .01  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =      .01


 306 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 307 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L          85.  OVERLAND FLOW LENGTH
                          S        .1570  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 308 RD            MAIN CHANNEL
                          L        1689.  CHANNEL LENGTH
                          S        .0010  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD        10.00  BOTTOM WIDTH OR DIAMETER
                          Z         3.00  SIDE SLOPE
```

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          RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                    COMPUTATION TIME STEP
         ELEMENT      ALPHA        M          DT         DX         PEAK     TIME TO     VOLUME      MAXIMUM
                                                                              PEAK                    CELERITY
                                             (MIN)      (FT)        (CFS)     (MIN)       (IN)        (FPS)

        PLANE1          1.69      1.67        .64      16.97       26.58     724.79       5.56          .45
        MAIN             .44      1.42       5.00     844.65       83.50     735.00       5.58         2.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9806E+01  EXCESS= .1601E+01 OUTFLOW= .1129E+02 BASIN STORAGE= .4162E-02 PERCENT ERROR=    1.0

                                      INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

        MAIN             .44      1.42       5.00                  83.50     735.00       5.58

   ***        ***        ***        ***        ***

                HYDROGRAPH AT STATION       CH9

  TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      34.58-HR
+   (CFS)      (HR)
                          (CFS)
+     84.     12.25                  18.          6.          4.          4.
                        (INCHES)   4.525       5.576       5.584       5.584
                        (AC-FT)       9.         11.         11.         11.

                  CUMULATIVE AREA =     .04 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
   309 KK     *      N5T   *
              *            *
              **************
                       RUNOFF AREA N5T

   311 KO          OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS

                 SUBBASIN RUNOFF DATA

   312 BA          SUBBASIN CHARACTERISTICS
                         TAREA         .03  SUBBASIN AREA

                   PRECIPITATION DATA

    11 PH                                DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......    ............... TP-40 ..............    ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN     2-HR     3-HR     6-HR    12-HR    24-HR    2-DAY    4-DAY    7-DAY   10-DAY
                     .74    1.57    3.19     4.18     4.52     5.47     6.43     7.44      .00      .00      .00      .00

                                                      STORM AREA =       .03

   313 LS          SCS LOSS RATE
                          STRTL          .38  INITIAL ABSTRACTION
                         CRVNBR        84.00  CURVE NUMBER
                          RTIMP          .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
   314 UK            OVERLAND-FLOW ELEMENT NO. 1
                              L        1134.  OVERLAND FLOW LENGTH
                              S        .0200  SLOPE
                              N         .350  ROUGHNESS COEFFICIENT
                             PA        100.0  PERCENT OF SUBBASIN
                          DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

                   KINEMATIC WAVE
   315 RK            MAIN CHANNEL
                              L         154.  CHANNEL LENGTH
                              S        .0020  SLOPE
                              N         .030  CHANNEL ROUGHNESS COEFFICIENT
```

```
              CA          .03  CONTRIBUTING AREA
           SHAPE         TRAP  CHANNEL SHAPE
              WD          .00  BOTTOM WIDTH OR DIAMETER
               Z         4.00  SIDE SLOPE
          NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
          RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                          ***
                         COMPUTED KINEMATIC PARAMETERS
                              VARIABLE TIME STEP
                             (DT SHOWN IS A MINIMUM)

    ELEMENT    ALPHA      M        DT       DX      PEAK    TIME TO   VOLUME   MAXIMUM
                                                            PEAK               CELERITY
                                  (MIN)    (FT)    (CFS)    (MIN)     (IN)     (FPS)

    PLANE1      .60     1.67      5.00   125.96    50.66    750.75    5.52      .42
    MAIN        .87     1.33       .30    51.38    50.41    754.37    5.52     3.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .9338E+01 OUTFLOW= .9275E+01 BASIN STORAGE= .4378E-01 PERCENT ERROR=     .2

                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

    MAIN        .87     1.33      5.00             50.41    755.00    5.51

   ***         ***         ***         ***         ***

              HYDROGRAPH AT STATION       N5T

  TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR      34.58-HR
+  (CFS)        (HR)
                         (CFS)
+      50.      12.58                15.          5.          3.          3.
                       (INCHES)   4.428       5.498       5.513       5.513
                        (AC-FT)      7.          9.          9.          9.

              CUMULATIVE AREA =      .03 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
 316 KK      *      N5S   *
             *            *
             **************
                        RUNOFF AREA N5S

 318 KO           OUTPUT CONTROL VARIABLES
                        IPRNT             3  PRINT CONTROL
                        IPLOT             0  PLOT CONTROL
                        QSCAL            0.  HYDROGRAPH PLOT SCALE
                        IPNCH             7  PUNCH COMPUTED HYDROGRAPH
                         IOUT            21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1             1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2           416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT          .083  TIME INTERVAL IN HOURS

              SUBBASIN RUNOFF DATA

 319 BA           SUBBASIN CHARACTERISTICS
                        TAREA           .01  SUBBASIN AREA

                  PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =       .01

 320 LS           SCS LOSS RATE
                        STRTL           .33  INITIAL ABSTRACTION
                       CRVNBR         86.00  CURVE NUMBER
                        RTIMP           .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 321 UK             OVERLAND-FLOW ELEMENT NO. 1
                            L          126.  OVERLAND FLOW LENGTH
                            S         .1400  SLOPE
                            N          .350  ROUGHNESS COEFFICIENT
                           PA         100.0  PERCENT OF SUBBASIN
```

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                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS

                KINEMATIC WAVE
322 RK            MAIN CHANNEL
                        L         629.  CHANNEL LENGTH
                        S        .0100  SLOPE
                        N         .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA          .01  CONTRIBUTING AREA
                    SHAPE         TRAP  CHANNEL SHAPE
                       WD          .00  BOTTOM WIDTH OR DIAMETER
                        Z         4.00  SIDE SLOPE
                   NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
                   RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                              COMPUTED KINEMATIC PARAMETERS
                                  VARIABLE TIME STEP
                                 (DT SHOWN IS A MINIMUM)

           ELEMENT    ALPHA       M        DT        DX       PEAK    TIME TO    VOLUME   MAXIMUM
                                                                       PEAK               CELERITY
                                          (MIN)     (FT)     (CFS)    (MIN)      (IN)      (FPS)

          PLANE1       1.59     1.67      .94     25.22     33.64    725.19      5.79       .51
          MAIN         1.93     1.33      .73    209.60     32.50    726.07      5.79      5.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2161E+01 OUTFLOW= .2161E+01 BASIN STORAGE= .1163E-03 PERCENT ERROR=    .0

                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

          MAIN         1.93     1.33     5.00               31.52    725.00      5.79

   ***        ***        ***        ***        ***

                    HYDROGRAPH AT STATION     N5S

  TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.65, TOTAL EXCESS =    5.79

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                 6-HR       24-HR      72-HR     34.58-HR

+  (CFS)       (HR)
                         (CFS)
+     32.     12.08                4.         1.         1.         1.
                      (INCHES)  4.683      5.791      5.792      5.792
                       (AC-FT)     2.         2.         2.         2.

                    CUMULATIVE AREA =     .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
323 KK        *     CN5    *
              *            *
              **************
                     COMBINE N5 AREAS

325 KO          OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


326 HC          HYDROGRAPH COMBINATION
                    ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                          ***

   ***        ***        ***        ***        ***

                    HYDROGRAPH AT STATION     CN5

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                 6-HR       24-HR      72-HR     34.58-HR

+  (CFS)       (HR)
                         (CFS)
+     63.     12.08               18.         6.         4.         4.
                      (INCHES)  4.458      5.545      5.564      5.564
                       (AC-FT)     9.        11.        11.        11.

                    CUMULATIVE AREA =     .04 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  327 KK      *     CH5    *
              *            *
              **************
                             RUNOFF AREA CH5

  329 KO        OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  330 BA        SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

   11 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =       .01

  331 LS        SCS LOSS RATE
                     STRTL          .38  INITIAL ABSTRACTION
                    CRVNBR        84.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  332 UK          OVERLAND-FLOW ELEMENT NO. 1
                         L         101.  OVERLAND FLOW LENGTH
                         S        .1980  SLOPE
                         N         .350  ROUGHNESS COEFFICIENT
                        PA        100.0  PERCENT OF SUBBASIN
                     DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  333 RD          MAIN CHANNEL
                         L        1359.  CHANNEL LENGTH
                         S        .0010  SLOPE
                         N         .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA          .01  CONTRIBUTING AREA
                     SHAPE         TRAP  CHANNEL SHAPE
                        WD        10.00  BOTTOM WIDTH OR DIAMETER
                         Z         3.00  SIDE SLOPE
                    RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                            COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                   COMPUTATION TIME STEP
                  ELEMENT     ALPHA       M         DT        DX        PEAK    TIME TO    VOLUME    MAXIMUM
                                                                                 PEAK                CELERITY
                                                  (MIN)      (FT)      (CFS)    (MIN)       (IN)      (FPS)

                 PLANE1        1.89      1.67       .69     20.16     24.88    724.60      5.56        .52
                 MAIN           .44      1.42      5.00    679.30     66.15    740.00      5.54       2.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1142E+02  EXCESS= .1512E+01 OUTFLOW= .1288E+02 BASIN STORAGE= .8477E-02 PERCENT ERROR=     .4

                                    INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN           .44      1.42      5.00               66.15    740.00      5.54

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       CH5

    TOTAL RAINFALL =     7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW       TIME                           MAXIMUM AVERAGE FLOW
                                           6-HR        24-HR       72-HR       34.58-HR
+   (CFS)        (HR)
                               (CFS)
+     66.        12.33                      21.           6.          5.           5.
                             (INCHES)     4.444        5.521       5.538        5.538
```

```
                    (AC-FT)        10.           13.           13.           13.

                    CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 334 KK       *     N6T    *
              *            *
              **************
                            RUNOFF AREA N6T

 336 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 337 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                          DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                              STORM AREA =       .01

 338 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 339 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         476.  OVERLAND FLOW LENGTH
                          S        .0200  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

                 KINEMATIC WAVE
 340 RK            MAIN CHANNEL
                          L         653.  CHANNEL LENGTH
                          S        .0050  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         4.00  SIDE SLOPE
                     NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                        COMPUTED KINEMATIC PARAMETERS
                                              VARIABLE TIME STEP
                                           (DT SHOWN IS A MINIMUM)

                   ELEMENT    ALPHA      M        DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                               PEAK                CELERITY
                                                 (MIN)     (FT)     (CFS)    (MIN)       (IN)      (FPS)

                  PLANE1        .60     1.67     4.47     95.22     20.75    732.88      5.54        .36
                  MAIN         1.37     1.33     1.02    217.64     20.70    737.48      5.54       3.88

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2550E+01 OUTFLOW= .2541E+01 BASIN STORAGE= .3798E-02 PERCENT ERROR=     .2

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN         1.37     1.33     5.00               20.47    735.00      5.53

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION      N6T

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56
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```
 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+  (CFS)       (HR)
                          (CFS)
+     20.      12.25                   4.           1.          1.          1.
                          (INCHES)    4.475       5.520       5.528       5.528
                          (AC-FT)      2.           3.          3.          3.

                          CUMULATIVE AREA =      .01 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 341 KK       *      N6S   *
              *            *
              **************
                      RUNOFF AREA N6S

 343 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

 344 BA            SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                   PRECIPITATION DATA

 11 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ..............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                     .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                  STORM AREA =        .01

 345 LS            SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
 346 UK              OVERLAND-FLOW ELEMENT NO. 1
                            L          86.  OVERLAND FLOW LENGTH
                            S        .2000  SLOPE
                            N         .350  ROUGHNESS COEFFICIENT
                           PA        100.0  PERCENT OF SUBBASIN
                        DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

                   KINEMATIC WAVE
 347 RK              MAIN CHANNEL
                            L         641.  CHANNEL LENGTH
                            S        .0050  SLOPE
                            N         .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA          .01  CONTRIBUTING AREA
                        SHAPE         TRAP  CHANNEL SHAPE
                           WD          .00  BOTTOM WIDTH OR DIAMETER
                            Z         4.00  SIDE SLOPE
                       NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
                       RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                   COMPUTED KINEMATIC PARAMETERS
                                        VARIABLE TIME STEP
                                      (DT SHOWN IS A MINIMUM)

                  ELEMENT    ALPHA       M         DT         DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                 (MIN)       (FT)      (CFS)    (MIN)       (IN)      (FPS)

                  PLANE1      1.90      1.67        .59      17.15      32.70    724.84      5.79       .50
                  MAIN        1.37      1.33        .91     213.76      30.94    725.80      5.79      4.27


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1976E+01 OUTFLOW= .1976E+01 BASIN STORAGE= .4982E-04 PERCENT ERROR=     .0


                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL
```

```
              MAIN          1.37       1.33       5.00                 30.36    725.00      5.80

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION         N6S

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR      72-HR     34.58-HR
+   (CFS)       (HR)
                           (CFS)
+     30.      12.08                    3.          1.         1.          1.
                          (INCHES)   4.692       5.800      5.801       5.801
                          (AC-FT)       2.          2.         2.          2.

                          CUMULATIVE AREA =      .01 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  348 KK      *     CN6    *
              *            *
              **************
                         COMBINE N6 AREAS

  350 KO          OUTPUT CONTROL VARIABLES
                        IPRNT          3  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE
                        IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                         IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       .083  TIME INTERVAL IN HOURS

  351 HC          HYDROGRAPH COMBINATION
                        ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                  ***

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION         CN6

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR      72-HR     34.58-HR
+   (CFS)       (HR)
                           (CFS)
+     44.      12.08                    7.          2.         2.          2.
                          (INCHES)   4.554       5.637      5.644       5.644
                          (AC-FT)       4.          5.         5.          5.

                          CUMULATIVE AREA =      .02 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  352 KK      *    CCH6    *
              *            *
              **************
                         COMBINE AREAS N5 AND N6 AT CH6

  354 KO          OUTPUT CONTROL VARIABLES
                        IPRNT          3  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE
                        IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                         IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       .083  TIME INTERVAL IN HOURS

  355 HC          HYDROGRAPH COMBINATION
                        ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                  ***

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION        CCH6
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  PEAK FLOW      TIME                                MAXIMUM AVERAGE FLOW
                                        6-HR         24-HR        72-HR       34.58-HR
+   (CFS)        (HR)
                               (CFS)
+     100.      12.17                    28.           9.           6.            6.
                             (INCHES)   4.464        5.549        5.565         5.565
                              (AC-FT)     14.          17.          17.           17.

                             CUMULATIVE AREA =       .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
  356 KK      *      CH6   *
              *            *
              **************
                    RUNOFF AREA CH6

  358 KO         OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  359 BA         SUBBASIN CHARACTERISTICS
                       TAREA        .00  SUBBASIN AREA

                 PRECIPITATION DATA

   11 PH                            DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                 STORM AREA =       .00

  360 LS         SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  361 UK           OVERLAND-FLOW ELEMENT NO. 1
                          L        101.  OVERLAND FLOW LENGTH
                          S       .1700  SLOPE
                          N        .350  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  362 RD           MAIN CHANNEL
                          L       1371.  CHANNEL LENGTH
                          S       .0010  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD       20.00  BOTTOM WIDTH OR DIAMETER
                          Z        3.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                             COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                    COMPUTATION TIME STEP
                 ELEMENT    ALPHA      M         DT         DX        PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                PEAK                CELERITY
                                               (MIN)       (FT)      (CFS)     (MIN)       (IN)      (FPS)

                 PLANE1      1.76     1.67       .74      20.24      22.15    725.13       5.56        .50
                 MAIN         .30     1.48      5.00     685.60     101.78    740.00       5.54       2.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1739E+02  EXCESS= .1364E+01 OUTFLOW= .1868E+02 BASIN STORAGE= .1235E-01 PERCENT ERROR=     .4

                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN         .30     1.48      5.00                101.78    740.00       5.54

       ***          ***          ***          ***          ***
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                         HYDROGRAPH AT STATION      CH6

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =      5.56

  PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                        6-HR         24-HR        72-HR       34.58-HR
+   (CFS)        (HR)
                            (CFS)
+     102.       12.33                  30.           9.           7.            7.
                           (INCHES)    4.449        5.527        5.541         5.541
                            (AC-FT)     15.          19.          19.           19.

                         CUMULATIVE AREA =      .06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 363 KK     *     N7AT   *
            *            *
            **************
                 RUNOFF AREA N7AT

 365 KO          OUTPUT CONTROL VARIABLES
                       IPRNT             3  PRINT CONTROL
                       IPLOT             0  PLOT CONTROL
                       QSCAL            0.  HYDROGRAPH PLOT SCALE
                       IPNCH             7  PUNCH COMPUTED HYDROGRAPH
                        IOUT            21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1             1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2           416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT          .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 366 BA          SUBBASIN CHARACTERISTICS
                       TAREA           .02  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                   STORM AREA =        .02

 367 LS          SCS LOSS RATE
                       STRTL           .38  INITIAL ABSTRACTION
                      CRVNBR         84.00  CURVE NUMBER
                       RTIMP           .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 368 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L          583.  OVERLAND FLOW LENGTH
                           S         .0200  SLOPE
                           N          .350  ROUGHNESS COEFFICIENT
                          PA         100.0  PERCENT OF SUBBASIN
                       DXMIN             5  MINIMUM NUMBER OF DX INTERVALS

                 KINEMATIC WAVE
 369 RK            MAIN CHANNEL
                           L          408.  CHANNEL LENGTH
                           S         .0030  SLOPE
                           N          .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA           .02  CONTRIBUTING AREA
                       SHAPE          TRAP  CHANNEL SHAPE
                          WD           .00  BOTTOM WIDTH OR DIAMETER
                           Z          4.00  SIDE SLOPE
                      NDXMIN             2  MINIMUM NUMBER OF DX INTERVALS
                      RUPSTQ            NO  ROUTE UPSTREAM HYDROGRAPH

                                                   ***
                                      COMPUTED KINEMATIC PARAMETERS
                                           VARIABLE TIME STEP
                                          (DT SHOWN IS A MINIMUM)

                   ELEMENT    ALPHA       M          DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                                 PEAK                CELERITY
                                                   (MIN)      (FT)     (CFS)    (MIN)      (IN)      (FPS)

                  PLANE1        .60      1.67       4.35     97.14     42.01    738.86     5.54        .37
                  MAIN         1.06      1.33        .75    136.06     41.97    738.16     5.54       3.86

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5603E+01 OUTFLOW= .5580E+01 BASIN STORAGE= .9999E-02 PERCENT ERROR=     .2
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                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

         MAIN          1.06      1.33       5.00               41.55    740.00      5.48

   ***           ***         ***          ***          ***

                 HYDROGRAPH AT STATION       N7AT

  TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

 PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR       72-HR      34.58-HR
+   (CFS)      (HR)
                        (CFS)
+     42.     12.33                  9.           3.          2.          2.
                      (INCHES)     4.422       5.469       5.478       5.478
                       (AC-FT)        4.          6.          6.          6.

                  CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 370 KK     *    N7AS    *
            *            *
            **************
                  RUNOFF AREA N7AS

 372 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 373 BA          SUBBASIN CHARACTERISTICS
                      TAREA        .01  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =       .01

 374 LS          SCS LOSS RATE
                      STRTL        .33  INITIAL ABSTRACTION
                     CRVNBR      86.00  CURVE NUMBER
                      RTIMP        .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 375 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         92.  OVERLAND FLOW LENGTH
                          S       .2000  SLOPE
                          N        .350  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS

                 KINEMATIC WAVE
 376 RK            MAIN CHANNEL
                          L        467.  CHANNEL LENGTH
                          S       .0110  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        4.00  SIDE SLOPE
                     NDXMIN           2  MINIMUM NUMBER OF DX INTERVALS
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                       ***
                               COMPUTED KINEMATIC PARAMETERS
                                    VARIABLE TIME STEP
                                  (DT SHOWN IS A MINIMUM)

            ELEMENT    ALPHA      M        DT        DX       PEAK     TIME TO     VOLUME    MAXIMUM
                                                                         PEAK                CELERITY
                                          (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)
```

```
                PLANE1       1.90      1.67       .76     18.35     34.43   724.63      5.79       .52
                MAIN         2.03      1.33       .46    155.79     33.53   725.11      5.79      5.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2100E+01 OUTFLOW= .2098E+01 BASIN STORAGE= .5111E-04 PERCENT ERROR=     .0

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN         2.03      1.33      5.00                 33.45   725.00      5.80

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION     N7AS

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.65, TOTAL EXCESS =     5.79

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      34.58-HR
+   (CFS)        (HR)
                           (CFS)
+      33.      12.08                  3.           1.          1.            1.
                          (INCHES)   4.694        5.802       5.802         5.802
                           (AC-FT)     2.           2.          2.            2.

                       CUMULATIVE AREA =      .01 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  377 KK    *     CN7A   *
            *            *
            **************
                       COMBINE N7A AREAS

  379 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS

  380 HC          HYDROGRAPH COMBINATION
                        ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                      ***

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION     CN7A

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      34.58-HR
+   (CFS)        (HR)
                           (CFS)
+      61.      12.08                 12.           4.          3.            3.
                          (INCHES)   4.480        5.553       5.564         5.564
                           (AC-FT)     6.           8.          8.            8.

                       CUMULATIVE AREA =      .03 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  381 KK    *    CCH7A   *
            *            *
            **************
                       COMBINE AREAS N5, N6, N7A AT CH7A

  383 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS
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 384 HC        HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                     ***

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION     CCH7A

 PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR        72-HR      34.58-HR
+   (CFS)        (HR)
                            (CFS)
+     153.      12.33                      43.         13.          9.           9.
                          (INCHES)       4.453       5.534       5.548        5.548
                          (AC-FT)          21.         26.         26.          26.

                        CUMULATIVE AREA =     .09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

               **************
               *            *
 385 KK        *    CH7A    *
               *            *
               **************
                           RUNOFF AREA CH7A

 387 KO         OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 388 BA         SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                              DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =      .00

 389 LS         SCS LOSS RATE
                    STRTL          .38  INITIAL ABSTRACTION
                   CRVNBR        84.00  CURVE NUMBER
                    RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 390 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L          78.  OVERLAND FLOW LENGTH
                        S        .2030  SLOPE
                        N         .350  ROUGHNESS COEFFICIENT
                       PA        100.0  PERCENT OF SUBBASIN
                    DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 391 RD           MAIN CHANNEL
                        L         885.  CHANNEL LENGTH
                        S        .0010  SLOPE
                        N         .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA          .00  CONTRIBUTING AREA
                    SHAPE         TRAP  CHANNEL SHAPE
                       WD        40.00  BOTTOM WIDTH OR DIAMETER
                        Z         3.00  SIDE SLOPE
                   RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                                     ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                 ELEMENT    ALPHA       M         DT         DX        PEAK     TIME TO      VOLUME     MAXIMUM
                                                                                 PEAK                   CELERITY
                                                 (MIN)      (FT)      (CFS)     (MIN)        (IN)       (FPS)

                PLANE1        1.92      1.67        .70      15.66      17.79     724.44        5.56        .48
                MAIN           .19      1.54       5.00     885.29     153.03     745.00        5.53       2.40
```

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CONTINUITY SUMMARY (AC-FT) - INFLOW= .2630E+02  EXCESS= .1067E+01 OUTFLOW= .2726E+02 BASIN STORAGE= .1321E-01 PERCENT ERROR=     .4

                                                 INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN          .19      1.54      5.00              153.03    745.00       5.53

      ***             ***             ***              ***              ***

                        HYDROGRAPH AT STATION     CH7A

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                            (CFS)
+     153.      12.42                   44.         14.         10.         10.
                          (INCHES)    4.441       5.512       5.525       5.525
                           (AC-FT)      22.         27.         27.         27.

                        CUMULATIVE AREA =      .09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  392 KK    *     N7BT   *
            *            *
            **************
                         RUNOFF AREA N7BT

  394 KO        OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                       IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  395 BA        SUBBASIN CHARACTERISTICS
                      TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

   11 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                  STORM AREA =      .01

  396 LS        SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  397 UK          OVERLAND-FLOW ELEMENT NO. 1
                          L         563.  OVERLAND FLOW LENGTH
                          S        .0200  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

                KINEMATIC WAVE
  398 RK          MAIN CHANNEL
                          L         410.  CHANNEL LENGTH
                          S        .0030  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         4.00  SIDE SLOPE
                     NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                COMPUTED KINEMATIC PARAMETERS
                                      VARIABLE TIME STEP
                                    (DT SHOWN IS A MINIMUM)

                 ELEMENT    ALPHA        M          DT         DX        PEAK     TIME TO      VOLUME     MAXIMUM
```

```
                                                                           PEAK                 CELERITY
                                           (MIN)      (FT)      (CFS)     (MIN)       (IN)       (FPS)

                 PLANE1       .60      1.67       4.26     93.81     19.21    734.56      5.54        .37
                 MAIN        1.06      1.33        .87    136.73     19.17    738.52      5.54       3.16


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2520E+01 OUTFLOW= .2511E+01 BASIN STORAGE= .4450E-02 PERCENT ERROR=     .2

                                     INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN        1.06      1.33       5.00               18.96    740.00      5.51

    ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION     N7BT

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      34.58-HR
+   (CFS)        (HR)
                             (CFS)
+     19.       12.33                     4.           1.          1.           1.
                           (INCHES)     4.458       5.504       5.513        5.513
                            (AC-FT)        2.          2.          2.           2.

                       CUMULATIVE AREA =      .01 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  399 KK      *      N7BS  *
              *            *
              **************
                            RUNOFF AREA N7BS

  401 KO          OUTPUT CONTROL VARIABLES
                        IPRNT          3  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE
                        IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                         IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  402 BA          SUBBASIN CHARACTERISTICS
                        TAREA        .01  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =       .01

  403 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  404 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L          86.  OVERLAND FLOW LENGTH
                           S        .2000  SLOPE
                           N         .350  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS

                  KINEMATIC WAVE
  405 RK            MAIN CHANNEL
                           L          405.  CHANNEL LENGTH
                           S        .0140  SLOPE
                           N         .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA          .01  CONTRIBUTING AREA
                       SHAPE         TRAP  CHANNEL SHAPE
                          WD          .00  BOTTOM WIDTH OR DIAMETER
                           Z         4.00  SIDE SLOPE
                     NDXMIN             2  MINIMUM NUMBER OF DX INTERVALS
                     RUPSTQ            NO  ROUTE UPSTREAM HYDROGRAPH
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                                          ***
                           COMPUTED KINEMATIC PARAMETERS
                                 VARIABLE TIME STEP
                               (DT SHOWN IS A MINIMUM)

     ELEMENT    ALPHA       M          DT         DX        PEAK    TIME TO     VOLUME    MAXIMUM
                                                                      PEAK                CELERITY
                                      (MIN)      (FT)      (CFS)     (MIN)       (IN)      (FPS)

    PLANE1       1.90      1.67        .73      17.29      26.43    725.04       5.79        .51
    MAIN         2.29      1.33        .46     135.11      26.06    725.03       5.79       6.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1606E+01 OUTFLOW= .1605E+01 BASIN STORAGE= .3639E-04 PERCENT ERROR=    .0

                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

    MAIN         2.29      1.33       5.00                 26.03    725.00       5.80

      ***             ***             ***             ***             ***

                 HYDROGRAPH AT STATION        N7BS

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.65, TOTAL EXCESS =    5.79

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                              (CFS)
+      26.      12.08                    3.          1.          1.           1.
                            (INCHES)  4.696       5.804       5.804        5.804
                             (AC-FT)     1.          2.          2.           2.

                          CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
   406 KK     *      CN7B  *
              *            *
              **************
                            COMBINE N7B AREAS

   408 KO          OUTPUT CONTROL VARIABLES
                         IPRNT            3  PRINT CONTROL
                         IPLOT            0  PLOT CONTROL
                         QSCAL           0.  HYDROGRAPH PLOT SCALE
                         IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                          IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT         .083  TIME INTERVAL IN HOURS


   409 HC          HYDROGRAPH COMBINATION
                         ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                          ***

      ***             ***             ***             ***             ***

                 HYDROGRAPH AT STATION        CN7B

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                              (CFS)
+      39.      12.08                    7.          2.          1.           1.
                            (INCHES)  4.530       5.614       5.624        5.624
                             (AC-FT)     3.          4.          4.           4.

                          CUMULATIVE AREA =      .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
   410 KK     *     CCH7B  *
              *            *
              **************
                            COMBINE AREAS N5, N6, N7A, N7B AT CH7B
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 412 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


 413 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                     ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION     CCH7B

 PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
                                        6-HR         24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                         (CFS)
+     178.     12.33                     51.          16.          11.          11.
                       (INCHES)        4.449        5.525        5.538        5.538
                        (AC-FT)          25.          31.          31.          31.

                        CUMULATIVE AREA =     .11 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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             *            *
 414 KK      *      CH7B  *
             *            *
             **************
                          RUNOFF AREA CH7A

 416 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 417 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                                DEPTHS FOR    4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                      STORM AREA =       .01

 418 LS          SCS LOSS RATE
                      STRTL          .38  INITIAL ABSTRACTION
                     CRVNBR        84.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 419 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         109.  OVERLAND FLOW LENGTH
                          S        .1770  SLOPE
                          N         .350  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 420 RD            MAIN CHANNEL
                          L        1127.  CHANNEL LENGTH
                          S        .0010  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD        40.00  BOTTOM WIDTH OR DIAMETER
                          Z         3.00  SIDE SLOPE
                     RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

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                                     COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                            COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M          DT         DX        PEAK     TIME TO      VOLUME     MAXIMUM
                                                                                     PEAK                   CELERITY
                                                     (MIN)      (FT)       (CFS)     (MIN)        (IN)       (FPS)

                   PLANE1       1.79      1.67         .76      21.81      27.68     724.82       5.56        .52
                   MAIN          .19      1.54        5.00    1127.00     178.99     745.00       5.50       2.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3137E+02  EXCESS= .1690E+01 OUTFLOW= .3283E+02 BASIN STORAGE= .1812E-01 PERCENT ERROR=     .6

                                            INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          .19      1.54        5.00                178.99     745.00       5.50

      ***              ***             ***              ***              ***

                           HYDROGRAPH AT STATION     CH7B

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

   PEAK FLOW     TIME                                   MAXIMUM AVERAGE FLOW
                                          6-HR         24-HR        72-HR       34.58-HR
 +   (CFS)       (HR)
                            (CFS)
 +     179.      12.42                     53.          17.          11.           11.
                          (INCHES)       4.431        5.489        5.501         5.501
                           (AC-FT)         26.          33.          33.           33.

                          CUMULATIVE AREA =      .11 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
   421 KK     *      N8T   *
              *            *
              **************
                            RUNOFF AREA N8T

   423 KO          OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

   424 BA          SUBBASIN CHARACTERISTICS
                         TAREA         .03  SUBBASIN AREA

                   PRECIPITATION DATA

    11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                    STORM AREA =      .03

   425 LS          SCS LOSS RATE
                         STRTL         .38  INITIAL ABSTRACTION
                        CRVNBR       84.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
   426 UK            OVERLAND-FLOW ELEMENT NO. 1
                             L        552.  OVERLAND FLOW LENGTH
                             S       .0200  SLOPE
                             N        .350  ROUGHNESS COEFFICIENT
                            PA       100.0  PERCENT OF SUBBASIN
                         DXMIN           5  MINIMUM NUMBER OF DX INTERVALS

                   KINEMATIC WAVE
   427 RK            MAIN CHANNEL
                             L        668.  CHANNEL LENGTH
                             S       .0030  SLOPE
                             N        .030  CHANNEL ROUGHNESS COEFFICIENT
                            CA         .03  CONTRIBUTING AREA
                         SHAPE        TRAP  CHANNEL SHAPE
                            WD         .00  BOTTOM WIDTH OR DIAMETER
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               Z          4.00  SIDE SLOPE
          NDXMIN             2  MINIMUM NUMBER OF DX INTERVALS
          RUPSTQ            NO  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                         COMPUTED KINEMATIC PARAMETERS
                              VARIABLE TIME STEP
                            (DT SHOWN IS A MINIMUM)

     ELEMENT    ALPHA      M        DT        DX       PEAK    TIME TO    VOLUME    MAXIMUM
                                                                PEAK                CELERITY
                                   (MIN)     (FT)     (CFS)    (MIN)      (IN)      (FPS)

    PLANE1       .60      1.67      4.22     91.99     58.94   737.44     5.54       .37
    MAIN        1.06      1.33      1.03    222.57     58.33   737.03     5.54      4.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7648E+01 OUTFLOW= .7622E+01 BASIN STORAGE= .1297E-01 PERCENT ERROR=    .2

                             INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

    MAIN        1.06      1.33      5.00               58.04   740.00     5.53

     ***         ***         ***         ***         ***

                    HYDROGRAPH AT STATION       N8T

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

  PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR      34.58-HR
+   (CFS)      (HR)
                         (CFS)
+     58.     12.33                12.           4.          3.           3.
                      (INCHES)   4.479        5.525       5.534        5.534
                       (AC-FT)      6.           8.          8.           8.

                    CUMULATIVE AREA =      .03 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
  428 KK  *      N8S   *
          *            *
          **************
                  RUNOFF AREA N8S

  430 KO       OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS

             SUBBASIN RUNOFF DATA

  431 BA       SUBBASIN CHARACTERISTICS
                     TAREA        .02  SUBBASIN AREA

               PRECIPITATION DATA

   11 PH                          DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                             STORM AREA =       .02

  432 LS       SCS LOSS RATE
                     STRTL        .33  INITIAL ABSTRACTION
                    CRVNBR      86.00  CURVE NUMBER
                     RTIMP        .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  433 UK         OVERLAND-FLOW ELEMENT NO. 1
                         L        92.  OVERLAND FLOW LENGTH
                         S      .2000  SLOPE
                         N       .350  ROUGHNESS COEFFICIENT
                        PA      100.0  PERCENT OF SUBBASIN
                     DXMIN          5  MINIMUM NUMBER OF DX INTERVALS

               KINEMATIC WAVE
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434 RK          MAIN CHANNEL
                        L        925.  CHANNEL LENGTH
                        S      .0180  SLOPE
                        N       .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA        .02  CONTRIBUTING AREA
                    SHAPE       TRAP  CHANNEL SHAPE
                       WD        .00  BOTTOM WIDTH OR DIAMETER
                        Z       4.00  SIDE SLOPE
                   NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS
                   RUPSTQ         NO  ROUTE UPSTREAM HYDROGRAPH

                                                       ***
                                    COMPUTED KINEMATIC PARAMETERS
                                          VARIABLE TIME STEP
                                        (DT SHOWN IS A MINIMUM)

                ELEMENT    ALPHA      M        DT        DX      PEAK    TIME TO    VOLUME    MAXIMUM
                                                                          PEAK                CELERITY
                                              (MIN)     (FT)     (CFS)    (MIN)      (IN)      (FPS)

               PLANE1      1.90     1.67       .76     18.34     81.00    724.62     5.79       .52
               MAIN        2.60     1.33       .67    308.17     78.07    725.64     5.79      8.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4940E+01 OUTFLOW= .4939E+01 BASIN STORAGE= .1245E-03 PERCENT ERROR=    .0

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


               MAIN        2.60     1.33      5.00               77.49    725.00     5.80

      ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION        N8S

    TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.65, TOTAL EXCESS =    5.79

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR         24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+       77.     12.08                8.            2.           2.           2.
                       (INCHES)   4.689         5.797        5.797        5.797
                        (AC-FT)      4.            5.           5.           5.

                      CUMULATIVE AREA =      .02 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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            *            *
  435 KK    *       CN8  *
            *            *
            **************
                       COMBINE N8 AREAS

  437 KO        OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


  438 HC        HYDROGRAPH COMBINATION
                       ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                       ***

      ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION        CN8

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR         24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+      116.     12.08               20.            6.           4.           4.
                       (INCHES)   4.543         5.626        5.635        5.635
                        (AC-FT)     10.           13.          13.          13.

                      CUMULATIVE AREA =      .04 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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             *            *
  439 KK     *      C2W2  *
             *            *
             **************
                          COMBINE AREAS'N5-N9 INTO POND 2

  441 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


  442 HC          HYDROGRAPH COMBINATION
                        ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                     ***

      ***              ***              ***              ***              ***

                        HYDROGRAPH AT STATION     C2W2

  PEAK FLOW     TIME                               MAXIMUM AVERAGE FLOW
                                        6-HR          24-HR        72-HR       34.58-HR
+    (CFS)      (HR)
                           (CFS)
+      334.     12.33                    92.            29.          20.            20.
                        (INCHES)       4.469          5.536        5.547          5.547
                         (AC-FT)         46.            57.          57.            57.

                         CUMULATIVE AREA =      .19 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  443 KK     *        W2  *
             *            *
             **************
                          RUNOFF WITHIN POND 2

  445 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  446 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .02  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                    .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                              STORM AREA =      .02

  447 LS          SCS LOSS RATE
                        STRTL          .00  INITIAL ABSTRACTION
                       CRVNBR       100.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

  448 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .00  LAG

                                                                     ***

                                                           UNIT HYDROGRAPH
                                                       5 END-OF-PERIOD ORDINATES
                 89.         25.          5.          1.          0.
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     ***            ***            ***             ***            ***

                          HYDROGRAPH AT STATION       W2

   TOTAL RAINFALL =    7.44, TOTAL LOSS =     .00, TOTAL EXCESS =    7.44

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+      79.     12.08                         9.          3.          2.           2.
                        (INCHES)      5.468       7.437       7.440        7.440
                         (AC-FT)         4.          6.          6.           6.

                          CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  449 KK     *   PND2IN   *
             *            *
             **************
                           COMBINE AREAS INTO POND 2

  451 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


  452 HC          HYDROGRAPH COMBINATION
                        ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                       ***

     ***            ***            ***             ***            ***

                          HYDROGRAPH AT STATION   PND2IN

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+     366.     12.25                       101.         31.         22.          22.
                        (INCHES)      4.523       5.645       5.688        5.688
                         (AC-FT)        50.         62.         63.          63.

                          CUMULATIVE AREA =     .21 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  453 KK     *   PD2OUT   *
             *            *
             **************
                           ROUTE THROUGH POND W2

  455 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

  456 RS          STORAGE ROUTING
                        NSTPS            1  NUMBER OF SUBREACHES
                         ITYP         ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC       454.00  INITIAL CONDITION
                            X          .00 WORKING R AND D COEFFICIENT

  457 SA              AREA          .0       4.4       6.8       8.3       8.4       8.5       8.6       8.9       9.1
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458 SE         ELEVATION     454.00    454.50    455.00    455.50    456.00    456.50    457.00    458.00    459.00

460 SL         LOW-LEVEL OUTLET
                    ELEVL     456.00  ELEVATION AT CENTER OF OUTLET
                    CAREA      28.27  CROSS-SECTIONAL AREA
                     COQL        .80  COEFFICIENT
                     EXPL        .50  EXPONENT OF HEAD

459 SS         SPILLWAY
                     CREL     458.00  SPILLWAY CREST ELEVATION
                    SPWID      25.00  SPILLWAY WIDTH
                     COQW       2.60  WEIR COEFFICIENT
                     EXPW       1.50  EXPONENT OF HEAD

                                                          ***

                                                COMPUTED STORAGE-ELEVATION DATA

           STORAGE       .00       .74      3.53      7.28     11.44     15.66     19.94     28.69     37.69
         ELEVATION    454.00    454.50    455.00    455.50    456.00    456.50    457.00    458.00    459.00

                                                COMPUTED OUTFLOW-ELEVATION DATA

           OUTFLOW       .00       .00    284.43    280.08    275.86    271.77    267.80    263.94    260.19    256.55
         ELEVATION    454.00    456.00    458.46    458.38    458.31    458.24    458.18    458.12    458.06    458.00

           OUTFLOW    307.16    313.30    319.87    326.90    334.39    342.35    350.80    359.75    369.22    379.21
         ELEVATION    458.48    458.53    458.58    458.63    458.69    458.74    458.81    458.87    458.93    459.00


                                            COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

           STORAGE       .00       .74      3.53      7.28     11.44     15.66     19.94     28.69     32.78     32.97
           OUTFLOW       .00       .00       .00       .00       .00    128.27    181.41    256.55    304.59    307.16
         ELEVATION    454.00    454.50    455.00    455.50    456.00    456.50    457.00    458.00    458.46    458.48

           STORAGE     33.40     33.86     34.34     34.85     35.37     35.92     36.48     37.07     37.69
           OUTFLOW    313.30    319.87    326.90    334.39    342.35    350.80    359.75    369.22    379.21
         ELEVATION    458.53    458.58    458.63    458.69    458.74    458.81    458.87    458.93    459.00

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION     PD2OUT

  PEAK FLOW      TIME                            MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR        72-HR     34.58-HR
+   (CFS)        (HR)
                            (CFS)
+     201.      13.00                   88.           26.          18.          18.
                         (INCHES)     3.933         4.651        4.651        4.651
                          (AC-FT)       43.           51.          51.          51.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                       6-HR         24-HR        72-HR     34.58-HR
+  (AC-FT)       (HR)
       22.      13.00                   15.           12.           9.           9.

  PEAK STAGE     TIME                            MAXIMUM AVERAGE STAGE
                                       6-HR         24-HR        72-HR     34.58-HR
+   (FEET)       (HR)
    457.26      13.00                456.44        456.08       455.54       455.54

                      CUMULATIVE AREA =      .21 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
461 KK     *       N14  *
           *            *
           **************
                                 RUNOFF AREA N14

463 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

464 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .04  SUBBASIN AREA
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              PRECIPITATION DATA

 11 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =       .04

 465 LS       SCS LOSS RATE
                   STRTL          .38  INITIAL ABSTRACTION
                  CRVNBR        84.00  CURVE NUMBER
                   RTIMP          .00  PERCENT IMPERVIOUS AREA

 466 US       SNYDER UNITGRAPH
                      TP          .38  LAG
                      CP          .67  PEAKING COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                           ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=    .45 HR,        R=    .31 HR
                                            SNYDER   TP=    .38 HR,       CP=    .67

                                                        UNIT HYDROGRAPH
                                                   23 END-OF-PERIOD ORDINATES
                4.        15.        29.        41.        46.        42.        33.        25.        19.        14.
               11.         8.         6.         5.         4.         3.         2.         2.         1.         1.
                1.         1.         0.

      ***           ***            ***             ***            ***

                     HYDROGRAPH AT STATION        N14

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR          24-HR        72-HR       34.58-HR
+   (CFS)       (HR)
                         (CFS)
+        88.    12.42                 20.           6.           4.           4.
                       (INCHES)    4.495        5.536        5.536        5.536
                        (AC-FT)      10.          12.          12.          12.

                     CUMULATIVE AREA =      .04 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 467 KK   *      N15   *
          *            *
          **************
                     RUNOFF AREA N15

 469 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 470 BA       SUBBASIN CHARACTERISTICS
                   TAREA          .03  SUBBASIN AREA

              PRECIPITATION DATA

 11 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                  STORM AREA =       .03

 471 LS       SCS LOSS RATE
                   STRTL          .38  INITIAL ABSTRACTION
                  CRVNBR        84.00  CURVE NUMBER
                   RTIMP          .00  PERCENT IMPERVIOUS AREA

 472 US       SNYDER UNITGRAPH
                      TP          .47  LAG
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                    CP          .68  PEAKING COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                         ***

                                                 UNIT HYDROGRAPH PARAMETERS
                                           CLARK   TC=    .56 HR,        R=   .36 HR
                                          SNYDER   TP=    .47 HR,       CP=   .69

                                                      UNIT HYDROGRAPH
                                                 27 END-OF-PERIOD ORDINATES
               2.        7.        14.       21.       27.       29.       28.       23.       18.       15.
              12.        9.         7.        6.        5.        4.        3.        2.        2.        1.
               1.        1.         1.        1.        0.        0.        0.

     ***            ***             ***              ***             ***

                    HYDROGRAPH AT STATION       N15

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =     5.56

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                            (CFS)
+      61.     12.50                    15.           5.           3.            3.
                           (INCHES)   4.491        5.534        5.534         5.534
                            (AC-FT)      7.           9.           9.            9.

                           CUMULATIVE AREA =      .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  473 KK     *    C1N14   *
             *            *
             **************
                      COMBINE AREAS N14, N15 & POND 2

  475 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                         IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT         .083  TIME INTERVAL IN HOURS


  476 HC          HYDROGRAPH COMBINATION
                        ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                         ***

     ***            ***             ***              ***             ***

                    HYDROGRAPH AT STATION     C1N14

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR        72-HR      34.58-HR
+   (CFS)       (HR)
                            (CFS)
+     325.     12.58                   120.          37.          25.           25.
                           (INCHES)   3.995        4.870        4.878         4.878
                            (AC-FT)     59.          72.          73.           73.

                           CUMULATIVE AREA =      .28 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  477 KK     *       S2   *
             *            *
             **************
                            RUNOFF AREA S2

  479 KO          OUTPUT CONTROL VARIABLES
                        IPRNT            3  PRINT CONTROL
                        IPLOT            0  PLOT CONTROL
                        QSCAL           0.  HYDROGRAPH PLOT SCALE
                        IPNCH            7  PUNCH COMPUTED HYDROGRAPH
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                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 480 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .05  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                  .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                               STORM AREA =       .05

 481 LS         SCS LOSS RATE
                     STRTL          .38  INITIAL ABSTRACTION
                    CRVNBR        84.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 482 US         SNYDER UNITGRAPH
                        TP          .73  LAG
                        CP          .67  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                                 UNIT HYDROGRAPH PARAMETERS
                                           CLARK   TC=   .84 HR,        R=   .59 HR
                                          SNYDER   TP=   .74 HR,       CP=   .68

                                                      UNIT HYDROGRAPH
                                                 43 END-OF-PERIOD ORDINATES
                    1.         4.         8.        13.        18.        23.        26.        29.        30.        29.
                   26.        23.        20.        17.        15.        13.        11.        10.         9.         7.
                    6.         6.         5.         4.         4.         3.         3.         2.         2.         2.
                    2.         1.         1.         1.         1.         1.         1.         1.         1.         0.
                    0.         0.         0.

      ***          ***          ***            ***            ***

                      HYDROGRAPH AT STATION         S2

   TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

 PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR         72-HR       34.58-HR
+   (CFS)       (HR)
                         (CFS)
+      75.     12.75                    24.            7.            5.            5.
                       (INCHES)       4.475         5.531         5.531         5.531
                        (AC-FT)         12.           15.           15.           15.

                      CUMULATIVE AREA =      .05 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 483 KK     *      N19   *
            *            *
            **************
                      RUNOFF AREA N19

 485 KO         OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE
                     IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                      IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT         .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 486 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
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                 ..... HYDRO-35 ......    ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44      .00     .00     .00     .00

                                                  STORM AREA =       .00

 487 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 488 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         44.  OVERLAND FLOW LENGTH
                           S       .3300  SLOPE
                           N        .350  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 489 RD            MAIN CHANNEL
                           L       1305.  CHANNEL LENGTH
                           S       .0016  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA        M          DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

                  PLANE1        2.45      1.67        .46      8.73     14.05    724.63      5.56        .45
                  MAIN           .55      1.42       5.00    652.50     75.13    775.00      5.53       2.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1454E+02  EXCESS= .8301E+00 OUTFLOW= .1535E+02 BASIN STORAGE= .2158E-02 PERCENT ERROR=     .1

                                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN           .55      1.42       5.00               75.13    775.00      5.53

      ***            ***            ***            ***            ***

                           HYDROGRAPH AT STATION       N19

    TOTAL RAINFALL =      7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =      5.56

 PEAK FLOW      TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      34.58-HR
+   (CFS)       (HR)
                          (CFS)
+      75.     12.92                     25.           8.          5.          5.
                        (INCHES)       4.473       5.526       5.526       5.526
                         (AC-FT)         12.          15.         15.         15.

                        CUMULATIVE AREA =     .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 490 KK     *      N18   *
            *            *
            **************
                           RUNOFF AREA N18

 492 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS

               SUBBASIN RUNOFF DATA

 493 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA
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                 PRECIPITATION DATA

  11 PH                          DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                               STORM AREA =       .01

 494 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 495 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         41.  OVERLAND FLOW LENGTH
                           S       .3300  SLOPE
                           N        .350  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 496 RD            MAIN CHANNEL
                           L       1123.  CHANNEL LENGTH
                           S       .0016  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       15.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT          DX        PEAK     TIME TO     VOLUME     MAXIMUM
                                                                                     PEAK                  CELERITY
                                                   (MIN)       (FT)       (CFS)      (MIN)       (IN)       (FPS)

                   PLANE1        2.45      1.67        .35       8.24       32.11     724.67       5.56        .43
                   MAIN           .45      1.45       5.00     561.70       77.82     780.00       5.52       2.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1535E+02  EXCESS= .1897E+01 OUTFLOW= .1723E+02 BASIN STORAGE= .2334E-02 PERCENT ERROR=      .1

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN           .45      1.45       5.00                  77.82     780.00       5.52

      ***            ***            ***             ***             ***

                          HYDROGRAPH AT STATION       N18

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW       TIME                              MAXIMUM AVERAGE FLOW
                                         6-HR          24-HR        72-HR      34.58-HR
 +    (CFS)        (HR)
                               (CFS)
 +       78.     13.00                     28.            9.            6.            6.
                             (INCHES)    4.470         5.523         5.523         5.523
                              (AC-FT)      14.           17.           17.           17.

                          CUMULATIVE AREA =       .06 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 497 KK     *       O5   *
            *            *
            **************
                                 OFFSITE AREA O5

 499 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS

               SUBBASIN RUNOFF DATA
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 500 BA          SUBBASIN CHARACTERISTICS
                       TAREA          .18  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =        .18

 501 LS          SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                      CRVNBR        84.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

 502 US          SNYDER UNITGRAPH
                          TP          .59  LAG
                          CP          .64  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                ***

                                                      UNIT HYDROGRAPH PARAMETERS
                                                CLARK    TC=    .67 HR,         R=    .52 HR
                                               SNYDER    TP=    .59 HR,        CP=    .64

                                                             UNIT HYDROGRAPH
                                                      38 END-OF-PERIOD ORDINATES
                     7.        24.        48.        74.       100.       119.       129.       129.       116.        99.
                    84.        72.        61.        52.        44.        38.        32.        27.        23.        20.
                    17.        14.        12.        10.         9.         7.         6.         5.         5.         4.
                     3.         3.         2.         2.         2.         1.         1.         1.

      ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION        O5

    TOTAL RAINFALL =     7.44, TOTAL LOSS =     1.88, TOTAL EXCESS =     5.56

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR        72-HR      34.58-HR
+   (CFS)        (HR)
                           (CFS)
+     302.      12.67                   88.          27.          19.          19.
                          (INCHES)    4.481        5.533        5.533        5.533
                          (AC-FT)       43.          54.          54.          54.

                          CUMULATIVE AREA =       .18 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 503 KK     *      S1    *
            *            *
            **************
                                 RUNOFF AREA S1

 505 KO          OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH            7  PUNCH COMPUTED HYDROGRAPH
                        IOUT           21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2          416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT         .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 506 BA          SUBBASIN CHARACTERISTICS
                       TAREA          .02  SUBBASIN AREA

                 PRECIPITATION DATA

  11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                   STORM AREA =        .02

 507 LS          SCS LOSS RATE
                       STRTL          .38  INITIAL ABSTRACTION
                      CRVNBR        84.00  CURVE NUMBER
```

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                    RTIMP          .00  PERCENT IMPERVIOUS AREA

 508 US       SNYDER UNITGRAPH
                       TP          .75  LAG
                       CP          .70  PEAKING COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                         ***

                                               UNIT HYDROGRAPH PARAMETERS
                                         CLARK    TC=    .86 HR,        R=    .56 HR
                                        SNYDER    TP=    .75 HR,       CP=    .69

                                                    UNIT HYDROGRAPH
                                               42 END-OF-PERIOD ORDINATES
              0.         1.         3.         4.         6.         8.         9.        10.        10.        10.
              9.         8.         7.         6.         5.         4.         4.         3.         3.         2.
              2.         2.         2.         1.         1.         1.         1.         1.         1.         1.
              0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
              0.         0.

     ***            ***            ***             ***             ***

                      HYDROGRAPH AT STATION        S1

   TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

 PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR       34.58-HR
+  (CFS)       (HR)
                         (CFS)
+      25.     12.75                  8.           2.           2.           2.
                       (INCHES)   4.479        5.534        5.534        5.534
                        (AC-FT)      4.           5.           5.           5.

                     CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 509 KK     *      N17   *
            *            *
            **************
                           RUNOFF AREA N17

 511 KO       OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 512 BA       SUBBASIN CHARACTERISTICS
                    TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

  11 PH                             DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR    12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .74    1.57    3.19    4.18    4.52    5.47    6.43    7.44     .00     .00     .00     .00

                                                 STORM AREA =      .01

 513 LS       SCS LOSS RATE
                    STRTL          .38  INITIAL ABSTRACTION
                   CRVNBR        84.00  CURVE NUMBER
                    RTIMP          .00  PERCENT IMPERVIOUS AREA

 514 US       SNYDER UNITGRAPH
                       TP          .12  LAG
                       CP          .64  PEAKING COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                         ***

                                               UNIT HYDROGRAPH PARAMETERS
                                         CLARK    TC=    .14 HR,        R=    .09 HR
                                        SNYDER    TP=    .12 HR,       CP=    .64
```

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                                                                  UNIT HYDROGRAPH
                                                              7 END-OF-PERIOD ORDINATES
                  11.        21.        13.         5.         2.         1.         0.

        ***             ***             ***              ***              ***

                                 HYDROGRAPH AT STATION       N17

      TOTAL RAINFALL =    7.44, TOTAL LOSS =    1.88, TOTAL EXCESS =    5.56

   PEAK FLOW      TIME                               MAXIMUM AVERAGE FLOW
                                          6-HR         24-HR       72-HR      34.58-HR
 +    (CFS)        (HR)
                               (CFS)
 +      24.      12.17                      3.           1.          1.            1.
                             (INCHES)     4.508        5.545       5.545         5.545
                              (AC-FT)        2.           2.          2.            2.

                                 CUMULATIVE AREA =      .01 SQ MI


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   515 KK     *     C107   *
              *            *
              **************
                                  COMBINE AREAS S1, O6, AND N17-19

   517 KO          OUTPUT CONTROL VARIABLES
                         IPRNT             3  PRINT CONTROL
                         IPLOT             0  PLOT CONTROL
                         QSCAL            0.  HYDROGRAPH PLOT SCALE
                         IPNCH             7  PUNCH COMPUTED HYDROGRAPH
                          IOUT            21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1             1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2           416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT          .083  TIME INTERVAL IN HOURS


   518 HC          HYDROGRAPH COMBINATION
                         ICOMP             4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                     ***

        ***             ***             ***              ***              ***

                                 HYDROGRAPH AT STATION       C107

   PEAK FLOW      TIME                               MAXIMUM AVERAGE FLOW
                                          6-HR         24-HR       72-HR      34.58-HR
 +    (CFS)        (HR)
                               (CFS)
 +     395.      12.67                    127.          39.         27.           27.
                             (INCHES)     4.476        5.531       5.531         5.531
                              (AC-FT)       63.          78.         78.           78.

                                 CUMULATIVE AREA =      .26 SQ MI

1
                                                                  RUNOFF SUMMARY
                                                           FLOW IN CUBIC FEET PER SECOND
                                                        TIME IN HOURS,  AREA IN SQUARE MILES

                                            PEAK    TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD        BASIN     MAXIMUM     TIME OF
            OPERATION        STATION        FLOW      PEAK                                             AREA       STAGE     MAX STAGE
 +                                                               6-HOUR      24-HOUR      72-HOUR

            HYDROGRAPH AT
 +                                O1        298.    12.42          70.          22.          15.        .14

            HYDROGRAPH AT
 +                               O1A         70.    12.58          18.           6.           4.        .04

            HYDROGRAPH AT
 +                                O2       2171.    12.75         767.         239.         166.       1.58

            HYDROGRAPH AT
 +                                S4        113.    13.00          43.          13.           9.        .09

            3 COMBINED AT
 +                               CS4       2337.    12.75         828.         258.         179.       1.70

            HYDROGRAPH AT
 +                                N1         39.    12.42           9.           3.           2.        .02

            HYDROGRAPH AT
 +                                O3         62.    12.33          12.           4.           3.        .03
```

+	3 COMBINED AT	C1MWY	2396.	12.75	848.	264.	183.	1.74		
+	HYDROGRAPH AT	S3	45.	12.83	15.	5.	3.	.03		
+	HYDROGRAPH AT	N20	47.	13.00	17.	5.	4.	.04		
+	2 COMBINED AT	C2MWY	2437.	12.75	865.	269.	187.	1.78		
+	HYDROGRAPH AT	N11T	12.	12.25	2.	1.	0.	.00		
+	HYDROGRAPH AT	N11S	32.	12.08	3.	1.	1.	.01		
+	2 COMBINED AT	CN11	41.	12.08	6.	2.	1.	.01		
+	HYDROGRAPH AT	CH11	40.	12.25	8.	2.	2.	.02		
+	HYDROGRAPH AT	N2T	31.	12.25	7.	2.	1.	.01		
+	HYDROGRAPH AT	N2S	24.	12.08	2.	1.	1.	.00		
+	2 COMBINED AT	CN2	47.	12.08	9.	3.	2.	.02		
+	2 COMBINED AT	CCH2	82.	12.17	17.	5.	4.	.04		
+	HYDROGRAPH AT	CH2	84.	12.25	18.	6.	4.	.04		
+	HYDROGRAPH AT	N12	28.	12.42	6.	2.	1.	.01		
+	HYDROGRAPH AT	N3T	122.	12.25	25.	7.	5.	.05		
+	HYDROGRAPH AT	N3S	26.	12.08	3.	1.	1.	.01		
+	3 COMBINED AT	CN3	156.	12.25	33.	10.	7.	.07		
+	2 COMBINED AT	CCH3	240.	12.25	51.	15.	11.	.11		
+	HYDROGRAPH AT	CH3	237.	12.33	53.	16.	11.	.11		
+	HYDROGRAPH AT	N4T	23.	12.33	6.	2.	1.	.01		
+	HYDROGRAPH AT	N4S	34.	12.08	4.	1.	1.	.01		
+	2 COMBINED AT	CN4	50.	12.08	9.	3.	2.	.02		
+	HYDROGRAPH AT	CH4	62.	12.17	12.	4.	3.	.02		
+	2 COMBINED AT	C1CH4A	288.	12.25	65.	20.	14.	.14		
+	HYDROGRAPH AT	CH4A	286.	12.25	66.	20.	14.	.14		
+	HYDROGRAPH AT	N13	55.	12.58	14.	4.	3.	.03		
+	HYDROGRAPH AT	W1	67.	12.08	8.	3.	2.	.01		
+	3 COMBINED AT	PND1IN	352.	12.25	87.	27.	19.	.18		
+	ROUTED TO	PND1OU	229.	12.75	202.	198.	197.	.18		
+									456.04	12.75
+	HYDROGRAPH AT	N16	12.	12.25	2.	1.	0.	.00		
+	HYDROGRAPH AT	CHW1	13.	12.33	3.	1.	1.	.01		

+	3 COMBINED AT	MIDRD	2673.	12.75	1070.	468.	385.	1.97
+	HYDROGRAPH AT	S5	3.	12.25	0.	0.	0.	.00
+	2 COMBINED AT	CS5	2674.	12.75	1070.	468.	385.	1.97
+	HYDROGRAPH AT	O4	269.	12.50	65.	20.	14.	.13
+	2 COMBINED AT	C4MWY	2887.	12.75	1135.	488.	399.	2.10
+	HYDROGRAPH AT	N10T	37.	12.42	9.	3.	2.	.02
+	HYDROGRAPH AT	N10S	55.	12.08	6.	2.	1.	.01
+	2 COMBINED AT	CN10	78.	12.08	15.	5.	3.	.03
+	HYDROGRAPH AT	CH10	115.	12.17	21.	6.	5.	.04
+	2 COMBINED AT	CABELM	2933.	12.75	1156.	494.	403.	2.14
+	HYDROGRAPH AT	N9T	40.	12.33	9.	3.	2.	.02
+	HYDROGRAPH AT	N9S	73.	12.08	7.	2.	2.	.01
+	2 COMBINED AT	CN9	99.	12.08	16.	5.	3.	.03
+	HYDROGRAPH AT	CH9	84.	12.25	18.	6.	4.	.04
+	HYDROGRAPH AT	N5T	50.	12.58	15.	5.	3.	.03
+	HYDROGRAPH AT	N5S	32.	12.08	4.	1.	1.	.01
+	2 COMBINED AT	CN5	63.	12.08	18.	6.	4.	.04
+	HYDROGRAPH AT	CH5	66.	12.33	21.	6.	5.	.04
+	HYDROGRAPH AT	N6T	20.	12.25	4.	1.	1.	.01
+	HYDROGRAPH AT	N6S	30.	12.08	3.	1.	1.	.01
+	2 COMBINED AT	CN6	44.	12.08	7.	2.	2.	.02
+	2 COMBINED AT	CCH6	100.	12.17	28.	9.	6.	.06
+	HYDROGRAPH AT	CH6	102.	12.33	30.	9.	7.	.06
+	HYDROGRAPH AT	N7AT	42.	12.33	9.	3.	2.	.02
+	HYDROGRAPH AT	N7AS	33.	12.08	3.	1.	1.	.01
+	2 COMBINED AT	CN7A	61.	12.08	12.	4.	3.	.03
+	2 COMBINED AT	CCH7A	153.	12.33	43.	13.	9.	.09
+	HYDROGRAPH AT	CH7A	153.	12.42	44.	14.	10.	.09
+	HYDROGRAPH AT	N7BT	19.	12.33	4.	1.	1.	.01
+	HYDROGRAPH AT	N7BS	26.	12.08	3.	1.	1.	.01
+	2 COMBINED AT	CN7B	39.	12.08	7.	2.	1.	.01

+	2 COMBINED AT	CCH7B	178.	12.33	51.	16.	11.	.11	
+	HYDROGRAPH AT	CH7B	179.	12.42	53.	17.	11.	.11	
+	HYDROGRAPH AT	N8T	58.	12.33	12.	4.	3.	.03	
+	HYDROGRAPH AT	N8S	77.	12.08	8.	2.	2.	.02	
+	2 COMBINED AT	CN8	116.	12.08	20.	6.	4.	.04	
+	3 COMBINED AT	C2W2	334.	12.33	92.	29.	20.	.19	
+	HYDROGRAPH AT	W2	79.	12.08	9.	3.	2.	.02	
+	2 COMBINED AT	PND2IN	366.	12.25	101.	31.	22.	.21	
+	ROUTED TO	PD2OUT	201.	13.00	88.	26.	18.	.21	
+									457.26 13.00
+	HYDROGRAPH AT	N14	88.	12.42	20.	6.	4.	.04	
+	HYDROGRAPH AT	N15	61.	12.50	15.	5.	3.	.03	
+	3 COMBINED AT	C1N14	325.	12.58	120.	37.	25.	.28	
+	HYDROGRAPH AT	S2	75.	12.75	24.	7.	5.	.05	
+	HYDROGRAPH AT	N19	75.	12.92	25.	8.	5.	.05	
+	HYDROGRAPH AT	N18	78.	13.00	28.	9.	6.	.06	
+	HYDROGRAPH AT	O5	302.	12.67	88.	27.	19.	.18	
+	HYDROGRAPH AT	S1	25.	12.75	8.	2.	2.	.02	
+	HYDROGRAPH AT	N17	24.	12.17	3.	1.	1.	.01	
+	4 COMBINED AT	C1O7	395.	12.67	127.	39.	27.	.26	

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SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT (INTERPOLATED TO COMPUTATION INTERVAL)	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
N20	MANE	5.00	46.52	780.00	5.53	5.00	46.52	780.00	5.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9325E+01 EXCESS= .1215E+01 OUTFLOW= .1052E+02 BASIN STORAGE= .2178E-02 PERCENT ERROR= .1

N11T	MANE	3.26	11.91	733.23	5.53	5.00	11.86	735.00	5.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1393E+01 OUTFLOW= .1385E+01 BASIN STORAGE= .1876E-02 PERCENT ERROR= .4

N11S	MANE	3.12	34.59	724.20	5.65	5.00	32.23	725.00	5.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2130E+01 OUTFLOW= .2077E+01 BASIN STORAGE= .4285E-03 PERCENT ERROR= 2.5

CH11	MANE	5.00	40.46	735.00	5.42	5.00	40.46	735.00	5.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3461E+01 EXCESS= .1364E+01 OUTFLOW= .4683E+01 BASIN STORAGE= .2406E-02 PERCENT ERROR= 2.9

N2T	MANE	3.86	31.70	737.41	5.49	5.00	31.34	735.00	5.49

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CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4180E+01 OUTFLOW= .4128E+01 BASIN STORAGE= .7392E-02 PERCENT ERROR=   1.1

             N2S  MANE        1.54     24.45    723.94      5.68      5.00     23.72    725.00         5.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1513E+01 OUTFLOW= .1483E+01 BASIN STORAGE= .2001E-03 PERCENT ERROR=   2.0

             CH2  MANE        3.94     84.60    733.28      5.48      5.00     84.05    735.00         5.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1030E+02 EXCESS= .7115E+00 OUTFLOW= .1099E+02 BASIN STORAGE= .1160E-02 PERCENT ERROR=    .2

             N3T  MANE        2.95    122.61    737.11      5.07      5.00    122.18    735.00         5.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1574E+02 OUTFLOW= .1436E+02 BASIN STORAGE= .2430E-01 PERCENT ERROR=   8.6

             N3S  MANE        3.63     25.94    725.04      5.73      5.00     25.88    725.00         5.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1667E+01 OUTFLOW= .1650E+01 BASIN STORAGE= .4547E-03 PERCENT ERROR=   1.0

             CH3  MANE        3.74    238.09    737.52      5.30      5.00    237.19    740.00         5.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3069E+02 EXCESS= .1097E+01 OUTFLOW= .3170E+02 BASIN STORAGE= .3574E-02 PERCENT ERROR=    .2

             N4T  MANE        2.52     22.88    740.50      5.47      5.00     22.84    740.00         5.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3439E+01 OUTFLOW= .3387E+01 BASIN STORAGE= .8891E-02 PERCENT ERROR=   1.3

             N4S  MANE        3.62     35.90    723.22      5.68      5.00     33.64    725.00         5.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2439E+01 OUTFLOW= .2392E+01 BASIN STORAGE= .5147E-03 PERCENT ERROR=   1.9

             CH4  MANE        5.00     62.27    730.00      5.53      5.00     62.27    730.00         5.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5767E+01 EXCESS= .1453E+01 OUTFLOW= .7200E+01 BASIN STORAGE= .1358E-02 PERCENT ERROR=    .3

            CH4A  MANE        1.73    287.49    737.40      5.34      5.00    286.30    735.00         5.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3891E+02 EXCESS= .3261E+00 OUTFLOW= .3920E+02 BASIN STORAGE= .2158E-02 PERCENT ERROR=    .1

            CHW1  MANE        5.00     13.02    740.00      5.49      5.00     13.02    740.00         5.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1240E+01 EXCESS= .4150E+00 OUTFLOW= .1639E+01 BASIN STORAGE= .1476E-02 PERCENT ERROR=    .9

            N10T  MANE        1.23     36.95    741.58      5.53      5.00     36.82    745.00         5.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5514E+01 OUTFLOW= .5490E+01 BASIN STORAGE= .1379E-01 PERCENT ERROR=    .2

            N10S  MANE         .62     55.67    725.10      5.79      5.00     55.40    725.00         5.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3551E+01 OUTFLOW= .3550E+01 BASIN STORAGE= .1045E-03 PERCENT ERROR=    .0

            CH10  MANE        3.89    120.07    728.17      5.59      5.00    114.78    730.00         5.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9055E+01 EXCESS= .3884E+01 OUTFLOW= .1288E+02 BASIN STORAGE= .2546E-02 PERCENT ERROR=    .4

             N9T  MANE        1.05     39.81    739.00      5.54      5.00     39.58    740.00         5.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5247E+01 OUTFLOW= .5229E+01 BASIN STORAGE= .8873E-02 PERCENT ERROR=    .2

             N9S  MANE         .57     73.17    725.45      5.79      5.00     72.83    725.00         5.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4570E+01 OUTFLOW= .4568E+01 BASIN STORAGE= .1143E-03 PERCENT ERROR=    .0
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             CH9  MANE        5.00     83.50    735.00       5.58       5.00     83.50    735.00         5.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9806E+01 EXCESS= .1601E+01 OUTFLOW= .1129E+02 BASIN STORAGE= .4162E-02 PERCENT ERROR=   1.0

             N5T  MANE         .30     50.41    754.37       5.52       5.00     50.41    755.00         5.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9338E+01 OUTFLOW= .9275E+01 BASIN STORAGE= .4378E-01 PERCENT ERROR=    .2

             N5S  MANE         .73     32.50    726.07       5.79       5.00     31.52    725.00         5.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2161E+01 OUTFLOW= .2161E+01 BASIN STORAGE= .1163E-03 PERCENT ERROR=    .0

             CH5  MANE        5.00     66.15    740.00       5.54       5.00     66.15    740.00         5.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1142E+02 EXCESS= .1512E+01 OUTFLOW= .1288E+02 BASIN STORAGE= .8477E-02 PERCENT ERROR=    .4

             N6T  MANE        1.02     20.70    737.48       5.54       5.00     20.47    735.00         5.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2550E+01 OUTFLOW= .2541E+01 BASIN STORAGE= .3798E-02 PERCENT ERROR=    .2

             N6S  MANE         .91     30.94    725.80       5.79       5.00     30.36    725.00         5.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1976E+01 OUTFLOW= .1976E+01 BASIN STORAGE= .4982E-04 PERCENT ERROR=    .0

             CH6  MANE        5.00    101.78    740.00       5.54       5.00    101.78    740.00         5.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1739E+02 EXCESS= .1364E+01 OUTFLOW= .1868E+02 BASIN STORAGE= .1235E-01 PERCENT ERROR=    .4

            N7AT  MANE         .75     41.97    738.16       5.54       5.00     41.55    740.00         5.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5603E+01 OUTFLOW= .5580E+01 BASIN STORAGE= .9999E-02 PERCENT ERROR=    .2

            N7AS  MANE         .46     33.53    725.11       5.79       5.00     33.45    725.00         5.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2100E+01 OUTFLOW= .2098E+01 BASIN STORAGE= .5111E-04 PERCENT ERROR=    .0

            CH7A  MANE        5.00    153.03    745.00       5.53       5.00    153.03    745.00         5.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2630E+02 EXCESS= .1067E+01 OUTFLOW= .2726E+02 BASIN STORAGE= .1321E-01 PERCENT ERROR=    .4

            N7BT  MANE         .87     19.17    738.52       5.54       5.00     18.96    740.00         5.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2520E+01 OUTFLOW= .2511E+01 BASIN STORAGE= .4450E-02 PERCENT ERROR=    .2

            N7BS  MANE         .46     26.06    725.03       5.79       5.00     26.03    725.00         5.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1606E+01 OUTFLOW= .1605E+01 BASIN STORAGE= .3639E-04 PERCENT ERROR=    .0

            CH7B  MANE        5.00    178.99    745.00       5.50       5.00    178.99    745.00         5.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3137E+02 EXCESS= .1690E+01 OUTFLOW= .3283E+02 BASIN STORAGE= .1812E-01 PERCENT ERROR=    .6

             N8T  MANE        1.03     58.33    737.03       5.54       5.00     58.04    740.00         5.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7648E+01 OUTFLOW= .7622E+01 BASIN STORAGE= .1297E-01 PERCENT ERROR=    .2

             N8S  MANE         .67     78.07    725.64       5.79       5.00     77.49    725.00         5.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4940E+01 OUTFLOW= .4939E+01 BASIN STORAGE= .1245E-03 PERCENT ERROR=    .0

             N19  MANE        5.00     75.13    775.00       5.53       5.00     75.13    775.00         5.53
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1454E+02 EXCESS= .8301E+00 OUTFLOW= .1535E+02 BASIN STORAGE= .2158E-02 PERCENT ERROR=    .1

              N18  MANE          5.00      77.82     780.00       5.52       5.00      77.82     780.00         5.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1535E+02 EXCESS= .1897E+01 OUTFLOW= .1723E+02 BASIN STORAGE= .2334E-02 PERCENT ERROR=    .1


*** NORMAL END OF HEC-1 ***
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VOLUME CALCULATIONS

EXCESS RAINFALL VOLUME CALCULATION

The volume generated by the site and the surrounding properties is calculated for the 25-year storm event. A summary of the design information that is included in this Appendix and related appendices are listed below.

- Excess rainfall and drainage areas used in the volume calculations were taken from the HEC-1 analysis located on pages IIIF-E-20 through IIIF-E-109.
- Updated permitted condition volume information is summarized on pages IIIF-E-112 through IIIF-E-114.

CAMELOT LANDFILL
1339-351-11-02-01
25-YEAR EXCESS RAINFALL
VOLUME CALCULATIONS

Required: Determine the 25-year 24-hour storm volume generated by the site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the permitted site conditions.

Method: 1. Use the excessive rainfall data generated by the HEC-1 analysis (pages IIIF-E-20 through IIIF-E-108) to determine the volume produced by the site for the permitted conditions.

Updated Permitted Conditions

1. Volume Discharging Southeast Downstream of Entrance Road

1a. Volume Upstream of Entrance Road

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
O1	**0.1367**	**5.90**	**87.47**	**43**
O1A	**0.0366**	**5.67**	**23.42**	**11**
O2	**1.5754**	**5.66**	**1,008.23**	**476**
S4	**0.0897**	**5.56**	**57.41**	**27**
Total Volume Upstream of Entrance Road				**556**

1b. Non-Landfill Areas Downstream of Entrance Road

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
N1	**0.0176**	**5.56**	**11.26**	**5**
O3	**0.0253**	**5.56**	**16.18**	**7**
S3	**0.0316**	**5.56**	**20.21**	**9**
N20	**0.0041**	**5.56**	**2.62**	**1**
Total Volume of Non-Landfill Areas D.S. of Entrance Road				**23**

1c. Landfill Areas Discharging into Pond W1 and Flowing under Entrance Road

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
N11T	**0.0047**	**5.56**	**3.03**	**1**
N11S	**0.0069**	**5.79**	**4.40**	**2**
CH11	**0.0046**	**5.56**	**2.97**	**1**
N2T	**0.0141**	**5.56**	**9.05**	**4**
N2S	**0.0049**	**5.79**	**3.16**	**2**
CH2	**0.0024**	**5.56**	**1.56**	**1**
N12	**0.0124**	**5.56**	**7.96**	**4**
N3T	**0.0531**	**5.56**	**34.01**	**16**
N3S	**0.0054**	**5.79**	**3.47**	**2**
CH3	**0.0037**	**5.56**	**2.39**	**1**
N4T	**0.0116**	**5.56**	**7.45**	**3**
N4S	**0.0079**	**5.79**	**5.05**	**2**
CH4	**0.0049**	**5.56**	**3.11**	**1**
CH4A	**0.0011**	**5.56**	**0.68**	**0**
N13	**0.0293**	**5.56**	**18.73**	**9**
W1	**0.0130**	**7.44**	**8.30**	**5**
N16	**0.0043**	**5.56**	**2.72**	**1**
CHW1	**0.0014**	**5.56**	**0.89**	**0**
S5	**0.0010**	**5.56**	**0.67**	**0**
Total Volume Flowing under Entrance Road				**57**

Total Volume Discharging Southeast Downstream
of Entrance Road = **637** **ac-ft**

2. Volume in Midway Branch Exiting Permit Boundary

2a. Volume in Midway Branch Entering Permit Boundary

Offsite Area Entering Midway Branch	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
O4	**0.1344**	**5.56**	**86.04**	**40**
Total Volume in Midway Branch Entering Permit Boundary				**40**

2b. Landfill Areas Flowing East into Midway Branch

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
N10T	**0.0186**	**5.56**	**11.93**	**6**
N10S	**0.0115**	**5.79**	**7.39**	**4**
CH10	**0.0131**	**5.56**	**8.41**	**4**
Total Volume Flowing East into Midway Branch				**13**

Total Volume in Midway Branch Excluding Section 1 Discharge Volume = **53** **ac-ft**

Total Volume in Midway Branch Exiting Permit Boundary = **689** **ac-ft**

3. Volume Discharging South into Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
N9T	**0.0177**	**5.56**	**11.35**	**5**
N9S	**0.0148**	**5.79**	**9.50**	**5**
CH9	**0.0054**	**5.56**	**3.48**	**2**
N5T	**0.0315**	**5.56**	**20.18**	**9**
N5S	**0.0070**	**5.79**	**4.50**	**2**
CH5	**0.0051**	**5.56**	**3.26**	**2**
N6T	**0.0086**	**5.56**	**5.48**	**3**
N6S	**0.0064**	**5.79**	**4.10**	**2**
CH6	**0.0046**	**5.56**	**2.95**	**1**
N7AT	**0.0189**	**5.56**	**12.08**	**6**
N7AS	**0.0068**	**5.79**	**4.36**	**2**
CH7A	**0.0036**	**5.56**	**2.30**	**1**
N7BT	**0.0085**	**5.56**	**5.45**	**3**
N7BS	**0.0052**	**5.79**	**3.34**	**2**
CH7B	**0.0057**	**5.56**	**3.66**	**2**
N8T	**0.0258**	**5.56**	**16.52**	**8**
N8S	**0.0160**	**5.79**	**10.27**	**5**
W2	**0.0154**	**7.44**	**9.83**	**6**
Total Volume Discharging South into Elm Fork				**64**

CAMELOT LANDFILL
1339-351-11-02-01
25-YEAR EXCESS RAINFALL
VOLUME CALCULATIONS

4. Volume Discharging Southeast into Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
N15	**0.0311**	**5.56**	**19.93**	**9**
Total Volume Discharging Southeast into Elm Fork				**9**

5. Volume Discharging Southwest into Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
N14	**0.0407**	**5.56**	**26.06**	**12**
Total Volume Discharging Southwest into Elm Fork				**12**

6. Southern Volume Discharging Southwest Towards Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
N17	**0.0068**	**5.56**	**4.32**	**2**
Total Southern Volume Discharging Southwest Towards Elm Fork				**2**

7. Northern Volume Discharging West Towards Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S2	**0.0493**	**5.56**	**31.53**	**15**
N19	**0.0028**	**5.56**	**1.82**	**1**
N18	**0.0064**	**5.56**	**4.12**	**2**
Total Northern Volume Discharging West Towards Elm Fork				**17**

8. Volume Discharging from Northwest Corner Towards Elm Fork

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (ac)	Volume (ac-ft)
S1	**0.0163**	**5.56**	**10.40**	**5**
Total Volume Discharging from NW Corner Towards Elm Fork				**5**

Total Volume Exiting Permit Boundary = 799 ac-ft

VELOCITY CALCULATIONS

Required: Determine the flow velocities entering and exiting the permit boundary using HYDROCALC HYDRAULICS (Version 1.2a, 1996) for the flows calculated for the 25-year storm event in the HEC-1 analysis. HEC-RAS is used to determine the velocity in Elm Fork.

Method:

1. Use the flow data generated by the HEC-1 analysis to determine velocity of runoff entering the landfill permit boundary.
2. Use the flow data generated by the HEC-1 analysis to determine velocity of runoff exiting the landfill permit boundary.

1. Flow Velocity entering the landfill permit boundary

DP1

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2171 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2171	0.010	0.03	4.00	20.00	60.00	2.85	8.08

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP2

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 62 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	62	0.090	0.03	4.00	6.00	87.00	0.16	4.38

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP4

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2887 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2887	0.005	0.03	10.00	2.00	22.00	6.00	8.29

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP12

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 298 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	298	0.001	0.03	77.00	83.00	0.00	1.65	1.38

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP13

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 70 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	70	0.019	0.03	50.00	48.00	0.00	0.66	3.27

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

2. Flow Velocity exiting the landfill permit boundary

DP3

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2674 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2674	0.008	0.03	16.00	17.00	27.00	3.86	7.64

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP5

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 2933 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	2933	0.008	0.03	2.00	2.00	9.00	8.75	12.64

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP6

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 201 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	201	0.030	0.03	1.00	2.00	1.00	3.17	11.00

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP7

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 61 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	61	0.010	0.03	24.00	29.00	0.00	0.89	2.89

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP8

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 88 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	88	0.083	0.03	4.50	5.00	0.00	1.32	10.64

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP9

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 24 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	24	0.089	0.03	99.00	100.00	0.00	0.25	3.76

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

DP10

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 78 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	78	0.001	0.03	3.00	3.00	20.00	1.64	1.91

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

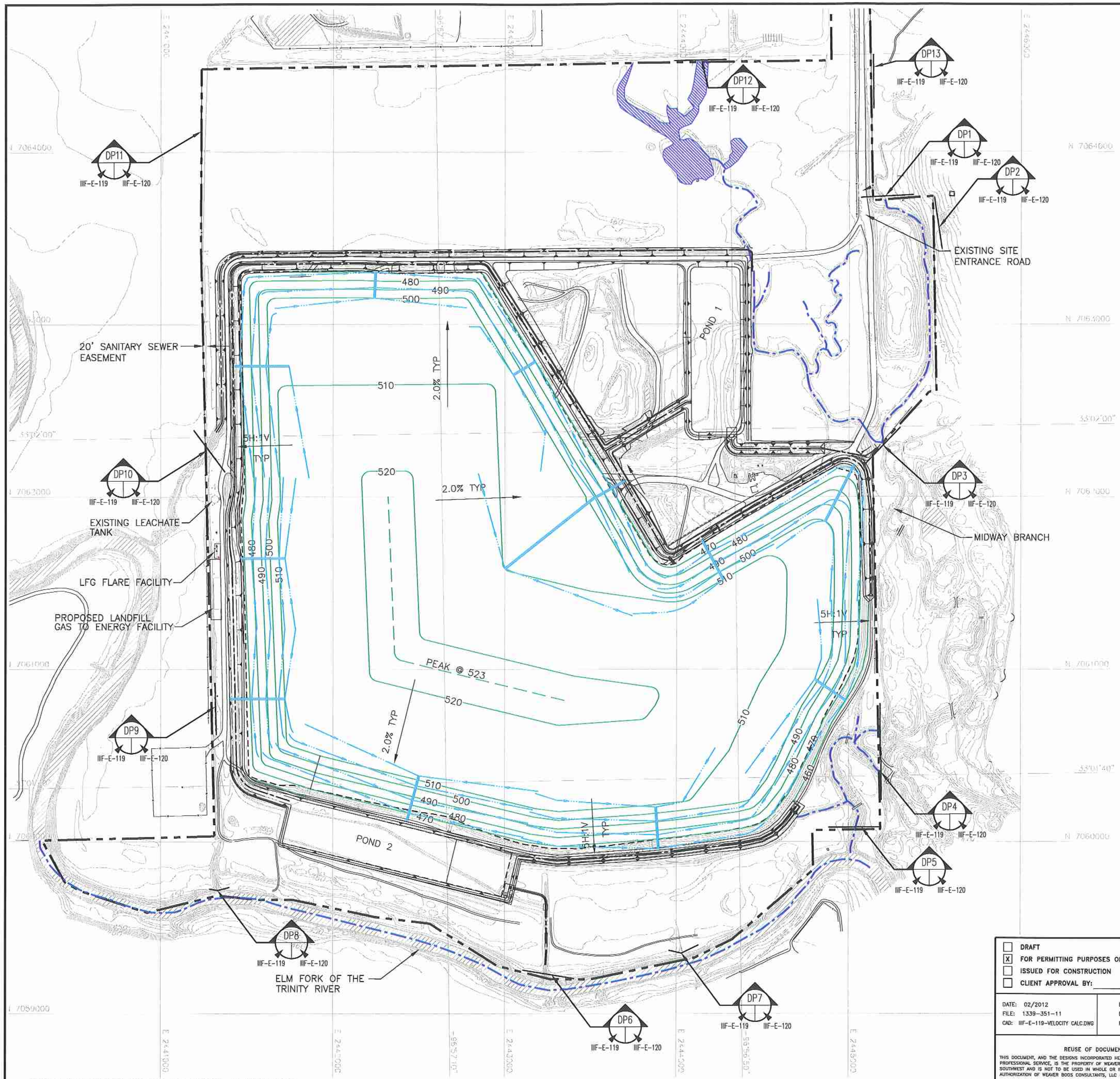
DP11

- Flow for the 25-year storm event was obtained from the HEC-1 files included in this Appendix and are summarized below.

Q_{25} = 25 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
25	25	0.001	0.03	100.00	100.00	0.00	0.60	0.70

Note: Calculations were performed using the HYDROCALC HYDRAULICS for Windows program developed by Dodson and Associates (Version 1.2a, 1996).



N

0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- AUTHORIZED LIMIT OF WASTE
- N 7064000 STATE PLANE COORDINATE SYSTEM
- 33°02'00" GEODETIC COORDINATE SYSTEM
- 600 PERMITTED FINAL COVER CONTOUR
- 500 EXISTING CONTOUR (SEE NOTE 1)
- PERMITTED DRAINAGE SWALE
- PERMITTED LETDOWN STRUCTURE
- USACE SECTION 404 JURISDICTIONAL WATERS OF THE U.S. (SEE NOTE 2)
- USACE JURISDICTIONAL WETLANDS

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY METROPOLITAN AERIAL SURVEYS COMPILED FROM AERIAL PHOTOGRAPHY FLOWN 8-28-2010. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON NAVD 1988.
2. SECTION 404 JURISDICTIONAL WATERS OF THE U.S. AND WETLANDS REPRODUCED FROM THE GOSHAWK ENVIRONMENTAL CONSULTANTS, INC. SEPTEMBER 2010 REPORT WHICH IS INCLUDED IN PARTS I/II, APPENDIX I/IIB.
3. PERMIT BOUNDARY WAS PREPARED BY PEISER SUREYING CO. IN NOVEMBER 2010.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION
☐ CLIENT APPROVAL BY: ____________

DATE: 02/2012	DRAWN BY: SRF
FILE: 1339-351-11	DESIGN BY: CRM
CAD: IIIF-E-119-VELOCITY CALC.DWG	REVIEWED BY: JPY

PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
UPDATED PERMITTED DISCHARGE POINT VELOCITY CALCULATIONS

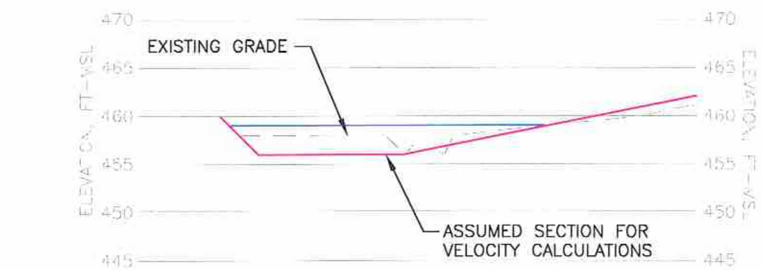
CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO
FORT WORTH, TX (817) 735-9770
GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

SHEET IIIF-E-119

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-E\IIIF-E-119 DISCHARGE PT VEL CALC.dwg, jwilson, 1:2

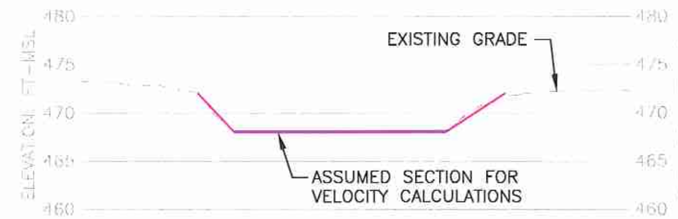


DISCHARGE POINT 1

DP1 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

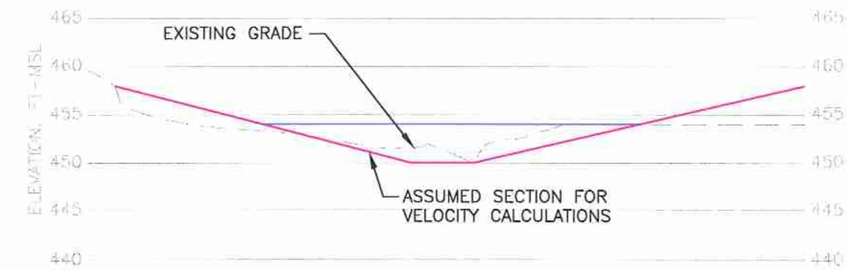


DISCHARGE POINT 2

DP2 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 3

DP3 IIIF-E-119 IIIF-E-120

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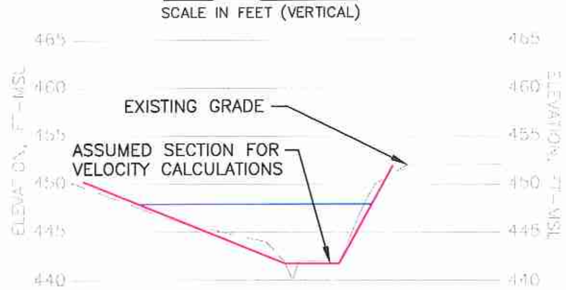
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 4

DP4 IIIF-E-119 IIIF-E-120

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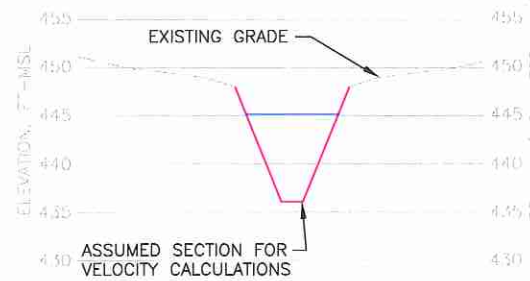
0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 5

DP5 IIIF-E-119 IIIF-E-120

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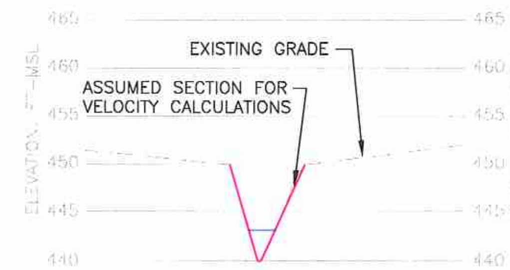
0 10 20 SCALE IN FEET (VERTICAL)

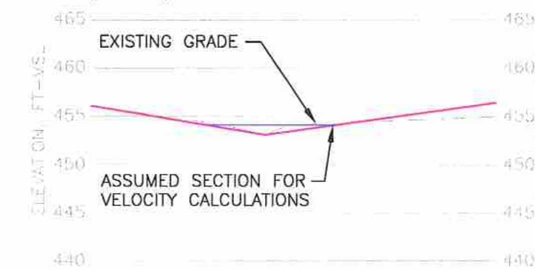


DISCHARGE POINT 6

DP6 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

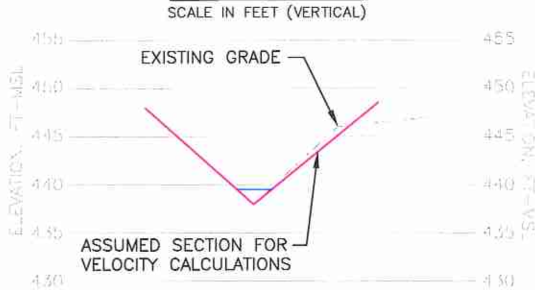


DISCHARGE POINT 7

DP7 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

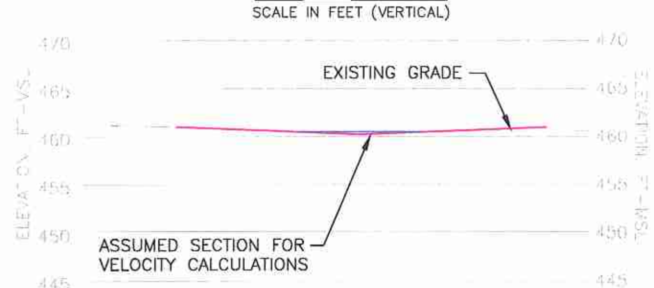


DISCHARGE POINT 8

DP8 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

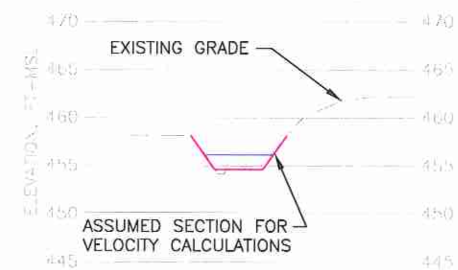


DISCHARGE POINT 9

DP9 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

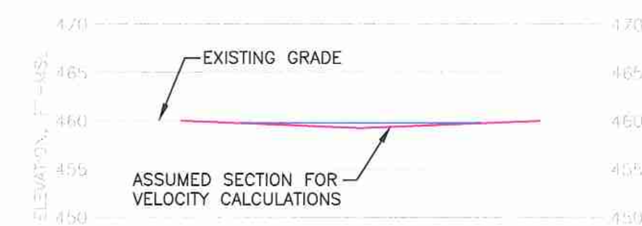


DISCHARGE POINT 10

DP10 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

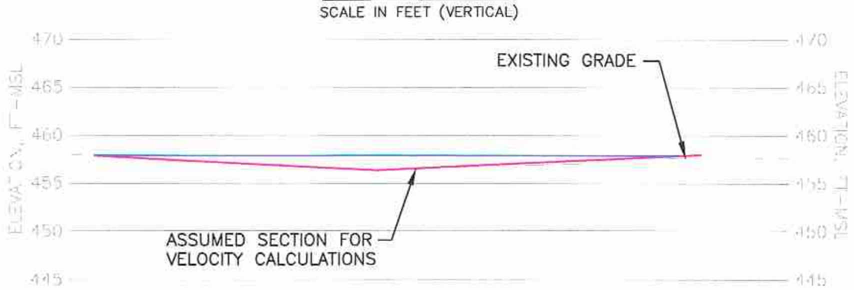


DISCHARGE POINT 11

DP11 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

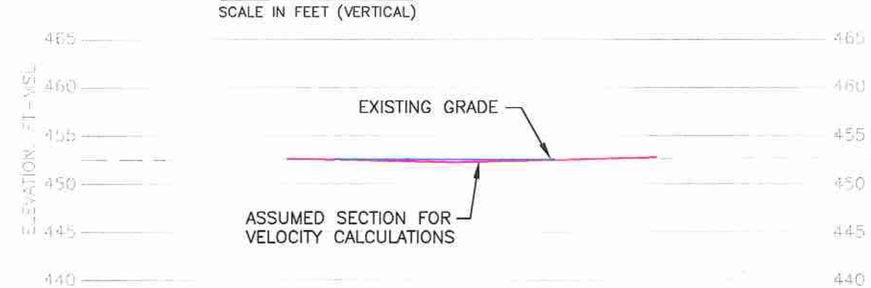


DISCHARGE POINT 12

DP12 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)



DISCHARGE POINT 13

DP13 IIIF-E-119 IIIF-E-120

0 40 80 SCALE IN FEET (HORIZONTAL)

0 10 20 SCALE IN FEET (VERTICAL)

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☐ CLIENT APPROVAL BY:

DATE: 02/2012
FILE: 1339-351-11
CAD: IIIF-E-120-DISCHARGE PT VEL CALC.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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PREPARED FOR

CITY OF FARMERS BRANCH

REVISIONS

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CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants

TBPE REGISTRATION NO. F-3727

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SHEET IIIF-E-120

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-E\IIIF-E-120-DISCHARGE POINT SECTIONS.dwg, jwilson, 1:2

APPENDIX IIIF-F

EROSION CONTROL PLAN FOR ALL PHASES OF LANDFILL OPERATION

STATE OF TEXAS
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Includes pages IIIF-F-1 through IIIF-F-14

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EROSION CONTROL PLAN FOR ALL PHASES OF LANDFILL OPERATION

1.0 Introduction

The purpose of this appendix is to provide an Erosion Control Plan (ECP) to meet the requirements of Title 30 Texas Administrative Code (TAC) Chapter §330.305(d), which are listed below.

> *"The landfill design must provide effective erosional stability to top dome surfaces and external embankment side slopes during all phases of landfill operation, closure, and post-closure care in accordance with the following.*
>
> *(1) Estimated peak velocities for top surfaces and external embankment slopes should be less than the permissible non-erodible velocities under similar conditions.*
>
> *(2) The top surfaces and external embankment slopes of municipal solid waste landfill units must be designed to minimize erosion and soil loss through the use of appropriate side slopes, vegetation, and other structural and nonstructural controls, as necessary. Soil erosion loss (tons/acre) for the top surfaces and external embankment slopes may be calculated using the Soil Conservation Service of the United States Department of Agriculture's Universal Soil Loss Equation, in which case the potential soil loss should not exceed the permissible soil loss for comparable soil-slope lengths and soil-cover conditions."*

This ECP has also been developed to meet the requirements of the Texas Commission on Environmental Quality (TCEQ) guidance document titled, "Guidance for Addressing Erosional Stability During All Phases of Landfill Operation." As noted in the above guidance document, landfill cover phases are defined as daily cover, intermediate cover, and final cover. Top dome surfaces and external embankment side slopes are:

- Those above grade slopes that directly drain to the site perimeter stormwater management system (i.e., areas where the stormwater directly flows to a perimeter channel or detention pond designed in accordance with Title 30 TAC §330.63(c), §330.303, and §330.305);
- Above grade slopes that have received intermediate or final cover; and
- Above grade slopes that have either reached their permitted elevation, or will subsequently remain inactive for longer than 180 days. For example, after an above grade slope has reached the permitted elevation and intermediate cover has been placed, the structural erosion control features (e.g., drainage swales, letdown

structures, and/or sedimentation ponds) will be in-place 180 days after intermediate cover has been placed.

Slopes which drain to ongoing waste placement areas, pre-excavated areas, areas that have received only daily cover, and areas under construction which have not received waste are not considered external side slopes.

The ECP for daily cover areas and top dome surfaces and external side slopes that drain directly to the site perimeter stormwater management system, have received intermediate cover, and either reached their permitted configuration or will remain inactive for longer than 180 days are addressed in the following sections. Erosion control measures for final cover areas are addressed in the currently TCEQ-approved Site Development Plan (SDP).

Inspection, maintenance, and recordkeeping requirements are included in the Site Operating Plan (SOP) and discussed in Section 2.4. The word "temporary" is used throughout the ECP to describe any erosion control feature that is not a permanent erosion control feature that is included in the approved Site Development Plan. Additionally, "temporary" is defined as the time between construction of intermediate cover and the construction of final cover. Temporary erosion controls are those controls which are installed or constructed within 180 days from when the intermediate cover is constructed and in place until permanent controls are constructed for the final cover.

2.0 Erosion Control Plan for Top Dome Surfaces and External Side Slopes with Intermediate Cover

Erosion control for above grade top dome surfaces and external embankment side slopes that drain directly to the site perimeter stormwater management system, have received intermediate cover, and either reached their permitted configuration or will remain inactive for longer than 180 days will be managed using a system of nonstructural and structural erosion and sediment controls to meet rule requirements for the intermediate cover phase of landfill construction.

The structural controls will consist of a combination of vegetation, temporary add-on swales, and letdown structures. These structural controls will be configured in a manner that will result in a net soil loss of 50 tons/acre/year or less from the external slope area. As shown on Sheet IIIF-F-9, stormwater runoff will be collected in swales and conveyed to drainage letdown structures down the 25 percent slopes to the perimeter drainage system. The primary goal will be to establish the vegetative cover percentage and swale spacing distance indicated in the swale design summary table on Sheet IIIF-F-10 on all external top dome surfaces and external embankment slopes. These criteria will result in a net soil loss of 50 tons/acres/year or less for each drainage swale and letdown combination specified on Sheets IIIF-F-9 and IIIF-F-10 (refer to Section 2.1 for additional information).

Mulch, woodchips, compost or straw/hay will be used as a layer placed over the intermediate cover to protect the exposed soil surface from erosive forces and conserve soil moisture until vegetation can be established. The mulch, woodchips, compost or straw/hay will be used to stabilize recently graded or seeded areas. If needed, the mulch, woodchips, compost or straw/hay will be spread evenly over a recently seeded area and tracked into the surface to protect the soil from erosion and moisture loss, and provide additional erosional stability to the intermediate cover surface during the establishment of vegetation. These materials are not required for the establishment of vegetation on the intermediate cover unless they are needed to provide additional erosional stability to the intermediate cover surface. These materials will vary in thickness but the mulch, woodchips, compost or straw/hay will be placed so as not to inhibit the growth of vegetation. In the event that the indicated vegetative ground cover required for a specific swale spacing distance is not obtained within 180 days after intermediate cover is placed on a top dome or external side slope, mulch, woodchips, compost or straw/hay will be used as a secondary measure to limit soil loss to 50 tons/acre/year or less until vegetation is established. In the above referenced cases, other erosion protection measures will only be used upon prior written authorization by TCEQ (e.g., permit modification). Stormwater discharge from the site must comply with the current TPDES for the site. The discharge locations for the site are identified in Appendix IIIF as a part of the final drainage design and cannot be revised based on this ECP. Design and use of temporary erosion control measures can not result in offsite discharge exceeding the peak flow rates, volumes, or velocities listed in Table 4-1 of Appendix IIIF.

As an alternative to mulch, wood chips, compost, or straw/hay, a detention/sedimentation pond may be used as a secondary measure to limit the discharge of eroded soil loss to 50 tons/acre/year or less (refer to Section 2.2 for additional information) if the required percent vegetation goal is not obtained within 180 days after intermediate cover is placed on the top dome or external side slopes. In this case, the detention/sedimentation pond will remain in place until the specified percent vegetation goal is met (e.g., 60 percent vegetation on the external embankment slopes and top dome surfaces).

2.1 Drainage Swale and Letdown Structure Requirements

Sheet IIIF-F-9 shows a typical layout for erosion control structures, including temporary add-on swales and drainage letdowns. Sheet IIIF-F-10 provides a swale design summary, which includes spacing and vegetative cover requirements for the swales. Supporting calculations for the specifications listed on Sheet IIIF-F-10 are provided in Appendix IIIF-F-1 – Temporary Add-on Swale Design. Appendix IIIF-F-1 also includes a demonstration to show that sheet flow velocities for the grass established surfaces for all swale spacings are less than 5 ft/sec and sheet flow velocity for "nearly bare ground" is less than 3.5 ft/sec (consistent with Title 30 TAC §330.305(d)(1)).

Letdown structures will be located and constructed in a manner that minimizes erosion loss. The letdowns are designed to convey runoff from the 25-year frequency storm event (refer to Appendix IIIF-F-2 – Temporary Letdown Design for more information). Sheet IIIF-F-11 shows letdown details and the letdown design summary. As shown on Sheet IIIF-F-11, the letdowns will consist of either a lined open channel structure or a pipe letdown. The type, size, and number of letdowns will be determined based on the size of the drainage area using the design information specified on Sheet IIIF-F-11. As noted on Sheet IIIF-F-11, the use of pipe letdowns will be limited to 1 inlet per letdown.

As noted on Sheet IIIF-F-9, the acceptable soil loss is determined for each acre on the top dome surfaces and external embankment side slopes. The soil loss for top dome surfaces and external embankment side slopes will vary depending on swale spacing and percent vegetative cover (refer to Sheet IIIF-F-10 for soil loss estimates). If certain percent vegetation cover is not achieved, a sediment control pond will be temporarily used for sediment capture to reduce the discharge of eroded soil from the external slopes to a rate that is equal to or less than 50 tons/acre/year. The swale spacing as shown on Sheet IIIF-F-10 for top dome and side slope surfaces is based on the limiting soil loss of 50 tons/acres/year. If a vegetative coverage and swale spacing configuration results in a soil loss greater than 50 tons/acre/year, the following procedure will be used to verify that an acceptable intermediate cover thickness is maintained.

- Intermediate cover areas will be inspected to detect erosion gullies and vegetation loss.
- After identifying the areas requiring additional soil, these areas will be replenished with additional soil and graded to provide uniform surfaces prior to reseeding.
- Any damaged concentrated flow drainage structures such as swales will be repaired to eliminate uncontrolled concentrated flow.

Temporary open channel letdowns will be inspected for erosion/hollowing through and under the lining materials (e.g., gabions, grouted riprap, and turf reinforcement) and repaired as necessary to ensure the letdown is functioning as designed. As of October 2009, numerous erosion control structures have been installed at the site that conform to the requirements of this ECP, and these structures will remain in place and continue to serve as erosion control measures until they are decommissioned.

As stated previously, the primary goal is to obtain the required vegetation coverage percentage for each condition (e.g., swale spacing).

2.2 Sedimentation Pond Design

As noted on Sheets IIIF-F-9 and IIIF-F-10, if vegetative cover for any surface is maintained at or above the percentages given for swale spacing distances, the estimated soil loss is less than 50 tons/acre/year. In the event that certain percent ground cover that limits the soil loss to 50 tons/acre/year is not achieved and soil loss is temporarily greater than 50 tons/acre/year, a sedimentation pond will be used along with other structural and non-structural BMPs approved as part of this plan to limit the discharge of eroded soil. Sheet IIIF-F-12 provides a procedure for determining the required pond size. Supporting calculations for the procedure listed on Sheet IIIF-F-12 are included in Appendix IIIF-F-3 – Sediment Control Pond Design. If a sediment control pond is used to limit the off-site discharge of eroded soil to 50 tons/acre/year or less from the external slope area, a demonstration noting how the pond was sized will be documented and maintained in the

Site Operating Record. This document will also include a statement that notes how the temporary sedimentation pond, the pond outlet, and any related perimeter channels were constructed consistent with the requirements of the Site Development Plan. Sheet IIIF-F-13 shows the different options for typical pond outlet structures.

The sedimentation pond option is a secondary erosion control option, similar to mulch, wood chips, compost, or straw/hay, and will only be used if the required percent vegetation specification is not met. If the sedimentation pond option is implemented, the swales and letdowns specified will remain in-place. The sedimentation pond option simply allows for the control of sediment while vegetation is being established.

For example, if intermediate cover is placed over a 20-acre external side slope area that is at the permitted elevation on December 31, then the operator will install swales and letdowns on the 20-acre slope consistent with the design and specifications listed in Section 2.1. The operator then has 180 days (which for this example would be June 29) to obtain the required vegetation coverage on the 20-acre area. If in early June it becomes apparent that the percent vegetation will be less than the required coverage on June 29, then the operator may install a sedimentation pond downstream of the 20-acre area, consistent with the requirements shown on Sheet IIIF-F-12. Consistent with Section II.D of the TCEQ guidance document titled, "Guidance for Addressing Erosional Stability During All Phases of Landfill Operation," the sedimentation pond will remain in-place so that the net annual soil loss from the 20-acre area that could leave the facility boundary is less than 50 tons/acre/year until the required percent vegetation specification is met.

If a sedimentation pond is used as a source to maintain a soil loss equal to or less than 50 tons/acre/year, the following procedure will be used to verify that an acceptable intermediate cover thickness is maintained.

- Intermediate cover areas will be inspected to detect erosion gullies and vegetation loss.
- After identifying the areas requiring additional soil, these areas will be replenished with additional soil and graded to provide uniform surfaces prior to reseeding.
- Any damaged concentrated flow drainage structures such as swales will be repaired to eliminate uncontrolled concentrated flow.

As stated previously, the primary goal is to obtain the specified vegetation coverage percentage on top dome surfaces and external embankments. The sedimentation pond will only be used until the specified vegetation coverage percentage is obtained. The sedimentation pond may only be used for a period of 12 months after the 180-day period has expired (e.g., 12 months after the June 29th date used in the above example). Once the required vegetation percentage is achieved, then the sedimentation pond will no longer be needed (but may remain in-place as an additional BMP until the site reaches the permitted final configuration). If the percent vegetation does not meet the required specification within the 12-month period, then additional erosion control measures will be implemented. These measures will include: (1) adjusting the swale spacing, (2) applying mulch, wood chips, compost, or straw/hay, or similar TCEQ approved materials, or (3) the submittal of a permit modification to revise this erosion control plan to provide additional erosion protection measures that will allow the site to meet the goals of this plan.

2.3 Other Erosion Control BMPs

Other best management practices (BMPs) used in conjunction with the above erosion control measures are listed below.

- Check Dams – These structures will be used in channels to slow down flow velocities and improve sediment capture.
- Silt Fences – These structures will be used in capturing sediment transported by sheet flow and for diversion of flow for controlling sediment discharge.
- Compost Filter Berms – These structures may be used in capturing sediment transported by sheet flow and for diversion of flow for controlling sediment discharge.
- Erosion Booms – These structures may be used in capturing sediment and for diversion of flow for controlling sediment discharge.

These erosion control measures will be used on slopes to help control erosion loss. Rock check dams will be used in the detention/sedimentation pond. Refer to Sheet IIIF-F-14 for details of typical BMPs.

Nonstructural controls that will be used at the site to minimize erosion loss include: plans and designs to minimize disruption of the natural features, drainage, topography, and vegetative cover features; phased development to minimize the area of bare soil exposed at any given time; plans to disturb only the smallest area necessary to perform current activities; scheduling of construction activities during the time of year with the least erosion potential; and specific plans for the stabilization of exposed surfaces in a timely manner. Other BMPs will only be utilized upon prior written authorization (e.g., permit modification) by TCEQ.

2.4 Schedule and Recordkeeping Requirements

After an external side slope or top dome surface reaches the final permitted grade or will remain inactive for longer than 180 days, the structural erosion control features and letdown structures will be in place within 180 days from when intermediate cover is placed. During this 180 day period, the structural erosion control structures will be constructed and vegetation established. Structural erosion control measures consist of drainage swales, letdown structures, and detention ponds.

At the end of this 180-day period, the cover log will be updated to document the external side slope and top dome surface area, the structural controls that were installed, and a demonstration showing how the structural controls meet the 50 tons/acre/year or less soil loss requirement (e.g., percent vegetation coverage, swale spacing, and letdowns installed). Inspection requirements and schedules are listed in the SOP for all drainage features, including intermediate cover areas. If the required percent vegetation coverage is not achieved within the 180-day period, secondary erosion control measures such as mulch, wood chips or compost will be used to limit the soil loss to the 50 tons/acre/year or less. Other erosion protection measures will only be utilized upon prior written authorization (e.g., permit modification) by TCEQ. In addition, a detention/sedimentation pond may also be used until the required vegetation coverage is achieved. Any secondary measure used will be documented in the Site Operating Record at the end of the 180-day period to document compliance with this plan. In addition, the date the required vegetation cover is achieved and the date that the secondary measure is no longer needed will also be documented in the Site Operating Record. The dates and locations of installation of erosion and sediment control will also be documented in the Site Operating Record. Inspection requirements and schedules are listed in the SOP for all drainage features, including intermediate cover areas. Inspection and maintenance of the erosion and sediment control structures of the top dome surfaces and external embankment side slopes will follow the same schedule and methods as described in Section 4.24 of the facility's SOP.

For example, as stated in Section 4.18.3 of the current Site Operating Plan (SOP), intermediate cover areas are inspected weekly and within 72 hours of a rainfall event of 0.5 inches or more, or as soon as the areas are accessible, for proper placement, thickness, erosion, and compaction. Additionally, Section 4.23 of the SOP also requires inspections of perimeter channels and ponds to ensure they are functioning as designed (e.g., excess sediment removed, outlet structures intact, and erosion control measures intact, etc.) on a weekly basis and after a rainfall event of 0.5 inches or more, or as soon as the areas are accessible.

During the inspection of structural controls (e.g., vegetation over intermediate cover areas), if significant soil loss is identified in a given intermediate cover area, impacted areas will be replenished with additional soil. Prior to application of temporary erosion controls and seeding, the area will be graded to eliminate preferential path ways or any other uneven surface due to settlement to prevent concentrated flow over the intermediate cover areas. Soil for replenishment of cover areas will be borrowed from sedimentation ponds or any other soil source. If sediment collected from wet retention pond(s) (e.g., Pond P5 or temporary sedimentation ponds) is used for erosion layer replenishment, it will be stockpiled outside the ponds to dry out prior to being used for intermediate cover layer replenishment. Soil borrowed from other soil sources may be used as intermediate cover layer and erosion layer replenishment soil.

2.5 Construction Activities on Top Dome Surfaces and External Side Slopes with Intermediate Cover

Occasionally, top dome surfaces and external side slopes that have been stabilized through the use of swales, letdown structures, and compliance with the minimum required vegetation cover specification will be disturbed due to various construction activities such as the installation or repair of a landfill gas system, regrading of an area due to ponded water caused by uneven waste settlement, the repair of erosion rills, or damage due to an extreme storm event or natural disaster. Each of these events will be documented in the Site Operating Record. Recorded information will include the date of construction, approximate area disturbed, and the date re-seeding of the disturbed area occurred. In accordance with Title 30 TAC §330.165(g), previously stabilized surfaces will be repaired within 5 days of detection of the disturbance of these surfaces.

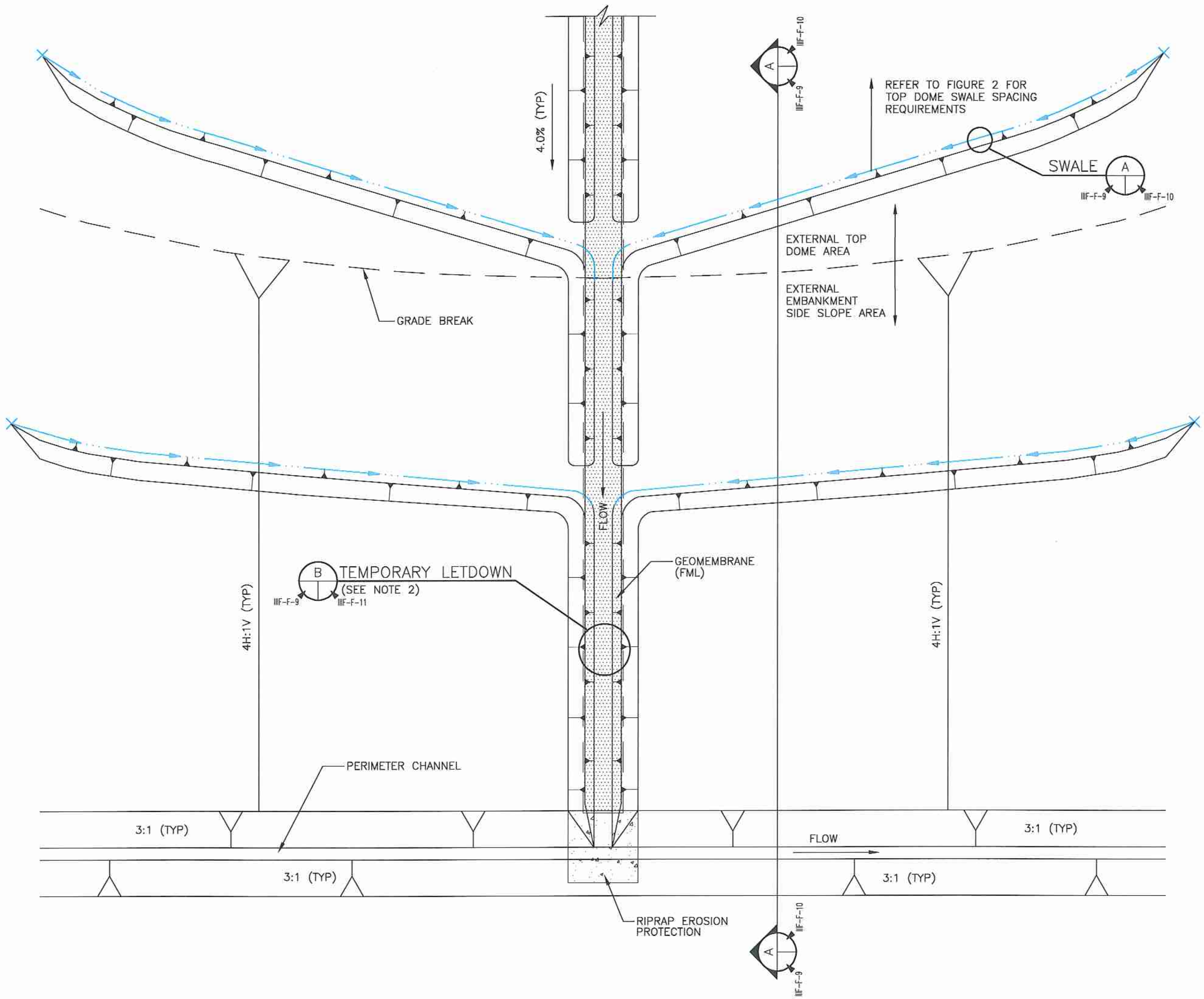
3.0 Erosion Control Plan for Daily Cover Areas and Intermediate Cover Areas for Non-External Side Slopes

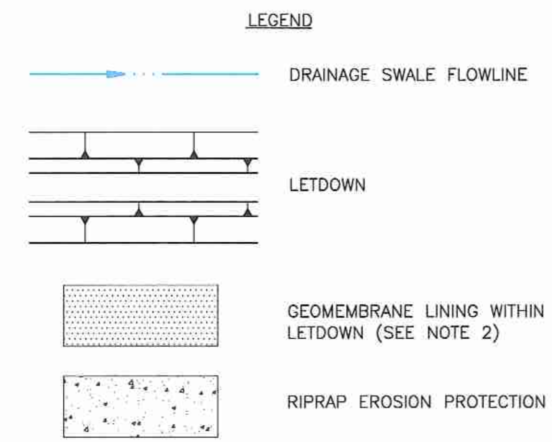
BMPs will be employed to control erosion. BMPs will include the use of temporary rock riprap, silt fences, straw bales, check dams, interceptor swales and berms, temporary and permanent seeding and sodding, surface roughening, matting and mulching, sediment traps, and surface wetting for dust control.

Examples of erosion and sedimentation control features that will be used during the phased development of the site are shown in Appendix IIIA-A of the Site Development Plan. The following provides general guidelines of how the erosion control features will minimize sediment discharge from the site.

- As noted in the SOP, vegetation will be established on above-grade intermediate cover areas that remain inactive. The temporary vegetative cover will minimize erosion potential.
- Typically, uncontaminated stormwater runoff from the site will be channeled through the perimeter channel system to detention ponds before being discharged from the site. Sediment that collects in the channels and detention ponds will be removed consistent with the stormwater system maintenance plan presented in Section 2.3 of Appendix IIIF.
- Erosion will be controlled by vegetation in drainage structures with flow velocities less than or equal to 5 ft/sec. For drainage structures with flow velocities greater than 5 ft/sec, rock riprap or gabions will be used for surface reinforcement. Other erosion protection measures will only be utilized upon prior written authorization (e.g., permit modification) by TCEQ.

Typical erosion control features are shown on Sheet IIIF-F-14. Inspection items and schedules are listed in the SOP for all drainage features, daily cover, and intermediate cover areas.





NOTES:

1. THE ACCEPTABLE SOIL LOSS IS LESS THAN OR EQUAL TO 50 TONS/ACRE/YEAR. THE SOIL LOSS FOR TOP DOME SURFACES AND EXISTING EXTERNAL EMBANKMENT SIDE SLOPES WILL VARY DEPENDING ON SWALE SPACING AND PERCENT VEGETATIVE COVER (REFER TO SHEET IIIF-F-10 FOR SOIL LOSS ESTIMATES).
2. TEMPORARY LETDOWN IS SHOWN AS AN OPEN CHANNEL WITH A GEOMEMBRANE LINER. AS NOTED ON SHEET IIIF-F-11, OTHER CHANNEL LININGS MAY BE USED (e.g., GABIONS, GROUT, GROUTED CONCRETE RIPRAP, AND TURF REINFORCEMENT MAT). IN ADDITION, PIPE LETDOWNS MAY ALSO BE USED. HOWEVER, IF PIPE LETDOWNS ARE USED THEY WILL BE LIMITED TO 1-INLET AS SHOWN ON SHEET IIIF-F-11.

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DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

EROSION CONTROL PLAN
TYPICAL EROSION CONTROL STRUCTURE LAYOUT

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727

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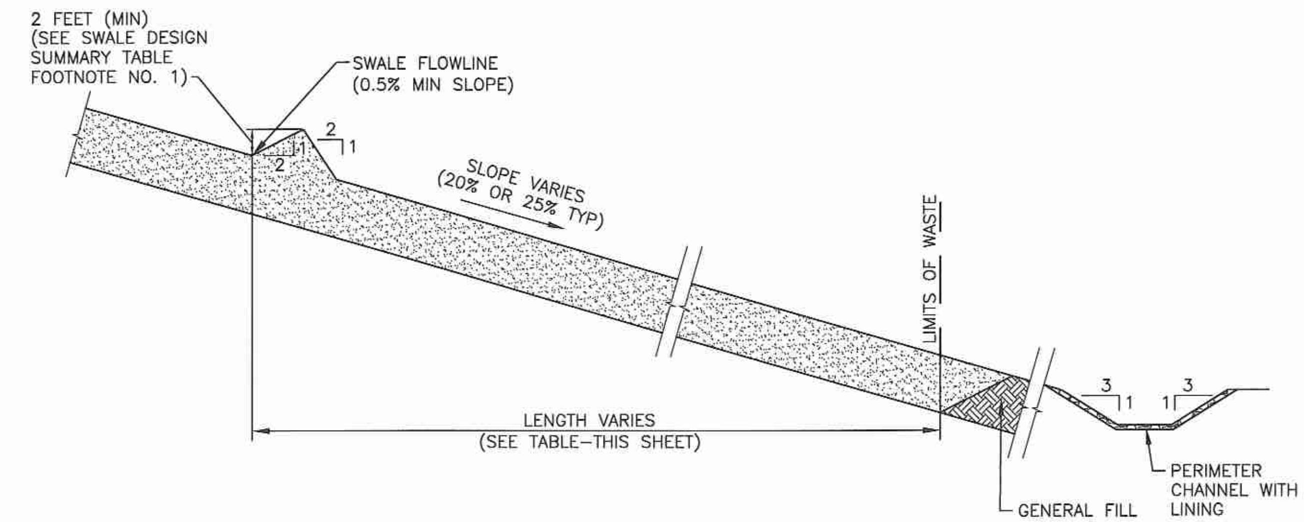
SPRINGFIELD, IL
ST. LOUIS, MO

SHEET IIIF-F-9

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-F\IIIF-F-9-TYPICAL SWALE SPACING.dwg, jwilson, 1:2



A SIDE SLOPE DRAINAGE SWALE
IIIF–F–9 IIIF–F–10

SWALE DESIGN SUMMARY[1]

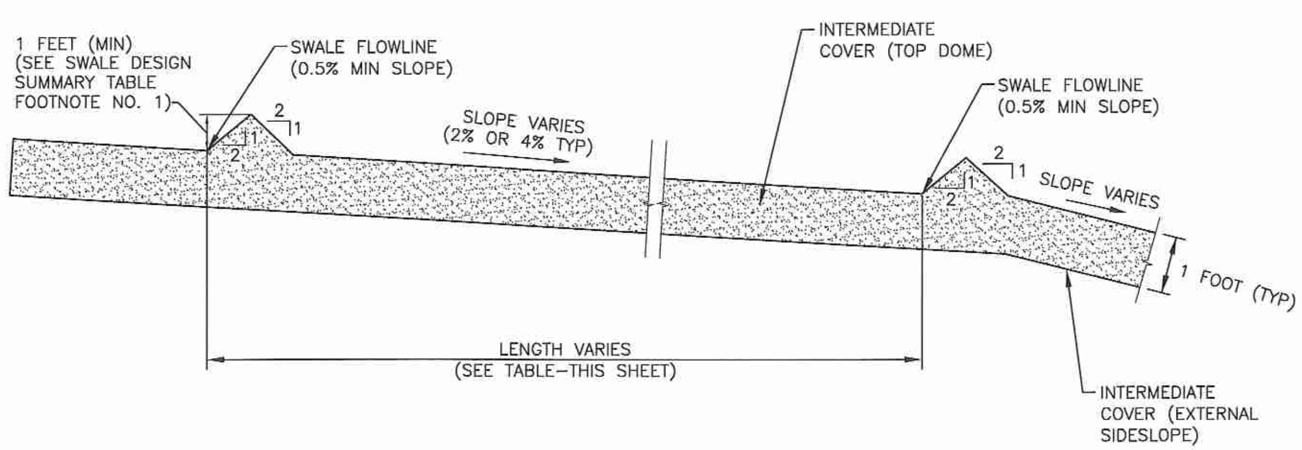
SIDE SLOPE (25%)			
VEGETATIVE COVER PERCENTAGE	DISTANCE BETWEEN SWALES (FT)	ESTIMATED SOIL LOSS (TONS/ACRE/YEAR)	ADDITIONAL SEDIMENT CAPTURE REQUIRED[2]
60	300	17.8	NO
70	300	7.2	NO
80	300	5.5	NO
90	300	2.7	NO
SIDE SLOPE (20%)			
60	300	13.3	NO
70	300	5.4	NO
80	300	4.1	NO
90	300	2.0	NO

TOP SLOPE (4%)			
VEGETATIVE COVER PERCENTAGE	DISTANCE BETWEEN SWALES[3] (FT)	ESTIMATED SOIL LOSS (TONS/ACRE/YEAR)	ADDITIONAL SEDIMENT CAPTURE REQUIRED[2]
60	500	1.3	NO
70	500	0.5	NO
80	500	0.4	NO
90	500	0.2	NO
60	600	1.4	NO
70	600	0.6	NO
80	600	0.4	NO
90	600	0.2	NO
60	700	1.5	NO
70	700	0.6	NO
80	700	0.5	NO
90	700	0.2	NO
TOP SLOPE (2%)			
60	700	0.7	NO
70	700	0.3	NO
80	700	0.2	NO
90	700	0.1	NO

[1] REFER TO APPENDIX IIIF–F–1 FOR SUPPORTING CALCULATIONS.

[2] IF SITE SPECIFIC CONDITIONS YIELD A MAXIMUM HORIZONTAL DISTANCE BETWEEN THE TOE OF THE SLOPE AND GRADE BREAK OF LESS THAN 300 FEET FOR SIDE SLOPES AND A DISTANCE OF 500 FEET FROM THE GRADE BREAK TO THE PEAK OF THE TOP SLOPES, ESTABLISHMENT OF 60% VEGETATION WILL BE SUFFICIENT MEANS OF EROSION CONTROL WITHOUT THE ADDITION OF TEMPORARY SWALES AND LETDOWNS GIVEN THAT THE TOTAL SOIL LOSS FOR THE SIDE SLOPE IS LESS THAN 50 TONS/ACRE/YEAR AND THE TOP SLOPE IS LESS THAN 50 TONS/ACRE/YEAR.

[3] NUMBERS INDICATE THE MAXIMUM SWALE SPACING FOR A GIVEN VEGETATIVE COVER PERCENTAGE.



A TOP DOME SURFACE DRAINAGE SWALE
IIIF–F–9 IIIF–F–10

SWALE DRAINAGE AREA SUMMARY

CONDITION (SWALE HEIGHT)	MAXIMUM DRAINAGE AREA (ACRES)	MINIMUM SWALE SPACING[1] (FEET)	MAXIMUM SWALE LENGTH[2] (FEET)
TOP SLOPE (2 FT SWALE, 2%)	48.4	500	4,216
TOP SLOPE (1.5 FT SWALE, 2%)	22.3	500	1,942
TOP SLOPE (1 FT SWALE, 2%)	7.4	500	644
TOP SLOPE (2 FT SWALE, 4%)	25.3	500	2,204
TOP SLOPE (1.5 FT SWALE, 4%)	11.7	500	1,019
TOP SLOPE (1 FT SWALE, 4%)	3.9	500	340
SIDE SLOPE (2 FT SWALE, 25%)	5.4	300	784
SIDE SLOPE (2 FT SWALE, 20%)	6.3	300	915

[1] THE MINIMUM SWALE SPACING IS USED TO DETAIN THE MAXIMUM SWALE LENGTH GIVEN THAT THE AREA IS FIXED. MINIMUM SWALE SPACING IS OBTAINED FROM THE CALCULATIONS PROVIDED ON PAGE IIIF–F–1–2.

[2] MAXIMUM SWALE LENGTH CALCULATED USING THE FOLLOWING EQUATION:

MAXIMUM DRAINAGE AREA x (43,560 SF/ACRE)/MINIMUM SWALE SPACING

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER
2-28-12

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DATE: 02/2012
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CAD: IIIF–F–10–SWALE DESIGN.DWG

DRAWN BY: SRF
DESIGN BY: CRM
REVIEWED BY: JPY

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PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS		
NO.	DATE	DESCRIPTION

EROSION CONTROL PLAN
SWALE DESIGN SUMMARY

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F–3727

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COLUMBUS, OH
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(817) 735–9770
GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

SHEET IIIF–F–10

O:\1339\351\EXPANSION 2009\PART III–SDP\IIIF\IIIF–F\IIIF–F–10–SWALE DESIGN.dwg, jwilson, 1:2

OPEN CHANNEL GEOMEMBRANE LETDOWN DESIGN SUMMARY

DESIGN IS APPLICABLE FOR A DRAINAGE AREA UP TO 35 ACRES (TOP DECK AND SIDE SLOPE).

25% SLOPE
MAXIMUM FLOW DEPTH = 0.59 FT.
BOTTOM WIDTH = 8 FT.

20% SLOPE
MAXIMUM FLOW DEPTH = 0.63 FT.
BOTTOM WIDTH = 8 FT.

4% SLOPE
MAXIMUM FLOW DEPTH = 1.00 FT.
BOTTOM WIDTH = 8 FT.

2% SLOPE
MAXIMUM FLOW DEPTH = 1.22 FT.
BOTTOM WIDTH = 8 FT.

OPEN CHANNEL GABION LETDOWN DESIGN SUMMARY

DESIGN IS APPLICABLE FOR A DRAINAGE AREA UP TO 20 ACRES (2% TOP DECK), 30 ACRES (4% TOP DECK), AND 35 ACRES (SIDE SLOPE).

25% SLOPE
MAXIMUM FLOW DEPTH = 1.31 FT.
BOTTOM WIDTH = 8 FT.

20% SLOPE
MAXIMUM FLOW DEPTH = 1.39 FT.
BOTTOM WIDTH = 8 FT.

4% SLOPE
MAXIMUM FLOW DEPTH = 1.98 FT.
BOTTOM WIDTH = 8 FT.

2% SLOPE
MAXIMUM FLOW DEPTH = 1.92 FT.
BOTTOM WIDTH = 8 FT.

OPEN CHANNEL ROCK RIPRAP LETDOWN DESIGN SUMMARY

DESIGN IS APPLICABLE FOR TOP DECK DRAINAGE AREAS ONLY – UP TO 20 ACRES (2% TOP DECK), AND 25 ACRES (4% TOP DECK).

2% SLOPE
MAXIMUM FLOW DEPTH = 1.92 FT.
BOTTOM WIDTH = 8 FT.

4% SLOPE
MAXIMUM FLOW DEPTH = 1.80 FT.
BOTTOM WIDTH = 8 FT.

OPEN CHANNEL GROUTED RIPRAP LETDOWN DESIGN SUMMARY

DESIGN IS APPLICABLE FOR A DRAINAGE AREA UP TO 25 ACRES (2% TOP DECK), 35 ACRES (4% TOP DECK), AND 35 ACRES (SIDE SLOPE).

25% SLOPE
MAXIMUM FLOW DEPTH = 1.11 FT.
BOTTOM WIDTH = 8 FT.

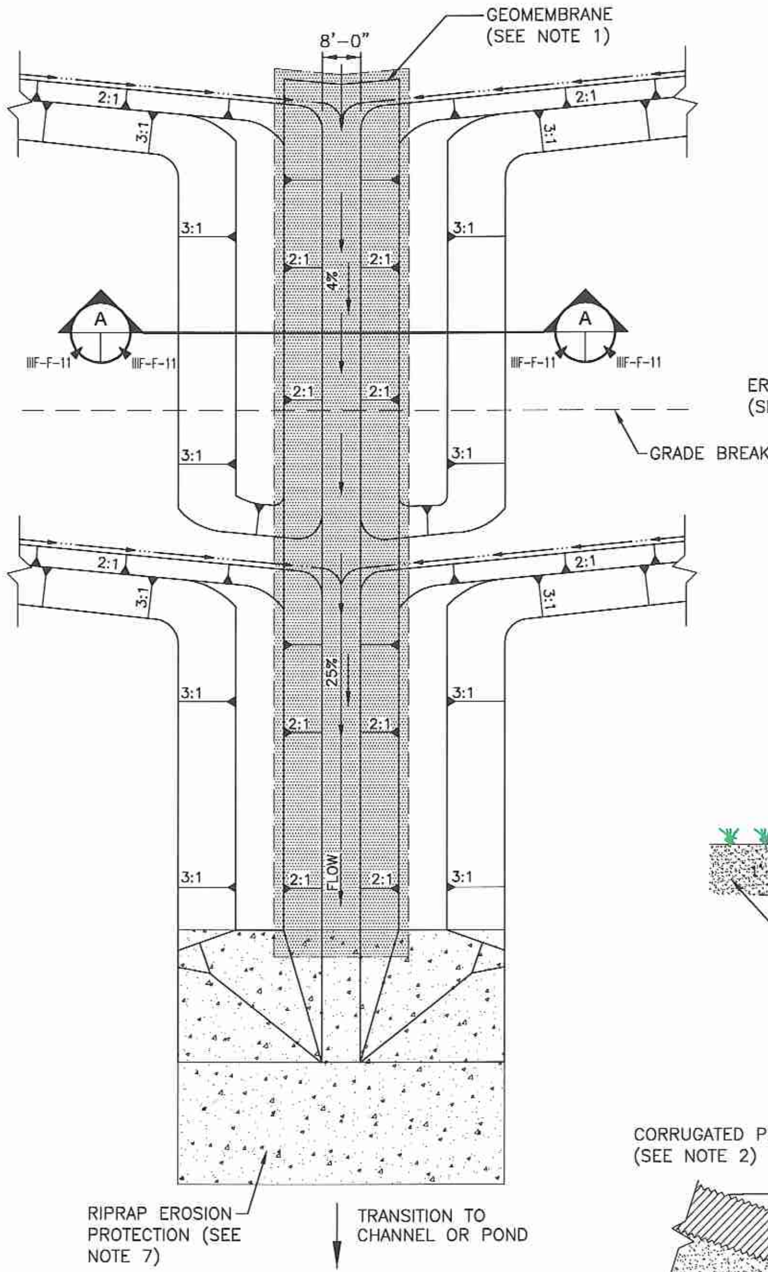
20% SLOPE
MAXIMUM FLOW DEPTH = 1.19 FT.
BOTTOM WIDTH = 8 FT.

4% SLOPE
MAXIMUM FLOW DEPTH = 1.85 FT.
BOTTOM WIDTH = 8 FT.

2% SLOPE
MAXIMUM FLOW DEPTH = 1.86 FT.
BOTTOM WIDTH = 8 FT.

OPEN CHANNEL TURF REINFORCEMENT LETDOWN DESIGN SUMMARY

SEE GROUTED RIPRAP LETDOWN DESIGN.



TEMPORARY OPEN CHANNEL LETDOWN (B, IIIF–F–9, IIIF–F–11)

0 20 40
SCALE IN FEET

20% PIPE LETDOWN DESIGN SUMMARY* (USE OF PIPE LETDOWN IS LIMITED TO 1–INLET)

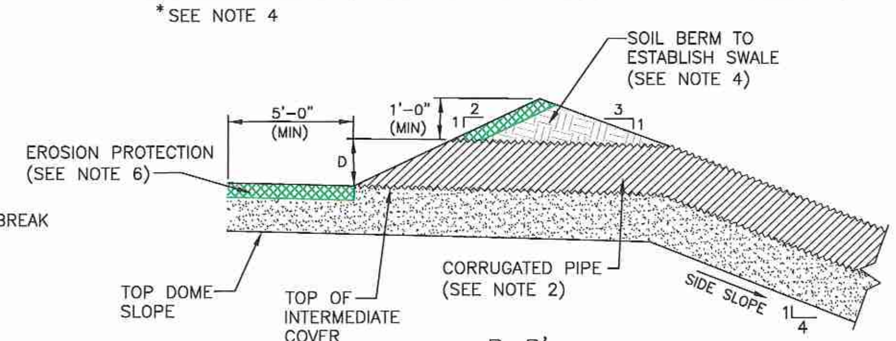
DRAINAGE AREA (ACRE)	DESIGN FLOW RATE (CFS)	REQUIRED PIPE DIAMETER (FT)
3.1	23.0	2
3.5	26.0	3

*SEE NOTE 4

25% PIPE LETDOWN DESIGN SUMMARY* (USE OF PIPE LETDOWN IS LIMITED TO 1–INLET)

DRAINAGE AREA (ACRE)	DESIGN FLOW RATE (CFS)	REQUIRED PIPE DIAMETER (FT)
2.2	16.0	2
2.8	21.0	3

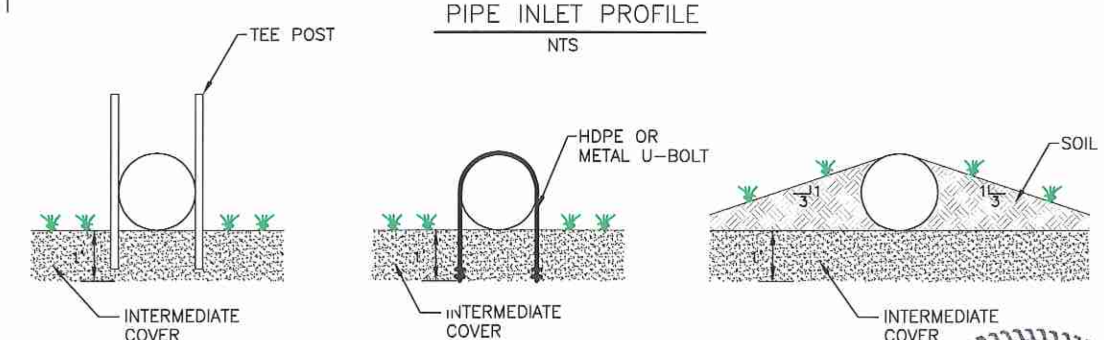
*SEE NOTE 4



B–B'

PIPE INLET PROFILE

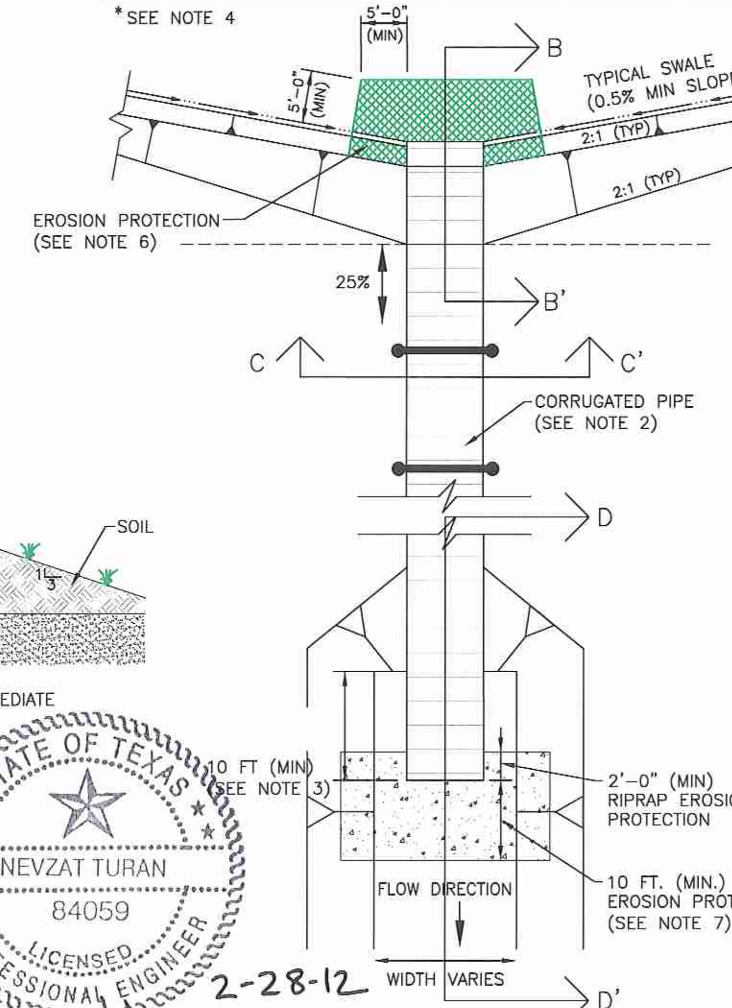
NTS



C–C'

ANCHORING DETAILS

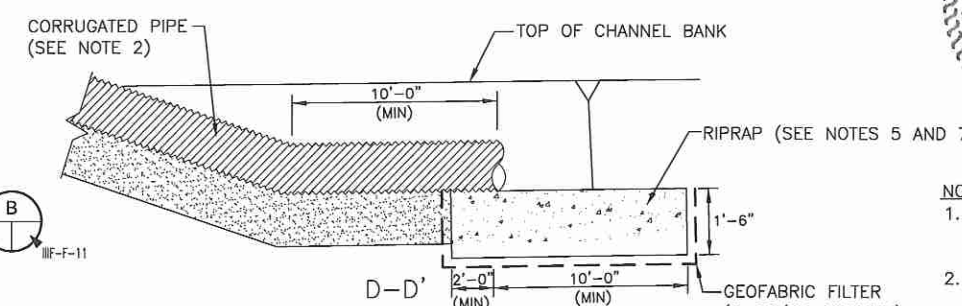
NTS



TEMPORARY PIPE LETDOWN

NTS

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER
2-28-12



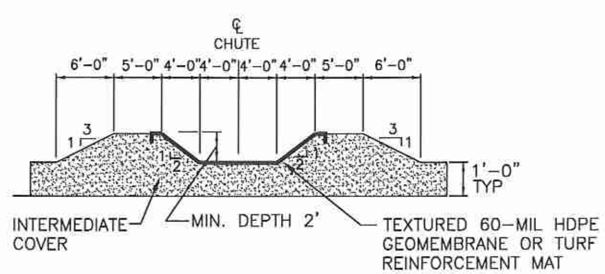
D–D'

PIPE OUTLET PROFILE (SEE NOTE 3)

NTS

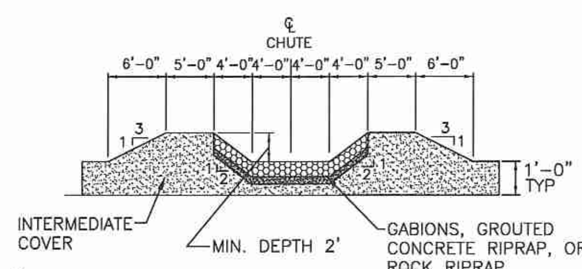
NOTES:

1. 60 MIL HDPE GEOMEMBRANE TEXTURED BOTH SIDES WILL BE USED FOR GEOMEMBRANE LETDOWN LINING. AS AN ALTERNATIVE, TEMPORARY LETDOWN CAN BE LINED WITH GABIONS, GROUTED CONCRETE RIPRAP, TURF REINFORCEMENT MAT, OR ROCK RIPRAP.
2. PIPE DRAINAGE LETDOWN WILL BE ANCHORED BY USING SOIL BERM AT THE INLET LOCATED WITHIN THE SWALE. ADDITIONAL ANCHORING ON THE SIDE SLOPE MAY BE PROVIDED USING SOIL, HDPE OR METAL U–BOLTS, T–POSTS OR EQUIVALENT MATERIALS.
3. PIPE WILL BE EXTENDED INTO THE CHANNEL TO MINIMIZE EROSION.
4. PIPE LETDOWNS WILL BE LIMITED TO 1 INLET PER LETDOWN. SOIL BERMS AROUND THE PIPE INLET WILL BE EXTENDED A MINIMUM 1–FOOT ABOVE THE LETDOWN PIPE INLET. REFER TO PAGE IIIF–F–2–25 FOR HYDRAULIC ANALYSIS.
5. RIPRAP APRON DESIGN IS PROVIDED ON PAGES IIIF–F–2–37 AND 38 AND IIIF–F–2–51 AND 52. D_{50} FOR RIPRAP 5–INCHES IS MINIMUM.
6. RIPRAP, GROUT, GROUTED RIPRAP, GABIONS, GEOMEMBRANE, EXISTING VEGETATION OR TURF REINFORCEMENT MAY BE USED FOR EROSION PROTECTION.
7. OTHER EROSION PROTECTION (e.g., RIPRAP, GROUT, GROUTED RIPRAP, GABIONS OR TURF REINFORCEMENT) MAY BE USED AT TEMPORARY LETDOWN OUTFALLS.
8. REFER TO PAGE IIIF–F–2–9 FOR EROSION PROTECTION DESIGN. IF LETDOWN DISCHARGES TO A POND, 10 FEET OF RIPRAP WILL BE SUFFICIENT.



A1 (IIIF–F–11) TEMPORARY GEOMEMBRANE OR TURF REINFORCEMENT LETDOWN OPTION

0 10 20
SCALE IN FEET



A2 (IIIF–F–11) TEMPORARY GABION LETDOWN OPTION

0 10 20
SCALE IN FEET

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FILE: 0120–87–11	DESIGN BY: CRM
CAD: IIIF–F–11–LETDOWN.DWG	REVIEWED BY: JPY

PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

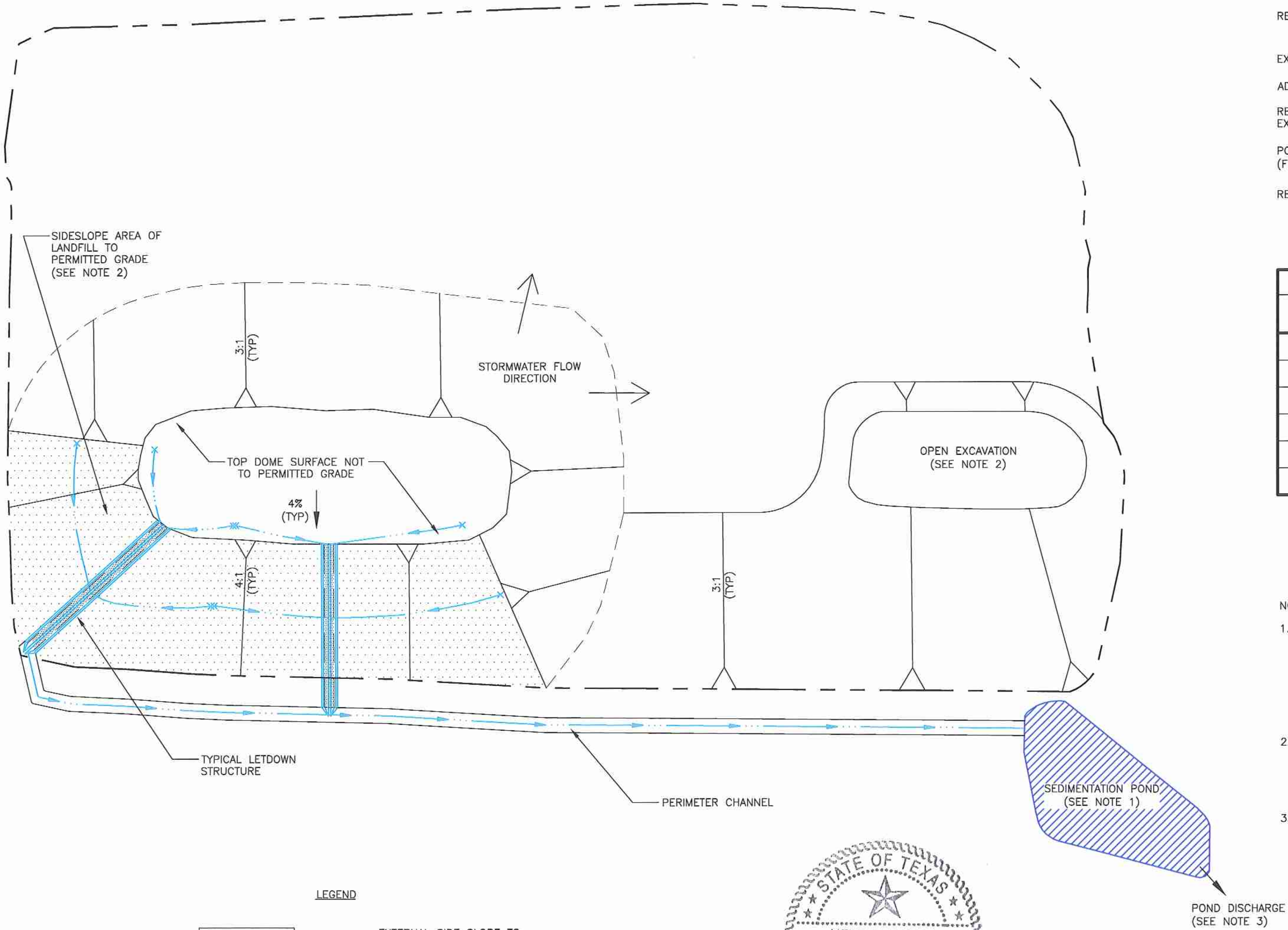
EROSION CONTROL PLAN
LETDOWN DESIGN SUMMARY

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

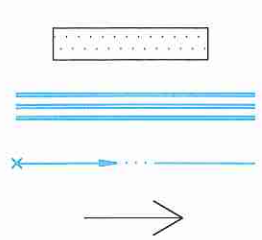
Weaver Boos Consultants
TBPE REGISTRATION NO. F–3727

CHICAGO, IL / NAPERVILLE, IL / COLUMBUS, OH / DENVER, CO — FORT WORTH, TX (817) 735–9770 — GRIFFITH, IN / SOUTH BEND, IN / SPRINGFIELD, IL / ST. LOUIS, MO

SHEET IIIF–F–11



LEGEND



EXAMPLE CALCULATION

REQUIRED POND SIZE = EXTERNAL EMBANKMENT AREA (ACRES) X POND AREA REQUIRED/UNIT DRAINAGE AREA FACTOR

EXTERNAL EMBANKMENT AREA DRAINING TO POND = 50 ACRES

ADDITIONAL UPLAND AREA DRAINING TO POND = 0 ACRES (SEE NOTE 1)

REQUIRED SEDIMENT REMOVAL FROM EXTERNAL SIDE SLOPE AREA = 80 TONS/ACRE/YEAR TO 50 TONS/ACRE/YEAR

POND AREA REQUIRED/UNIT DRAINAGE AREA FACTOR (FROM TABLE BELOW) = 0.060

REQUIRED POND SIZE = 50 ACRES X 0.060 = 3.00 ACRES

SIZE OF POND REQUIRED[1]		
REQUIRED SEDIMENT REMOVAL (TONS/ACRE/YEAR)	POND AREA REQUIRED/ UNIT DRAINAGE AREA FACTOR	EFFICIENCY OF POND (DYNAMIC AND QUIESCENT)
60 TO 50	0.025	16.6%
70 TO 50	0.040	28.9%
80 TO 50	0.060	37.6%
90 TO 50	0.075	45.0%
100 TO 50	0.110	50.3%
200 TO 50	0.300	75.0%

[1] REFER TO APPENDIX IIIF-F-3 FOR MORE INFORMATION. THE POND DESIGN AND DEMONSTRATION ARE PROVIDED TO ENSURE THAT SEDIMENT DISCHARGE FROM THE SITE WILL BE PREVENTED DURING INITIAL ESTABLISHMENT OF VEGETATION OVER THE SIDE SLOPES AND TOP DOME SURFACES.

NOTES:

1. EXAMPLE POND CONFIGURATION IS SHOWN. A DEMONSTRATION WILL BE INCLUDED IN THE SITE OPERATING RECORD TO SHOW THAT THE POND HAS THE CAPABILITY TO CAPTURE SEDIMENT SUCH THAT DISCHARGE IS LESS THAN OR EQUAL TO 50 TONS/ACRE/YEAR FROM THE EXTERNAL SIDE SLOPE AND TOP DOME AREA. THE DEMONSTRATION WILL ACCOUNT FOR THE ADDITIONAL SEDIMENT CREATED BY THE UPLAND AREA THAT FLOWS TO THE POND. FOR DEMONSTRATION PURPOSES, THE POND DEPTH WILL BE AN AVERAGE OF 4 FEET. OVERALL SEDIMENT DISCHARGE FROM THE SITE MUST COMPLY WITH THE CURRENT TPDES PERMIT FOR THE SITE.
2. EXCAVATED FUTURE CELL AREAS OR SOIL BORROW AREAS CAN ALSO BE USED AS SEDIMENTATION PONDS. IF THESE AREAS ARE USED FOR PONDS, A DEMONSTRATION NOTING THAT THE EXCAVATED FUTURE CELL AREA OR SOIL BORROW AREA HAS MORE CAPACITY THAN THE VOLUME PRODUCED BY THE 25-YEAR, 24-HOUR STORM WILL BE DOCUMENTED AND MAINTAINED IN THE SITE OPERATING RECORD.
3. AS STATED IN SECTION 2.2, A STATEMENT WILL BE ADDED TO THE SITE OPERATING RECORD EACH TIME A SEDIMENTATION POND IS INSTALLED TO NOTE HOW THE TEMPORARY SEDIMENTATION POND AND THE POND OUTLET WERE CONSTRUCTED CONSISTENT WITH THE REQUIREMENTS OF THE SITE DEVELOPMENT PLAN.

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DESIGN BY: CRM
REVIEWED BY: JPY

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SEDIMENT CONTROL POND PLAN

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DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727
CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO
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GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

SHEET IIIF-F-12

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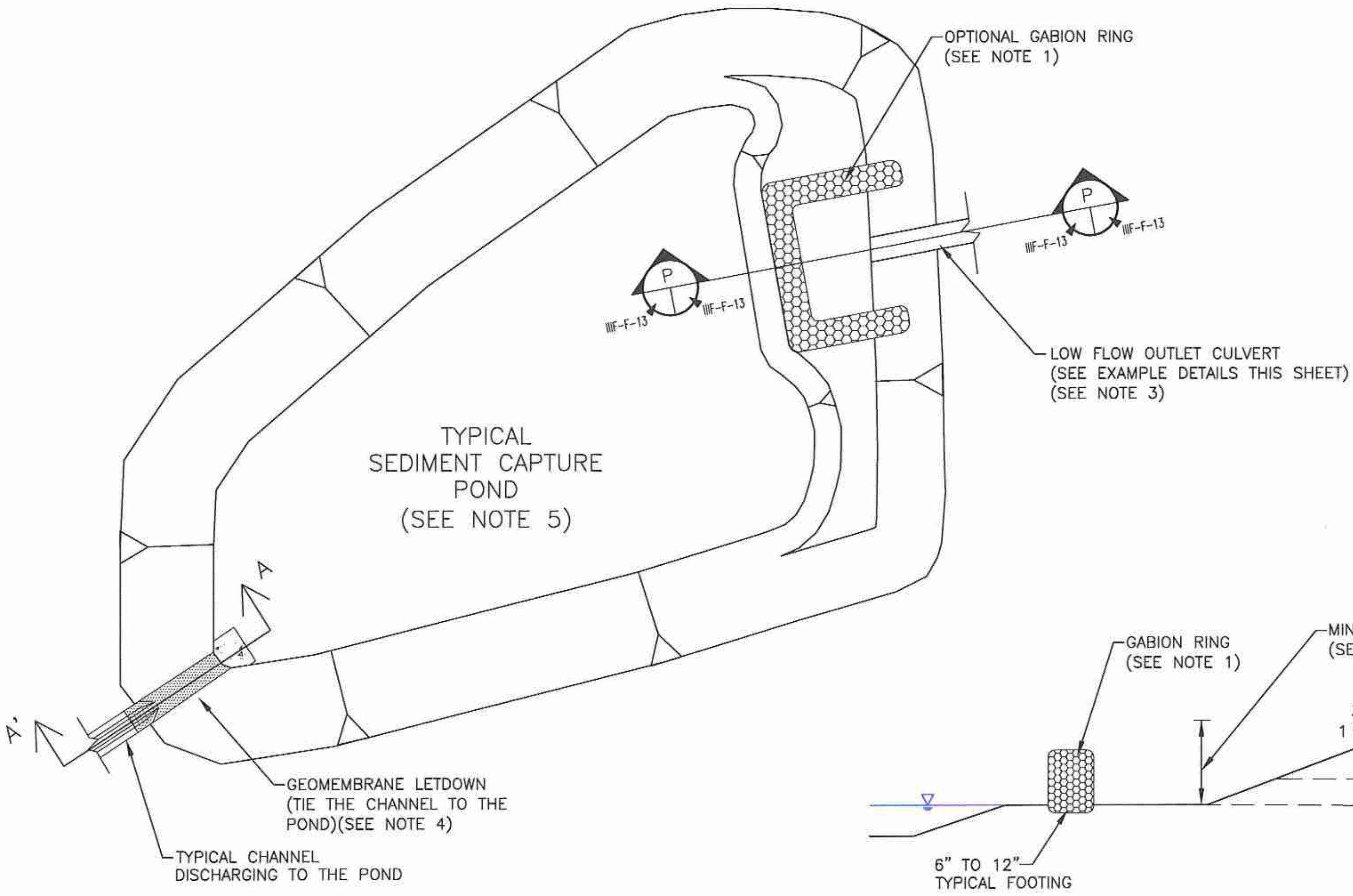
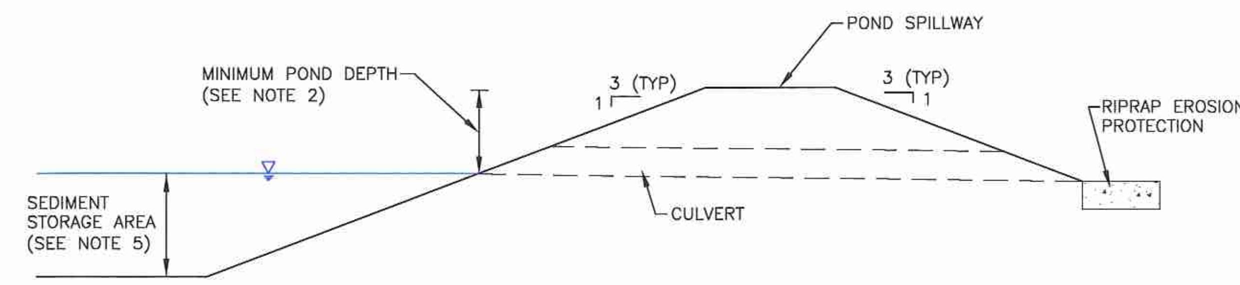
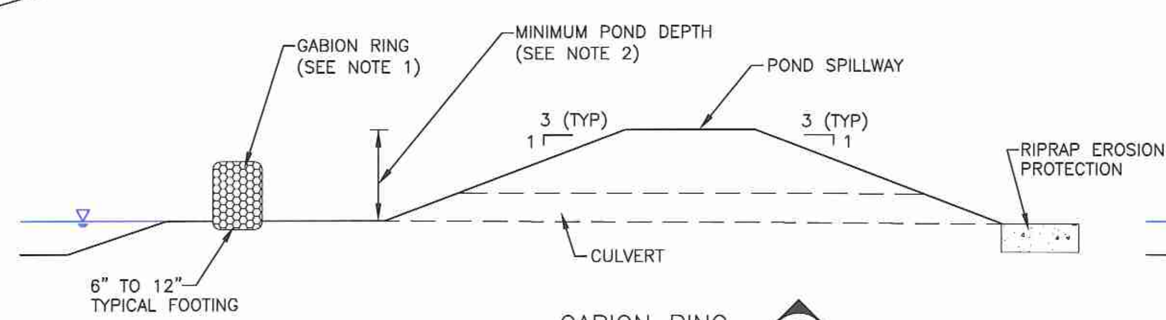




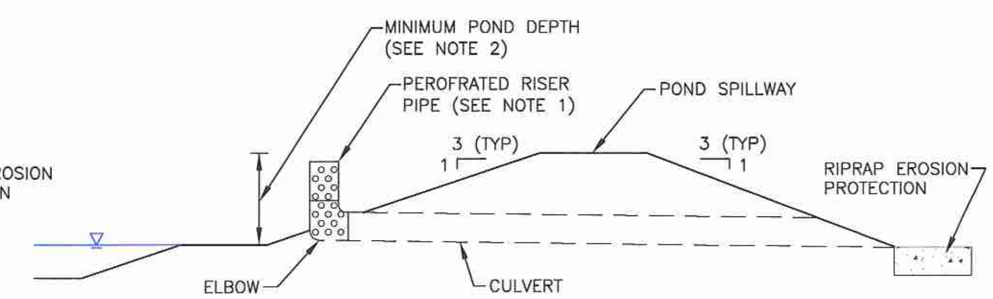
OUTLET STRUCTURE FOR PERMANENT POOL

P IIIF-F-13 IIIF-F-13



GABION RING

P IIIF-F-13 IIIF-F-13



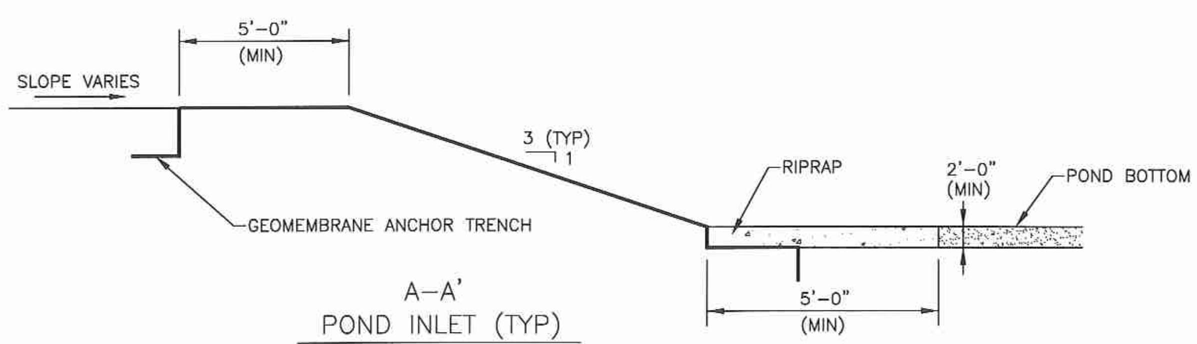
PERFORATED RISER PIPE

P IIIF-F-13 IIIF-F-13

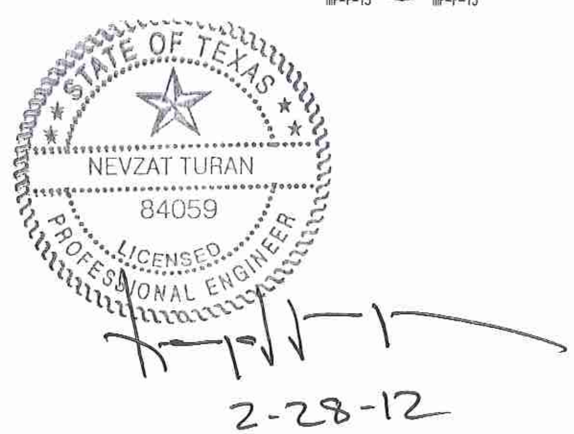
OPTIONS FOR DRY PONDS

NOTES:

1. AS AN OPTION TO THE GABION RING, A PERFORATED RISER PIPE (SHOWN ON THIS SHEET) MAY ALSO BE USED, AS WELL AS A ROCK CHECK DAM.
2. MINIMUM POND DEPTH IS 4 FEET BETWEEN THE LOW FLOW OUTLET FLOW LINE AND POND SPILLWAY ELEVATION.
3. IF THE POND IS INSTALLED WITHOUT A LOW FLOW OUTLET, THEN SEE NOTE 2 ON SHEET IIIF-F-12.
4. VEGETATIVE SURFACING, GROUTED RIPRAP, RIPRAP, GABIONS, OR TURF REINFORCEMENT MAY BE USED TO ENSURE THE STABILITY OF THE POND INLET.
5. POND BOTTOM AREAS WILL BE EXCAVATED BELOW THE LOW FLOW OUTLET FLOW LINE ELEVATION TO PROVIDE SEDIMENT STORAGE. SEDIMENT ACCUMULATED IN POND WILL BE REMOVED AS NEEDED TO ENSURE SEDIMENT STORAGE CAPACITY BELOW THE FLOWLINE ELEVATION OF LOW FLOW OUTLET (REFER TO SECTION 2.4 FOR ADDITIONAL INFORMATION REGARDING SEDIMENT REMOVAL).



A–A'
POND INLET (TYP)
NTS



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DATE: 02/2012 DRAWN BY: SRF FILE: 0120-87-11 DESIGN BY: CRM CAD: IIIF-F-13-EROS. CONTROL.DWG REVIEWED BY: JPY	REVISIONS NO. / DATE / DESCRIPTION	Weaver Boos Consultants TBPE REGISTRATION NO. F-3727
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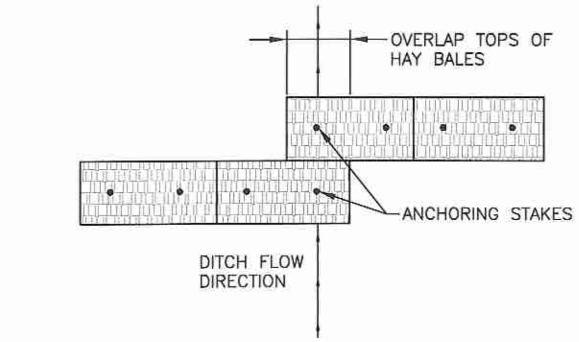
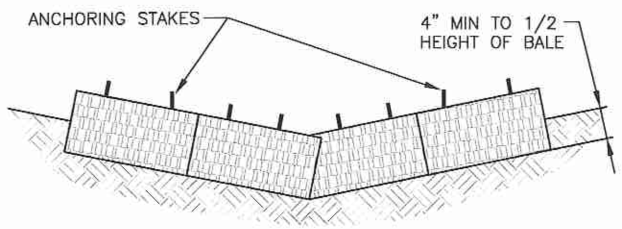
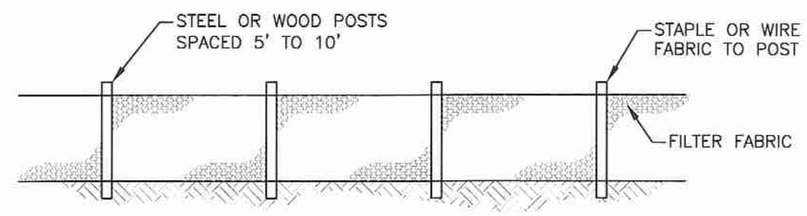


PLAN VIEW

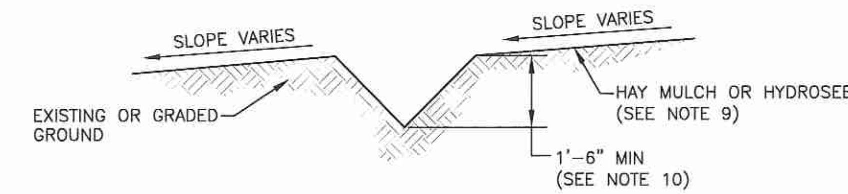


PROFILE VIEW

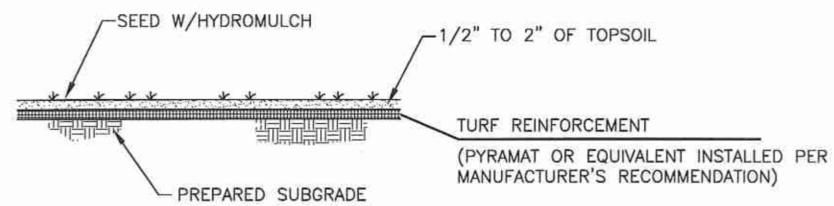
BALED HAY FOR EROSION CONTROL
NTS
(SEE NOTE 1)



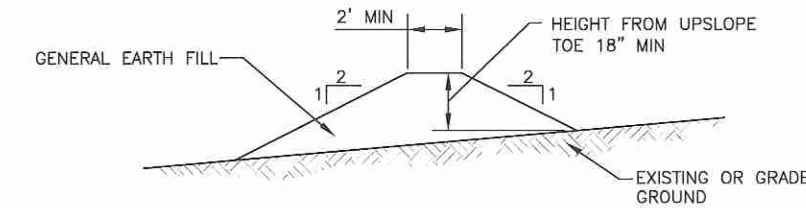
TEMPORARY SEDIMENT CONTROL FENCE
NTS
(SEE NOTE 3)



TEMPORARY DIVERSION CHANNEL
NTS
(SEE NOTE 6)

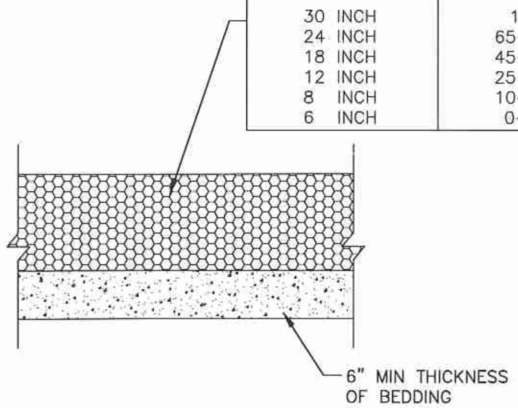


TURF REINFORCEMENT
NTS
(SEE NOTE 4)

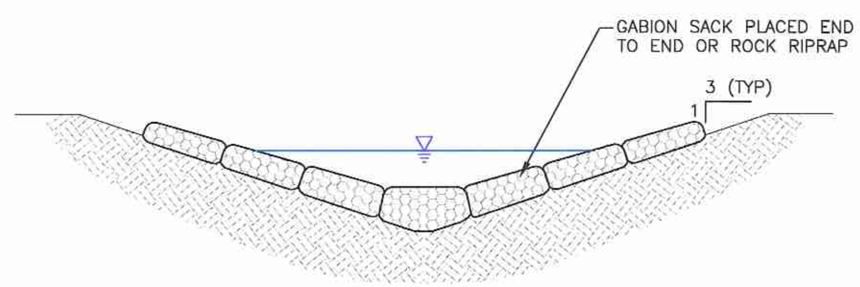


TEMPORARY DIVERSION BERM
NTS
(SEE NOTE 7)

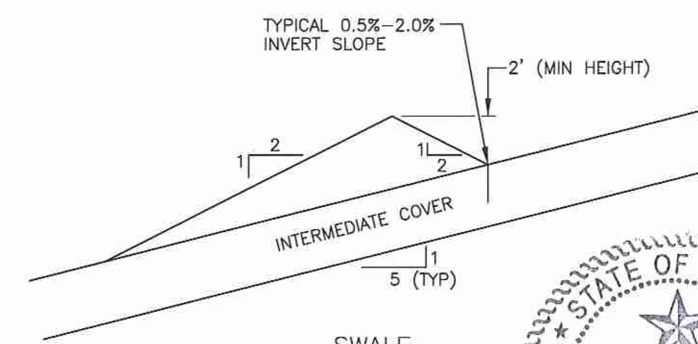
24" THICKNESS OF RIPRAP	
SIEVE SIZE SQUARE MESH	PERCENT PASSING
30 INCH	100
24 INCH	65–100
18 INCH	45–75
12 INCH	25–50
8 INCH	10–30
6 INCH	0–15



ROCK RIPRAP
NTS
(SEE NOTE 2)



ROCK CHECK DAM
NTS
(SEE NOTE 5)



SWALE
NTS
(SEE NOTE 8)

NOTES:

1. BALED HAY MAY BE USED IN NEWLY ESTABLISHED COVER AREAS OR DISTURBED/REGRADED SURFACES TO MAINTAIN SHEET FLOW UNTIL VEGETATION IS ESTABLISHED.
2. ROCK RIPRAP MAY BE USED IN AREAS WHERE CONCENTRATED FLOW WITH HIGH VELOCITIES MAY OCCUR (e.g., CULVERT INLETS/OUTLETS).
3. A TEMPORARY SEDIMENT CONTROL FENCE MAY BE USED IN CAPTURING SEDIMENT TRANSPORTED BY SHEET FLOW AND FOR DIVERSION OF FLOW FOR CONTROLLING SEDIMENT DISCHARGE.
4. TURF REINFORCEMENT MAY BE USED ON NEWLY ESTABLISHED SURFACES SUCH AS INTERMEDIATE COVER AND IN CHANNELS WHERE MODERATELY HIGH FLOW VELOCITIES ARE EXPECTED.
5. A ROCK CHECK DAM MAY BE USED IN CHANNELS TO SLOW DOWN FLOW VELOCITIES AND IMPROVE SEDIMENT CAPTURE.
6. A TEMPORARY DIVERSION CHANNEL MAY BE USED FOR SHORTENING SHEET FLOW DISTANCES IN UNDEVELOPED AREAS OR IN LARGER CHANNELS TO PROVIDE MEANDERING AND SLOWER FLOW VELOCITIES TO PREVENT IN-CHANNEL EROSION.
7. A TEMPORARY DIVERSION BERM MAY BE USED IN AREAS TO DIVERT FLOW FROM ENTERING STEEP SLOPED AREAS (e.g., TOP OF EXCAVATION) AND TO REDUCE SHEET FLOW LENGTHS.
8. A SWALE MAY BE USED IN AREAS TO DIVERT FLOW FROM ENTERING STEEP SLOPED AREAS (e.g., TOP OF EXCAVATION) AND TO REDUCE SHEET FLOW LENGTHS.
9. HAY MULCH AND HYDROSEED MAY ALSO BE USED FOR NEWLY ESTABLISHED SURFACES TO PROMOTE VEGETATION ESTABLISHMENT AND PREVENT EROSION.
10. THE VALUE SHOWN IS AT THE TIME OF CHANNEL INSTALLATION; CHANNEL WIDTH AND DEPTH MAY VARY.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
2-28-12

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☒ FOR PERMITTING PURPOSES ONLY
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☐ CLIENT APPROVAL BY: ____________

DATE: 02/2012 DRAWN BY: SRF
FILE: 0120-87-11 DESIGN BY: CRM
CAD: IIIF-F-14-TYPICAL BMPs.DWG REVIEWED BY: JPY

PREPARED FOR
CITY OF FARMERS BRANCH

REVISIONS

NO.	DATE	DESCRIPTION

EROSION CONTROL PLAN
TYPICAL BMPs

CAMELOT LANDFILL
DENTON COUNTY, TEXAS

Weaver Boos Consultants
TBPE REGISTRATION NO. F-3727
CHICAGO, IL NAPERVILLE, IL COLUMBUS, OH DENVER, CO FORT WORTH, TX (817) 735-9770 GRIFFITH, IN SOUTH BEND, IN SPRINGFIELD, IL ST. LOUIS, MO

SHEET IIIF-F-14

O:\1339\351\EXPANSION 2009\PART III-SDP\IIIF\IIIF-F\IIIF-F-14-TYPICAL BMPs.dwg, jwilson, 1:2

APPENDIX IIIF-F-1

TEMPORARY ADD-ON SWALE DESIGN

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

Includes pages IIIF-F-1-1 through IIIF-F-1-13

SWALE DESIGN

This appendix includes the expected soil loss calculations for various swale spacing intervals on the side slopes and top dome surfaces. An example calculation is provided on pages IIIF-F-1-2 through IIIF-F-1-4 for a vegetative cover of 60 percent. For the results of various percent vegetative covers and swale spacing intervals, refer to the table on page IIIF-F-1-5 and to Sheet IIIF-F-10 – Swale Design Summary. If the required percent vegetation coverage is not achieved within the 180-day period, secondary erosion control measures such as mulch, wood chips, compost or straw/hay will be used to limit the soil loss to 50 tons/acre/year or less. In addition, a detention/sedimentation pond may also be used until the required vegetation coverage is achieved. Any secondary measure used will be documented in the Site Operating Record at the end of the 180-day period to document compliance with this plan. In addition, the date the required percent vegetation coverage is achieved and the secondary measure is no longer needed will also be documented in the Site Operating Record.

Also included in this appendix are the sheet flow velocities for all swale spacing intervals on the side slopes and top dome surfaces. As noted in these calculations (pages IIIF-F-1-6 through IIIF-F-1-8), all velocities are acceptable.

Additionally, this appendix includes a calculation for the maximum drainage area that each swale can drain, as well as the maximum swale length. These calculations are included on pages IIIF-F-1-9 through IIIF-F-1-13.

Required: Determine the required spacing of the drainage swales for different percentages of vegetative cover for top dome surfaces and external embankment side slopes.

Method:
1. Estimate soil loss per acre based on percent ground cover and swale spacing for top dome surface and external side slope.
2. Summary.

Notes:
1. The following example calculation procedure has been developed for 60 percent ground cover.
2. The table on page IIIF-F-1-5 includes the results of the following procedure for 60, 70, 80, and 90 percent ground cover and various swale spacings. The results are also summarized on Figure 2 in Appendix IIIF-F.

References:
1. SCS National Engineering Handbook, Chapter 3 - Erosion.
2. TNRCC, *Use of the USLE in Final Cover/Configuration Design*, 1993.
3. United States Environmental Protection Agency, *Solid Waste Disposal Facility Criteria Technical Manual*, 1993.

Solution:
1. Estimate soil loss per acre based on percent ground cover and swale spacing for top dome surface and external side slope.

Soil Loss Equation: $A=RKL_SCP$

Where:
$A=$ Soil loss (tons/ac/yr)
$R=$ Rainfall factor
$K=$ Soil erodibility factor
$L_S=$ Slope length/slope gradient factor
$C=$ Plant cover or cropping management factor
$P=$ Erosion practice factor

The rainfall factor, R, represents the average intensity for the maximum intensity, 30 minute storms over a 22 year period of record compiled by the SCS. Using Figure 1 (Ref 2), Average Annual Values of the R Factor, the R factor for Denton County is:

$R=$ 275

The soil erodibility factor, K, factor represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. Assume an organic matter content of 2% to determine the K factor. The intermediate soil will consist of soils comparable to sandy clay. Additionally, compost will be added to intermediate soil as necessary to protect against erosion. Therefore, the following is a conservative K value for the site (Table 1 on page 6, Ref. 2).

$K=$ 0.15

The slope length/slope gradient factor, L_s, represents the erosion of the soil due to both slope length and degree of slope.

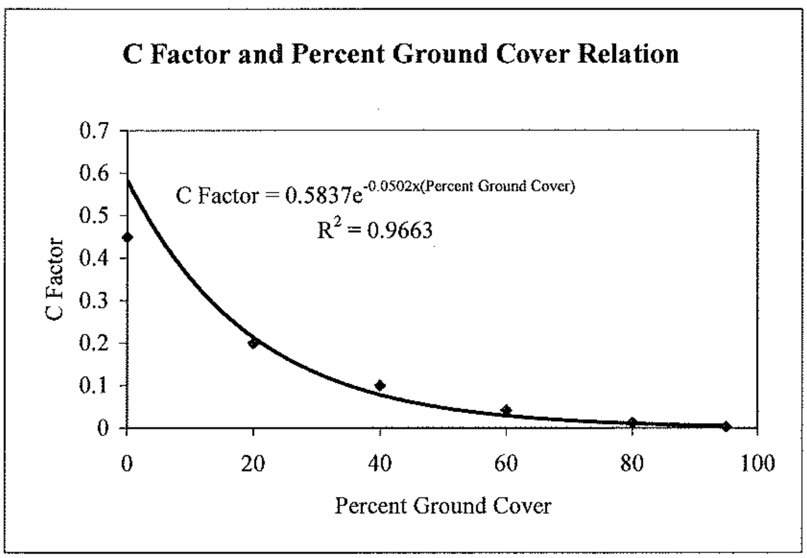
Case 1. Top Slope				Case 2. Side Slope		
slope =	4	%		slope =	20	%
length =	500	ft		length =	300	ft
Case 3. Side Slope				Case 4. Top Slope		
slope =	25	%		slope =	4	%
length =	300	ft		length =	600	ft
Case 5. Top Slope				Case 6. Top Slope		
slope =	4	%		slope =	2	%
length =	700	ft		length =	700	ft

Using the above information and Figure 2 (Ref 2, p.9), the L_s factors are determined.

Case	Slope (%)	Slope Length (ft)	L_s
1. Top Slope	4	500	0.75
2. Side Slope	20	300	7.70
3.Side Slope	25	300	10.30
4.Top Slope	4	600	0.80
5.Top Slope	4	700	0.88
6.Top Slope	2	700	0.38

The plant cover or cropping management factor, C, represents the percentage of soil loss that would occur if the surface were partially protected by some combination of cover and management practices. C Factor for Permanent Pasture, Range, and Idle Land with No Appreciable Canopy has the following relation with percent ground cover (GC) (from Ref 2, p.7).

% GC	C Factor:
0	0.45
20	0.20
40	0.10
60	0.042
80	0.013
95	0.003



C Factor= $0.5837e^{(-0.0502x60)}$
C Factor= 0.0420

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration , and runoff velocity. Contouring for this site will be done only to establish vegetation.

P = 1.00

Slope Condition	R	K	L_s	C	P	A (tons/ac/yr)
1. Top Slope 4% slope 500 ft length	275	0.15	0.75	0.0420	1.0	1.3
2. Side Slope 20% slope 300 ft length	275	0.15	7.70	0.0420	1.0	13.3
3. Side Slope 25% slope 300 ft length	275	0.15	10.30	0.0420	1.0	17.8
4. Top Slope 4% slope 600 ft length	275	0.15	0.80	0.0420	1.0	1.4
5. Top Slope 4% slope 700 ft length	275	0.15	0.88	0.0420	1.0	1.5
6. Top Slope 2% slope 700 ft length	275	0.15	0.38	0.0420	1.0	0.7

2. Summary

For a summary of soil loss rates for various percentages of ground cover, see Figure 2 in Appendix IIIF-F and page IIIF-F-1-5.

SOIL LOSS ESTIMATE SUMMARY TABLE

Case	Slope (%)	Length (ft)	L_s	Percent Ground Cover	C Factor	A (tons/ac/yr)
Top Slope	4	500	0.32	60	0.042	1.3
Top Slope	4	500	0.32	70	0.017	0.5
Top Slope	4	500	0.32	80	0.013	0.4
Top Slope	4	500	0.32	90	0.0064	0.2
Top Slope	4	600	0.80	60	0.042	1.4
Top Slope	4	600	0.80	70	0.017	0.6
Top Slope	4	600	0.80	80	0.013	0.4
Top Slope	4	600	0.80	90	0.0064	0.2
Top Slope	2	700	0.38	60	0.042	0.7
Top Slope	2	700	0.38	70	0.017	0.3
Top Slope	2	700	0.38	80	0.013	0.2
Top Slope	2	700	0.38	90	0.0064	0.1
Top Slope	4	700	0.88	60	0.042	1.5
Top Slope	4	700	0.88	70	0.017	0.6
Top Slope	4	700	0.88	80	0.013	0.5
Top Slope	4	700	0.88	90	0.0064	0.2
Side Slope	20	300	7.70	60	0.042	13.3
Side Slope	20	300	7.70	70	0.017	5.4
Side Slope	20	300	7.70	80	0.013	4.1
Side Slope	20	300	7.70	90	0.0064	2.0
Side Slope	25	300	10.30	70	0.017	17.8
Side Slope	25	300	10.30	80	0.013	7.2
Side Slope	25	300	10.30	90	0.0064	5.5
Side Slope	25	300	10.30	90	0.0064	2.7

Required: Determine the sheet flow velocity for the top dome surfaces and external embankment side slopes and compare to the permissible non-erodible flow velocity.

Method:
1. Determine the peak velocities for the cases listed on page IIIF-F-1-2.
2. Compare to permissible velocities.
3. Conclusion.

References:
1. National Engineering Handbook, Section 4, Hydrology. *Chapter 15 - Travel Time, Time of Concentration and Lag.*

Solution: Use the typical case scenarios from the USLE calculation to determine the expected peak sheet flow velocity.

Case 1. Top Slope
slope = 4 %
length = 500 ft

Case 2. Side Slope
slope = 20 %
length = 300 ft

Case 3. Side Slope
slope = 25 %
length = 300 ft

Case 4. Top Slope
slope = 4 %
length = 600 ft

Case 5. Top Slope
slope = 4 %
length = 700 ft

Case 6. Top Slope
slope = 2 %
length = 700 ft

1. Determine the peak velocities for the cases listed on page IIIF-F-1-2.

Cultivated Straight Row (Overland Flow)

From Figure 15.2 (page 15-8 in Ref. 1), determine the velocities for all cases.

Case 1.	V =	1.8	ft/s
Case 2.	V =	4.0	ft/s
Case 3.	V =	4.5	ft/s
Case 4.	V =	1.8	ft/s
Case 5.	V =	1.8	ft/s
Case 6.	V =	1.6	ft/s

Note: Figure 15.2 is reproduced on page IIIF-F-1-8.

2. Compare to permissible velocities.

Summary of Velocities

	Condition	Equivalent Percent Ground Coverage	Peak Velocity (ft/s)	Permissible Velocity[1] (ft/s)
Cultivated Straight Row	4%, 500 ft	>60%	1.8	5.0
	20%, 300 ft	>60%	4.0	5.0
	25%,300 ft	>60%	4.5	5.0
	4%, 600 ft	>60%	1.8	5.0
	4%, 700 ft	>60%	1.8	5.0
	2%, 700 ft	>60%	1.6	5.0

[1] Permissible velocity information is from USACE EM 1110-0-1418, Chapter 5 - Evaluation of Stability.

3. Conclusion.
The peak velocities for each case are listed in the above summary table. As shown peak velocities are below permissible velocities for the conditions analyzed. After 180 days, at least 60 percent vegetation will be established in order to maintain permissible non-erodible velocities.

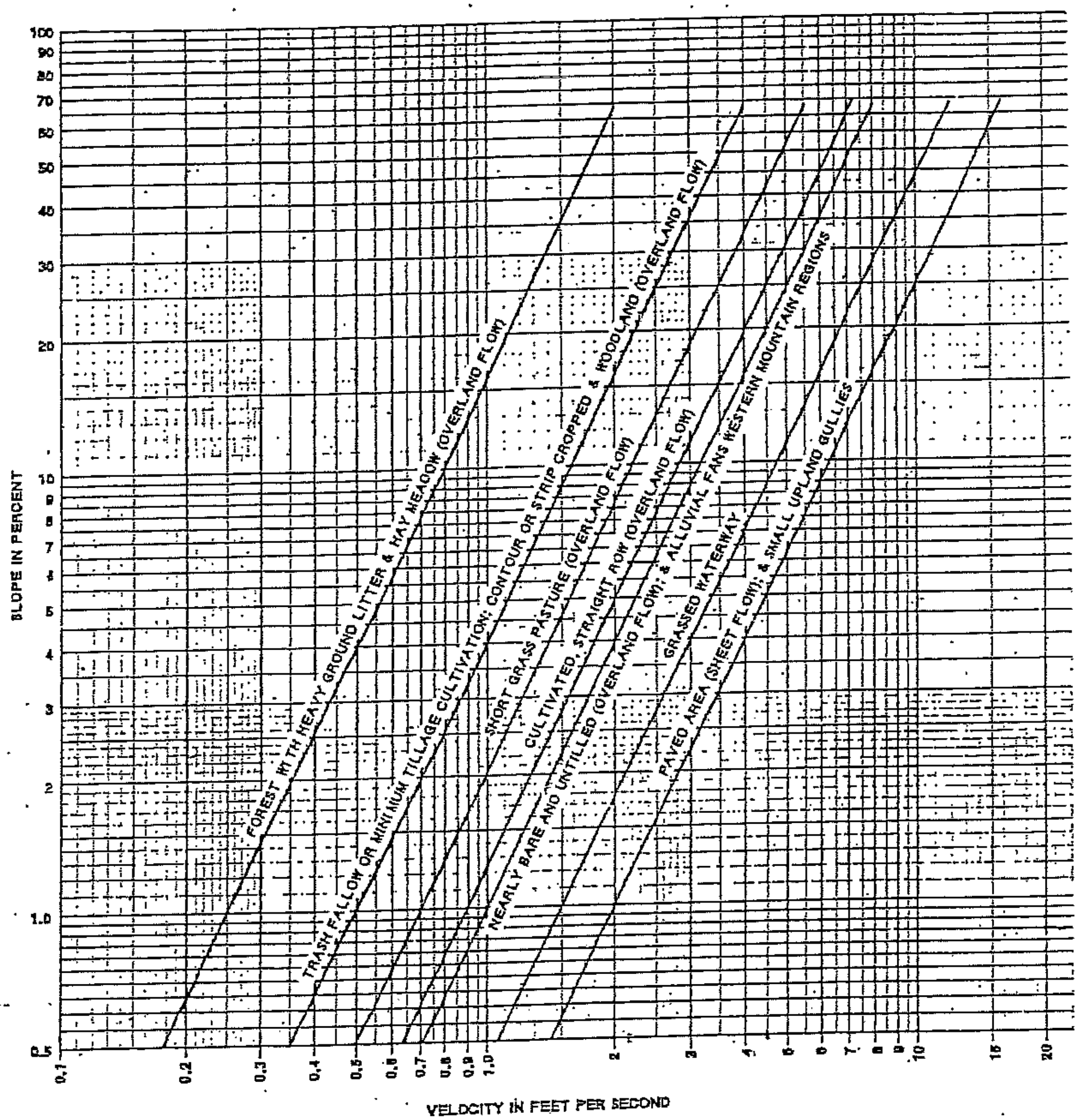


Figure 15.2.—Velocities for upland method of estimating T_c

Required: Analyze swales to determine the adequacy of the swale design.

Method:
1. Determine the 25-year, 24-hour flow rates for a maximum swale drainage area for top slopes and side slopes using the Rational Method.
2. Determine maximum swale length that corresponds to the maximum swale drainage area.

Reference:
1. State of Texas, Department of Transportation, Bridge Division, Hydraulic Manual, March 2004.

Solution:
1. Determine the 25-year, 24-hour flow rates for a maximum swale drainage area for top slopes and side slopes using the Rational Method.

$$Q = CIA$$

Where:
C= 0.8 (runoff coefficient, Ref 1.)
I = intensity, in/hr
A= drainage area, ac

$$I = \frac{b}{(t_c + d)^e}$$

b = 90 From Ref. 1, for Denton County
d = 8.5 25-year storm event
e = 0.781
t_c is assumed to be 10 min.

I = 9.22 in/hr

For Top Slope (2%) :

Maximum Drainage Area (2 ft swale) = 48.4 acres
Maximum Drainage Area (1.5 ft swale) = 22.3 acres
Maxumim Drainage Area (1 ft swale) = 7.4 acres

Flow Rate (2 ft swale) =	357.0	cfs
Flow Rate (1.5 ft swale) =	165.0	cfs
Flow Rate (1 ft swale) =	55.0	cfs

For Top Slope (4%) :

Maximum Drainage Area (2 ft swale) = 25.3 acres
Maximum Drainage Area (1.5 ft swale) = 11.7 acres
Maximum Drainage Area (1 ft swale) = 3.9 acres

Flow Rate (2 ft swale) =	186.5	cfs
Flow Rate (1.5 ft swale) =	86.3	cfs
Flow Rate (1 ft swale) =	28.8	cfs

For Side Slope:

Maximum Drainage Area (25%)= 5.4 acres
Maximum Drainage Area (20%)= 6.3 acres

Flow Rate (2 ft swale, 25%) =	39.8	cfs
Flow Rate (2 ft swale, 20%) =	46.5	cfs

2. Determine maximum swale length that corresponds to the maximum swale drainage area.

Condition (swale height)	Maximum Drainage Area (acres)	Minimum Swale Spacing[1] (ft)	Maximum Swale Length[2] (ft)
Top Slope (2 ft swale, 2%)	48.4	500	4,216
Top Slope (1.5 ft swale, 2%)	22.3	500	1,942
Top Slope (1 ft swale, 2%)	7.4	500	644
Top Slope (2 ft swale, 4%)	25.3	500	2,204
Top Slope (1.5 ft swale, 4%)	11.7	500	1,019
Top Slope (1 ft swale, 4%)	3.9	500	340
Side Slope (2 ft swale, 25%)	5.4	300	784
Side Slope (2 ft swale, 20%)	6.3	300	915

[1] Minimum swale spacing is taken from calculations provided on page IIIF-F-1-2.

[2] Maximum swale length calculated using the following equation:

Maximum Drainage Area x (43,560 sf/acre) / Minimum Swale Spacing

Prep By: TMB
Date: 2/21/2012

CAMELOT LANDFILL
0120-87-11-73-01
SWALE ANALYSIS

Chkd By: RCE
Date: 2-28-12

Flow Rate (cfs)	Bottom Slope (ft/ft)	n-value	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude No.	Velocity Head (ft)	Energy Head (ft)	Flow Area (sq. ft.)	Top Width of Flow (ft)
2 ft Top Slope and Side Slope Swale												
357	0.005	0.03	2	50	0	1.99	3.48	0.616	0.19	2.17	102.58	103.29
186.5	0.005	0.03	2	25	0	1.99	3.48	0.614	0.19	2.18	53.63	53.82
46.5	0.005	0.03	2	5	0	1.98	3.38	0.598	0.18	2.16	13.76	13.88
39.8	0.005	0.03	2	4	0	1.99	3.36	0.594	0.18	2.17	11.87	11.93
1.5 ft Top Slope Swale												
165.0	0.005	0.03	2	50	0	1.49	2.87	0.586	0.13	1.62	57.53	77.35
86.3	0.005	0.03	2	25	0	1.49	2.87	0.585	0.13	1.62	30.10	40.32
1 ft Top Slope Swale												
55.0	0.005	0.03	2	50	0.0	0.99	2.17	0.546	0.07	1.06	25.30	51.29
28.8	0.005	0.03	2	25	0	0.99	2.17	0.545	0.07	1.06	13.24	26.74

Note: Calculations were performed using the HYDROCALC HYDRAULICS program developed by Dodson and Associates (Version 1.2a, 1996).

Maximum flow depth is 1.99 ft < 2.0 ft (swale height).

Design is acceptable.

Example Calculation: Calculate the normal depth for the swale for the maximum size side slope drainage area.

List of Symbols

Q_d = design flow rate for channel, cfs
R = hydraulic radius, ft
n = Manning's roughness coefficient
S = channel slope, ft/ft
b = bottom width of channel, ft
z_r = z-ratio (ratio of run to rise for channel sideslope) for right side slope of swale
z_l = z-ratio (ratio of run to rise for channel sideslope) for left side slope of swale
A_f = flow area, sf
g = gravitational acceleration = 32.2 ft/s^2
T = top width of flow, ft
d = normal depth of swale, ft

The program uses an iterative process to calculate the normal depth of the swale to satisfy Manning's Equation

$$Q = \frac{1.486}{n} A R^{0.67} S^{0.5}$$

Design Inputs:

Q_d = 39.8 cfs
S = 0.005 ft/ft
b = 0 ft
z_r = 4 (H) : 1 (V)
z_l = 2 (H) : 1 (V)
n = 0.03

Step 1 - Based on the geometry of the swale cross-section, solve for R and A_f

$$R = \frac{bd + 1/2d^2(z_r + z_l)}{b + d((z_l^2 + 1)^{0.5} + (z_r^2 + 1)^{0.5})}$$

$$A_f = bd + 1/2d^2(z_r + z_l)$$

assume: d = 1.99 ft

R = 0.938 ft

A_f = 11.87 sf

solve for Q: $Q = 39.8$

if Q is not equal to Q_d, select a new d and repeat calculations

Step 2 - solve for velocity, T, Froude number, velocity head, and energy head

$Q = VA \Rightarrow \quad V = Q/A$

$V = 3.36$ ft/s

$T = b + d(z_l + z_r)$

$T = 11.93$ ft

$$F_r = \frac{V}{(gA/T)^{0.5}}$$

$F_r = 0.594$

$$\text{Velocity Head} = \frac{V^2}{2g}$$

Velocity Head = 0.18 ft

Energy Head = water elevation + velocity head

Energy Head = 2.17 ft

APPENDIX IIIF-F-2

TEMPORARY LETDOWN DESIGN

STATE OF TEXAS
NEVZAT TURAN
84059
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PROFESSIONAL ENGINEER

2-28-12

Includes Pages IIIF-F-2-1 through IIIF-F-2-52

LETDOWN (OR CHUTE) DESIGN

The temporary letdown structure options include open channel flow letdowns and pipe letdowns. Open channel flow letdowns will be lined with either geomembrane, turf reinforcement mat, gabions, grouted concrete riprap, or rock riprap. The pipe letdowns are typically corrugated plastic pipe. Both types of letdowns will have an energy dissipater structure at the bottom of the letdown. Typical letdown details are shown on Sheet IIIF-F-11 – Letdown Design Summary.

This appendix includes a demonstration to show that the letdown structure sizes shown on Sheet IIIF-F-11 will contain the peak flow rate produced by the 25-year storm event. The geomembrane-lined and gabion-lined chutes (as well as turf reinforcement, rock riprap, and grouted riprap-lined chutes) were analyzed for peak flow rates generated from drainage areas ranging from 5 acres to 35 acres. This analysis (pages IIIF-F-2-2 and IIIF-F-2-8) is summarized on Sheet IIIF-F-11 and shows the maximum drainage areas that the 2-foot-deep chutes (8 feet minimum bottom width) are adequate to handle (i.e., the maximum flow depth calculated is less than 2.00 feet).

Also included in this appendix is an analysis for the 24-inch- and 36-inch-diameter temporary pipe letdowns for 25 percent slopes. The maximum flow that these pipes were capable of conveying was determined, and from this design flow rate a maximum drainage area size was calculated. The drainage area corresponds to the area that could drain to the pipe at each inlet. As noted on Sheet IIIF-F-11, the use of pipe letdowns will be limited to 1 inlet per letdown. The design summary for geomembrane-lined letdowns and pipe letdowns is provided on Sheet IIIF-F-11.

Required: Analyze chutes to determine size of chute for drainage area that ranges from 5 acres to 35 acres.

Method: 1. Determine the 25-year, 24-hour flow rates for various sizes of chute drainage areas using the Rational Method.

Reference: 1. State of Texas, Department of Transportation, Bridge Division, Hydraulic Manual, March 2004.

Solution: 1. Determine the 25-year intensity flow rates.

$$Q = CIA$$

Where: C= 0.8 (runoff coefficient, Ref 1.)
I = intensity, in/hr
A= drainage area, ac

$$I = \frac{b}{(t_c + d)^e}$$

b = 90
d = 8.5
e = 0.781

From Ref. 1, for Denton County 25-year storm event

t_c is assumed to be 10 min.

I = 9.22 in/hr

Area (ac)	Flow (cfs)
5.0	36.9
10.0	73.8
15.0	110.6
20.0	147.5
25.0	184.4
30.0	221.3
35.0	258.2

CAMELOT LANDFILL
1339-351-11-02-6B.6
EROSION CONTROL STRUCTURE DESIGN
GEOMEMBRANE-LINED CHUTE DESIGN

Uniform flow design for the geomembrane-lined chutes on 2% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.02	0.01	2	2	8	0.40	10.60	3.100	1.75	2.14	3.48	9.58
73.8	0.02	0.01	2	2	8	0.60	13.49	3.276	2.83	3.42	5.47	10.38
110.6	0.02	0.01	2	2	8	0.75	15.45	3.378	3.71	4.46	7.16	11.01
147.5	0.02	0.01	2	2	8	0.89	16.97	3.451	4.48	5.37	8.69	11.55
184.4	0.02	0.01	2	2	8	1.01	18.23	3.506	5.16	6.17	10.12	12.04
221.3	0.02	0.01	2	2	8	1.12	19.31	3.552	5.79	6.91	11.46	12.48
258.2	0.02	0.01	2	2	8	1.22	20.26	3.590	6.38	7.60	12.75	12.88

Uniform flow design for the geomembrane-lined chutes on 4% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.04	0.01	2	2	8	0.32	13.20	4.245	2.71	3.03	2.79	9.29
73.8	0.04	0.01	2	2	8	0.49	16.93	4.509	4.46	4.94	4.36	9.94
110.6	0.04	0.01	2	2	8	0.62	19.46	4.654	5.88	6.50	5.68	10.46
147.5	0.04	0.01	2	2	8	0.73	21.43	4.757	7.14	7.86	6.88	10.91
184.4	0.04	0.01	2	2	8	0.83	23.06	4.836	8.27	9.09	8.00	11.31
221.3	0.04	0.01	2	2	8	0.92	24.47	4.901	9.30	10.22	9.04	11.68
258.2	0.04	0.01	2	2	8	1.00	25.69	4.953	10.26	11.26	10.05	12.02

Uniform flow design for the geomembrane-lined chutes on 20% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.20	0.01	2	2	8	0.20	21.92	8.839	7.47	7.67	1.68	8.80
73.8	0.20	0.01	2	2	8	0.30	28.35	9.401	12.49	12.79	2.60	9.21
110.6	0.20	0.01	2	2	8	0.38	32.88	9.760	16.80	17.79	3.36	9.53
147.5	0.20	0.01	2	2	8	0.45	36.41	9.992	20.60	21.05	4.05	9.82
184.4	0.20	0.01	2	2	8	0.52	39.35	10.171	24.06	24.58	4.69	10.07
221.3	0.20	0.01	2	2	8	0.58	41.90	10.318	27.28	27.85	5.28	10.31
258.2	0.20	0.01	2	2	8	0.63	44.15	10.441	30.29	30.92	5.85	10.53

CAMELOT LANDFILL
1339-351-11-02-6B.6
EROSION CONTROL STRUCTURE DESIGN
GEOMEMBRANE-LINED CHUTE DESIGN

Uniform flow design for the geomembrane-lined chutes on 25% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.25	0.01	2	2	8	0.19	23.59	9.836	8.65	8.84	1.56	8.75
73.8	0.25	0.01	2	2	8	0.28	30.43	10.408	14.39	14.67	2.43	9.13
110.6	0.25	0.01	2	2	8	0.36	35.25	10.779	19.31	19.67	3.14	9.44
147.5	0.25	0.01	2	2	8	0.43	39.14	11.071	23.80	24.23	3.77	9.70
184.4	0.25	0.01	2	2	8	0.49	42.32	11.272	27.84	28.32	4.36	9.94
221.3	0.25	0.01	2	2	8	0.54	45.08	11.435	31.58	32.12	4.91	10.16
258.2	0.25	0.01	2	2	8	0.59	47.53	11.574	35.10	35.69	5.43	10.37

Conclusions: Maximum normal depth is 1.22 feet. Chute design depth is 2.0 feet; therefore, design is acceptable.

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).

Prep By: CRM
Date: 2/21/2012

Chkd By: RCE
Date: 2-28-12

CAMELOT LANDFILL
1339-351-11-02-6B.6
EROSION CONTROL STRUCTURE DESIGN
GABION, TURF REINFORCEMENT MAT, ROCK RIPRAP, OR GROUTED CONCRETE RIPRAP-LINED CHUTE DESIGN

Chute flow design for the gabion and rock riprap-lined chutes on 2% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.02	0.04	2	2	8	0.89	4.24	0.863	0.28	1.17	8.69	11.56
73.8	0.02	0.04	2	2	8	1.32	5.28	0.906	0.43	1.75	13.99	13.26
110.6	0.02	0.04	2	2	8	1.64	5.96	0.931	0.55	2.20	18.56	14.58
147.5	0.02	0.04	2	2	8	1.92	6.48	0.949	0.65	2.57	22.76	15.69
184.4	0.02	0.04	2	2	8	2.16	6.91	0.962	0.74	2.91	26.69	16.66
221.3	0.02	0.04	2	2	8	2.38	7.28	0.974	0.82	3.21	30.42	17.53
258.2	0.02	0.04	2	2	8	2.58	7.60	0.983	0.90	3.48	33.99	18.33

Chute flow design for the gabion and rock riprap-lined chutes on 4% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.04	0.04	2	2	8	0.73	5.36	1.189	0.45	1.17	6.89	10.91
73.8	0.04	0.04	2	2	8	1.08	6.70	1.251	0.70	1.78	11.01	12.33
110.6	0.04	0.04	2	2	8	1.36	7.60	1.286	0.90	2.26	14.56	13.43
147.5	0.04	0.04	2	2	8	1.59	8.28	1.311	1.07	2.66	17.81	14.37
184.4	0.04	0.04	2	2	8	1.80	8.84	1.331	1.22	3.01	20.85	15.19
221.3	0.04	0.04	2	2	8	1.98	9.32	1.347	1.35	3.33	23.73	15.93
258.2	0.04	0.04	2	2	8	2.15	9.74	1.360	1.48	3.63	26.50	16.61

Chute flow design for the gabion and rock riprap-lined chutes on 20% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.20	0.04	2	2	8	0.45	9.10	2.498	1.29	1.74	4.05	9.82
73.8	0.20	0.04	2	2	8	0.68	11.55	2.637	2.07	2.75	6.39	10.73
110.6	0.20	0.04	2	2	8	0.86	13.19	2.718	2.70	3.57	8.38	11.45
147.5	0.20	0.04	2	2	8	1.02	14.46	2.774	3.25	4.27	10.20	12.07
184.4	0.20	0.04	2	2	8	1.15	15.52	2.819	3.74	4.90	11.88	12.61
221.3	0.20	0.04	2	2	8	1.28	16.42	2.854	4.19	5.47	13.48	13.11
258.2	0.20	0.04	2	2	8	1.39	17.21	2.885	4.60	5.99	15.00	13.57

Prep By: CRM
Date: 2/21/2012

Chkd By: RCE
Date: 2-28-12

CAMELOT LANDFILL
1339-351-11-02-6B.6
EROSION CONTROL STRUCTURE DESIGN
GABION, TURF REINFORCEMENT MAT, ROCK RIPRAP, OR GROUTED CONCRETE RIPRAP-LINED CHUTE DESIGN

Chute flow design for the gabion and rock riprap-lined chutes on 25% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.25	0.04	2	2	8	0.43	9.79	2.768	1.49	1.91	3.77	9.70
73.8	0.25	0.04	2	2	8	0.64	12.43	2.923	2.40	3.04	5.94	10.56
110.6	0.25	0.04	2	2	8	0.81	14.22	3.014	3.14	3.95	7.78	11.23
147.5	0.25	0.04	2	2	8	0.95	15.62	3.080	3.79	4.74	9.44	11.81
184.4	0.25	0.04	2	2	8	1.08	16.76	3.127	4.36	5.45	11.01	12.33
221.3	0.25	0.04	2	2	8	1.20	17.74	3.167	4.89	6.09	12.48	12.80
258.2	0.25	0.04	2	2	8	1.31	18.60	3.201	5.37	6.68	13.88	13.23

Conclusions: Maximum acceptable normal depth is 1.98 feet. Chute design depth is 2.0 feet; therefore, design is acceptable. Maximum velocity is 18.60 fps. As noted in footnote No. 2 below, the lining material will be selected so that the permissible velocity is not exceeded for erosion control.
Maximum drainage area allowed on the top deck is 20 acres for a 2% slope and 30 acres for a 4% slope since the normal depth in chutes with these slopes is greater than 2.0 feet for larger drainage areas.

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Permissible velocities are listed below, and lining material will be selected so that these are not exceeded.

Description	Permissible Velocity (fps)
Turf Reinforcement Mat (based on Pyramat or equivalent. Refer to Sheet 6B-D-2-6.)	25
Rock Riprap (based on Sheet IIIF-F-2-20 and a D_{50} of 12 inches. If other riprap is used, it will meet the D_{50} requirements listed on Sheet IIIF-F-2-7.)	9
Gabion/Concrete Grouted Riprap (based on Sheet IIIF-F-2-21 and a D_{50} of 0.62 ft. If other gabion is used it will meet the D_{50} requirements listed on Sheet IIIF-F-2-21. The permissible velocity for concrete grouted riprap will actually be greater than 21 fps because it is classified as a rigid channel lining material.	21

CAMELOT LANDFILL
1339-351-11-02-6B.6
EROSION CONTROL STRUCTURE DESIGN
GABION, TURF REINFORCEMENT MAT, ROCK RIPRAP, OR GROUTED CONCRETE RIPRAP-LINED CHUTE DESIGN

Chute flow design for the grouted riprap and turf reinforcement-lined chutes on 2% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.02	0.03	2	2	8	0.75	5.15	1.126	0.41	1.17	7.16	11.01
73.8	0.02	0.03	2	2	8	1.12	6.44	1.184	0.64	1.76	11.46	12.48
110.6	0.02	0.03	2	2	8	1.40	7.29	1.218	0.83	2.23	15.17	13.62
147.5	0.02	0.03	2	2	8	1.64	7.95	1.241	0.98	2.63	18.56	14.58
184.4	0.02	0.03	2	2	8	1.86	8.48	1.260	1.12	2.97	21.74	15.42
221.3	0.02	0.03	2	2	8	2.05	8.94	1.275	1.24	3.29	24.75	16.19
258.2	0.02	0.03	2	2	8	2.22	9.34	1.287	1.36	3.58	27.64	16.89

Chute flow design for the grouted riprap and turf reinforcement-lined chutes on 4% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.04	0.03	2	2	8	0.62	6.49	1.551	0.65	1.27	5.69	10.46
73.8	0.04	0.03	2	2	8	0.92	8.16	1.634	1.03	1.95	9.05	11.68
110.6	0.04	0.03	2	2	8	1.16	9.27	1.681	1.34	2.49	11.93	12.63
147.5	0.04	0.03	2	2	8	1.36	10.13	1.715	1.59	2.95	14.56	13.44
184.4	0.04	0.03	2	2	8	1.54	10.83	1.741	1.82	3.36	17.02	14.15
221.3	0.04	0.03	2	2	8	1.70	11.43	1.762	2.03	3.73	19.35	14.79
258.2	0.04	0.03	2	2	8	1.85	11.96	1.780	2.22	4.07	21.59	15.38

Chute flow design for the grouted riprap and turf reinforcement-lined chutes on 20% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.20	0.03	2	2	8	0.38	10.96	3.254	1.87	2.25	3.37	9.54
73.8	0.20	0.03	2	2	8	0.58	13.97	3.439	3.03	3.61	5.28	10.31
110.6	0.20	0.03	2	2	8	0.73	16.01	3.547	3.98	4.71	6.91	10.92
147.5	0.20	0.03	2	2	8	0.86	17.59	3.624	4.81	5.67	8.39	11.45
184.4	0.20	0.03	2	2	8	0.98	18.90	3.684	5.55	6.53	9.75	11.92
221.3	0.20	0.03	2	2	8	1.09	20.02	3.730	6.23	7.32	11.05	12.35
258.2	0.20	0.03	2	2	8	1.19	21.01	3.771	6.86	8.04	12.29	12.74

CAMELOT LANDFILL
1339-351-11-02-6B.6
EROSION CONTROL STRUCTURE DESIGN
GABION, TURF REINFORCEMENT MAT, ROCK RIPRAP, OR GROUTED CONCRETE RIPRAP-LINED CHUTE DESIGN

Chute flow design for the grouted riprap and turf reinforcement-lined chutes on 25% slope.

Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)	Flow Top Width (ft)
36.9	0.25	0.03	2	2	8	0.36	11.75	3.593	2.15	2.51	3.14	9.44
73.8	0.25	0.03	2	2	8	0.54	15.03	3.812	3.51	4.05	4.91	10.16
110.6	0.25	0.03	2	2	8	0.68	17.24	3.933	4.62	5.30	6.41	10.74
147.5	0.25	0.03	2	2	8	0.81	18.96	4.018	5.59	6.40	7.78	11.23
184.4	0.25	0.03	2	2	8	0.92	20.39	4.084	6.46	7.38	9.04	11.68
221.3	0.25	0.03	2	2	8	1.02	21.61	4.137	7.25	8.27	10.24	12.08
258.2	0.25	0.03	2	2	8	1.11	22.69	4.138	8.00	9.11	11.38	12.45

Conclusions: Maximum acceptable normal depth is 1.86 feet. Chute design depth is 2.0 feet; therefore, design is acceptable. Maximum velocity is 22.69 fps. As noted in footnote No. 2 below, the lining material will be selected so that the permissible velocity is not exceeded for erosion control.
Maximum drainage area allowed on the top deck is 25 acres for a 2% slope since the normal depth in chutes with this slope is greater than 2.0 feet for larger drainage areas.

1. Calculations were performed using the HYDROCALC Hydraulics for Windows program developed by Dodson and Associates (Version 1.2a, 1996).
2. Permissible velocities are listed below, and lining material will be selected so that these are not exceeded.

Description	Permissible Velocity (fps)
Turf Reinforcement Mat (based on Pyramat or equivalent. Refer to Sheet IIIF-F-2-19.)	25
Rock Riprap (based on Sheet IIIF-F-2-20 and a D_{50} of 12 inches. If other riprap is used, it will meet the D_{50} requirements listed on Sheet IIIF-F-2-20.)	9
Gabion/Concrete Grouted Riprap (based on Sheet IIIF-F-2-21 and a D_{50} of 0.62 ft. If other gabion is used, it will meet the D_{50} requirements listed on Sheet IIIF-F-2-21. The permissible velocity for concrete grouted riprap will actually be greater than 21 fps because it is classified as a rigid channel lining material.)	21

CAMELOT LANDFILL
1339-351-11-02-6B.6
OPEN CHANNEL LETDOWN
RIPRAP EROSION PROTECTION DESIGN

Required: Design the riprap erosion protection at the downstream end of the open channel letdown.

Method: Use HEC-RAS to model the open channel geomembrane-lined letdown to determine the hydraulic characteristics of the hydraulic jump that will occur at the downstream end of the letdown. Based on the results, design the riprap erosion protection area.

Note: This example calculation is shown for geomembrane-lined letdowns to conservatively estimate the length of riprap needed. As seen on pages IIIF-F-2-3 through IIIF-F-2-8, the geomembrane-lined letdowns have the highest velocities and represent the worst-case scenario. Therefore, this riprap design is applicable to all lined letdowns.

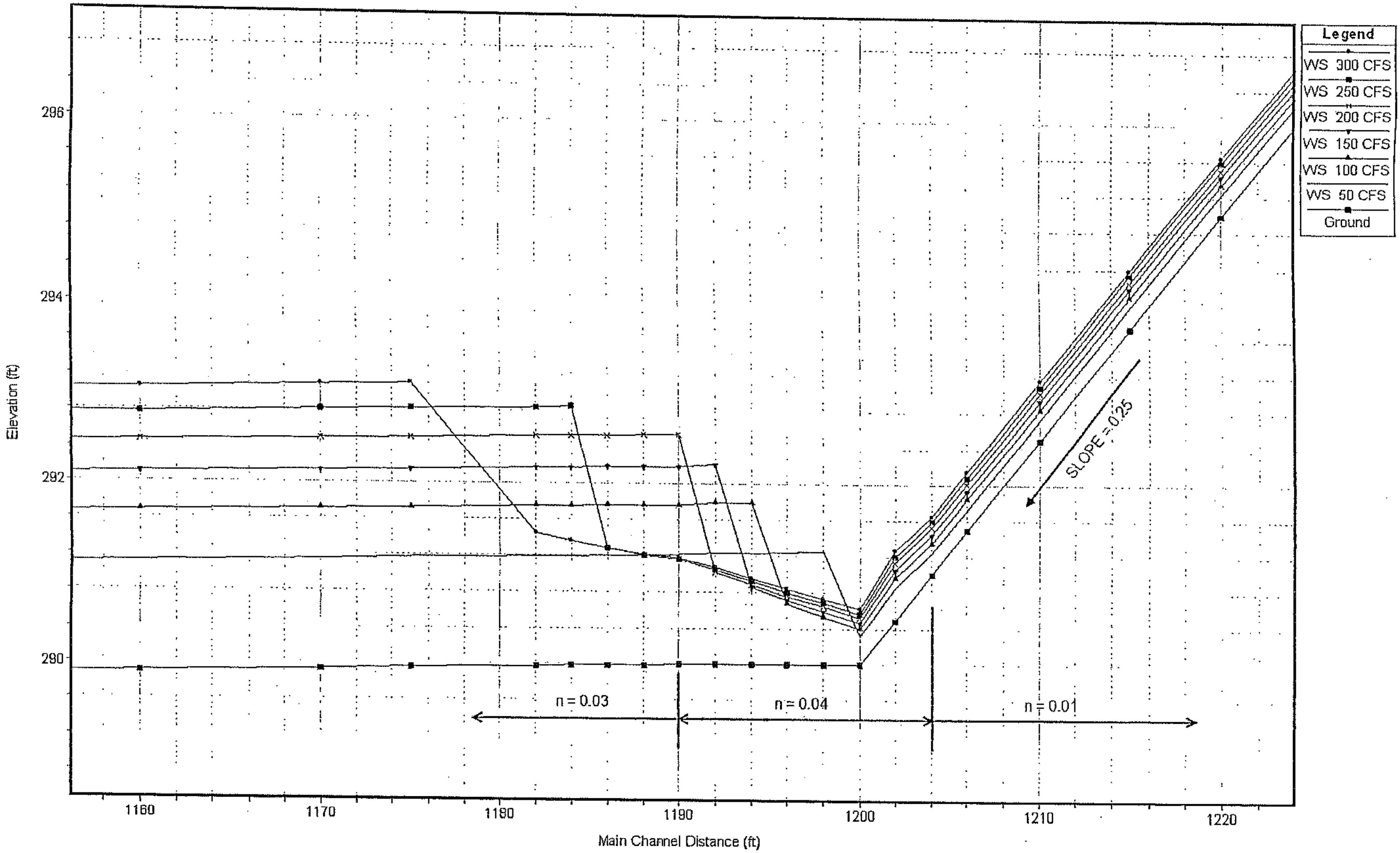
Solution:

Page IIIF-F-2-10 shows the water surface profile for incremental flows up to 300 cfs for the geomembrane letdown into a channel, as modeled in HEC-RAS. The modeling output is presented on pages IIIF-F-2-11 through IIIF-F-2-21. The following table summarizes the erosion protection design for the various flows.

Flow (cfs)	Drainage Area* (ac)	Length of Hydraulic Jump (ft)	Specified Runout of Riprap (ft)
50	5	2	10
100	10	6	10
150	15	8	10
200	20	10	10
250	30	16	16
300	35	25	25

* Drainage areas are approximated based on corresponding flows/drainage areas listed on page IIIF-F-2-2.

The values listed in the above table are specified riprap lengths for letdowns terminating into a perimeter channel. If the letdown terminates into a pond, 10 feet of riprap erosion control will be sufficient because the water in the pond will provide additional energy dissipation.


Legend
WS 300 CFS
WS 250 CFS
WS 200 CFS
WS 150 CFS
WS 100 CFS
WS 50 CFS
Ground
SLOPE = 0.25
n = 0.03
n = 0.04
n = 0.01
Elevation (ft)
296
294
292
290
Main Channel Distance (ft)
1160
1170
1180
1190
1200
1210
1220

HEC-RAS Version 4.0.0 March 2008
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX   XXXX        XXXX     XX    XXXX
X     X  X       X    X       X   X   X  X  X
X     X  X       X            X   X  X    X X
XXXXXXX  XXXX    X      XXX   XXXX   XXXXXX  XXXX
X     X  X       X            X X    X    X      X
X     X  X       X    X       X  X   X    X      X
X     X  XXXXXX   XXXX        X   X  X    X XXXXX
```

PROJECT DATA
Project Title: Hydraulic Jump
Project File : HydraulicJump.prj
Run Date and Time: 12/16/2009 3:52:23 PM

Project in English units

PLAN DATA

Plan Title: RUNUP 0.3%
Plan File : s:\Chuck\HEC-RAS\HydraulicJump.p07

Geometry Title: FML CHUTE with 4' RUNUP .003
Geometry File : s:\Chuck\HEC-RAS\HydraulicJump.g07

Flow Title : FML CHUTE 0.3%
Flow File : s:\Chuck\HEC-RAS\HydraulicJump.f03

Plan Summary Information:

Number of:				
Cross Sections	= 36	Multiple Openings	=	0
Culverts	= 0	Inline Structures	=	0
Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: FML CHUTE 0.3%
Flow File : s:\Chuck\HEC-RAS\HydraulicJump.f03

Flow Data (cfs)

River	Reach	RS	50 CFS	100 CFS	150 CFS	200 CFS	250 CFS	300 CFS
LF	FML Chute	5000	50	100	150	200	250	300

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
LF	FML Chute	50 CFS	Normal S = 0.25	Normal S = 0.003
LF	FML Chute	100 CFS	Normal S = 0.25	Normal S = 0.003
LF	FML Chute	150 CFS	Normal S = 0.25	Normal S = 0.003
LF	FML Chute	200 CFS	Normal S = 0.25	Normal S = 0.003
LF	FML Chute	250 CFS	Normal S = 0.25	Normal S = 0.003
LF	FML Chute	300 CFS	Normal S = 0.25	Normal S = 0.003

GEOMETRY DATA

Geometry Title: FML CHUTE with 4' RUNUP .003
Geometry File : s:\Chuck\HEC-RAS\HydraulicJump.g07

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 5000

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	500	20	490	28	490	48	500

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.01	0	.01	48	.01

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4900

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	475	20	465	28	465	48	475

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.01	0	.01	48	.01

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4800

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	450	20	440	28	440	48	450

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.01	0	.01	48	.01

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4700

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	425	20	415	28	415	48	425

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.01	0	.01	48	.01

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4600

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	400	20	390	28	390	48	400

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.01	0	.01	48	.01

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4500

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	375	20	365	28	365	48	375

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.01	0	.01	48	.01

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4400

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	350	20	340	28	340	48	350

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.01	0	.01	48	.01

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4300

```
INPUT
Description:
Station Elevation Data     num=      4
     Sta    Elev    Sta    Elev    Sta    Elev    Sta    Elev
       0     325     20     315     28     315     48     325

Manning's n Values          num=      3
     Sta   n Val    Sta   n Val    Sta   n Val
       0     .01      0     .01     48     .01

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0      48               75      75      75                .1       .5

CROSS SECTION


RIVER: LF
REACH: FML Chute             RS: 4225

INPUT
Description:
Station Elevation Data     num=      4
     Sta    Elev    Sta    Elev    Sta    Elev    Sta    Elev
       0  306.25     20  296.25     28  296.25     48  306.25

Manning's n Values          num=      3
     Sta   n Val    Sta   n Val    Sta   n Val
       0     .01      0     .01     48     .01

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0      48                5       5       5                .1       .5

CROSS SECTION


RIVER: LF
REACH: FML Chute             RS: 4220

INPUT
Description:
Station Elevation Data     num=      4
     Sta    Elev    Sta    Elev    Sta    Elev    Sta    Elev
       0     305     20     295     28     295     48     305

Manning's n Values          num=      3
     Sta   n Val    Sta   n Val    Sta   n Val
       0     .01      0     .01     48     .01

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0      48                5       5       5                .1       .5

CROSS SECTION


RIVER: LF
REACH: FML Chute             RS: 4215

INPUT
Description:
Station Elevation Data     num=      4
     Sta    Elev    Sta    Elev    Sta    Elev    Sta    Elev
       0  303.75     20  293.75     28  293.75     48  303.75

Manning's n Values          num=      3
     Sta   n Val    Sta   n Val    Sta   n Val
       0     .01      0     .01     48     .01

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0      48                5       5       5                .1       .5

CROSS SECTION


RIVER: LF
REACH: FML Chute             RS: 4210

INPUT
Description:
Station Elevation Data     num=      4
     Sta    Elev    Sta    Elev    Sta    Elev    Sta    Elev
       0   302.5     20   292.5     28   292.5     48   302.5

Manning's n Values          num=      3
     Sta   n Val    Sta   n Val    Sta   n Val
       0     .01      0     .01     48     .01

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0      48                4       4       4                .1       .5

CROSS SECTION


RIVER: LF
REACH: FML Chute             RS: 4206

INPUT
Description:
Station Elevation Data     num=      4
     Sta    Elev    Sta    Elev    Sta    Elev    Sta    Elev
       0   301.5     20   291.5     28   291.5     48   301.5

Manning's n Values          num=      3
     Sta   n Val    Sta   n Val    Sta   n Val
       0     .01      0     .01     48     .01

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
             0      48                2       2       2                .1       .5

CROSS SECTION


RIVER: LF
REACH: FML Chute             RS: 4204
```

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	301	20	291	28	291	48	301

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	48	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4202

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	300.5	20	290.5	28	290.5	48	300.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	48	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	48	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4200

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	300	30	290	42	290	72	300

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	72	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	72	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4198

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	300	30	290	42	290	72	300

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	72	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	72	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4196

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	300	30	290	42	290	72	300

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	72	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	72	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4194

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	300	30	290	42	290	72	300

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	72	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	72	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4192

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	300	30	290	42	290	72	300

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	72	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	72	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4190

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	310	60	290	72	290	132	310

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	72	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	72	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4188

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.994	60	289.994	72	289.994	132	309.994

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4186

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.988	60	289.988	72	289.988	132	309.988

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4184

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.982	60	289.982	72	289.982	132	309.982

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	2	2	2	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4182

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.976	60	289.976	72	289.976	132	309.976

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	7	7	7	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4175

INPUT
Description:

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.955	60	289.955	72	289.955	132	309.955

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	5	5	5	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4170

INPUT
Description:

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.94	60	289.94	72	289.94	132	309.94

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	10	10	10	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4160

INPUT
Description:

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.91	60	289.91	72	289.91	132	309.91

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	10	10	10	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4150

INPUT
Description:

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.88	60	289.88	72	289.88	132	309.88

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	10	10	10	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4140

INPUT
Description:

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.85	60	289.85	72	289.85	132	309.85

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	10	10	10	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4130

INPUT
Description:

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.82	60	289.82	72	289.82	132	309.82

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	10	10	10	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4120

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.79	60	289.79	72	289.79	132	309.79

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	10	10	10	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4110

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.76	60	289.76	72	289.76	132	309.76

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	10	10	10	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4100

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.73	60	289.73	72	289.73	132	309.73

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	100	100	100	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 4000

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	309.43	60	289.43	72	289.43	132	309.43

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	132	1000	1000	1000	.1	.5

CROSS SECTION

RIVER: LF
REACH: FML Chute RS: 3000

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	306.43	60	286.43	72	286.43	132	306.43

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	132	.03

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	132	.1	.5

SUMMARY OF MANNING'S N VALUES

River:LF

Reach	River Sta.	n1	n2	n3
FML Chute	5000	.01	.01	.01
FML Chute	4900	.01	.01	.01
FML Chute	4800	.01	.01	.01
FML Chute	4700	.01	.01	.01
FML Chute	4600	.01	.01	.01
FML Chute	4500	.01	.01	.01
FML Chute	4400	.01	.01	.01
FML Chute	4300	.01	.01	.01
FML Chute	4225	.01	.01	.01
FML Chute	4220	.01	.01	.01
FML Chute	4215	.01	.01	.01
FML Chute	4210	.01	.01	.01
FML Chute	4206	.01	.01	.01
FML Chute	4204	.04	.04	.04
FML Chute	4202	.04	.04	.04
FML Chute	4200	.04	.04	.04

FML Chute	4198	.04	.04	.04
FML Chute	4196	.04	.04	.04
FML Chute	4194	.04	.04	.04
FML Chute	4192	.04	.04	.04
FML Chute	4190	.03	.03	.03
FML Chute	4188	.03	.03	.03
FML Chute	4186	.03	.03	.03
FML Chute	4184	.03	.03	.03
FML Chute	4182	.03	.03	.03
FML Chute	4175	.03	.03	.03
FML Chute	4170	.03	.03	.03
FML Chute	4160	.03	.03	.03
FML Chute	4150	.03	.03	.03
FML Chute	4140	.03	.03	.03
FML Chute	4130	.03	.03	.03
FML Chute	4120	.03	.03	.03
FML Chute	4110	.03	.03	.03
FML Chute	4100	.03	.03	.03
FML Chute	4000	.03	.03	.03
FML Chute	3000	.03	.03	.03

SUMMARY OF REACH LENGTHS

River: LF

Reach	River Sta.	Left	Channel	Right
FML Chute	5000	100	100	100
FML Chute	4900	100	100	100
FML Chute	4800	100	100	100
FML Chute	4700	100	100	100
FML Chute	4600	100	100	100
FML Chute	4500	100	100	100
FML Chute	4400	100	100	100
FML Chute	4300	75	75	75
FML Chute	4225	5	5	5
FML Chute	4220	5	5	5
FML Chute	4215	5	5	5
FML Chute	4210	4	4	4
FML Chute	4206	2	2	2
FML Chute	4204	2	2	2
FML Chute	4202	2	2	2
FML Chute	4200	2	2	2
FML Chute	4198	2	2	2
FML Chute	4196	2	2	2
FML Chute	4194	2	2	2
FML Chute	4192	2	2	2
FML Chute	4190	2	2	2
FML Chute	4188	2	2	2
FML Chute	4186	2	2	2
FML Chute	4184	2	2	2
FML Chute	4182	7	7	7
FML Chute	4175	5	5	5
FML Chute	4170	10	10	10
FML Chute	4160	10	10	10
FML Chute	4150	10	10	10
FML Chute	4140	10	10	10
FML Chute	4130	10	10	10
FML Chute	4120	10	10	10
FML Chute	4110	10	10	10
FML Chute	4100	100	100	100
FML Chute	4000	1000	1000	1000
FML Chute	3000			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: LF

Reach	River Sta.	Contr.	Expan.
FML Chute	5000	.1	.5
FML Chute	4900	.1	.5
FML Chute	4800	.1	.5
FML Chute	4700	.1	.5
FML Chute	4600	.1	.5
FML Chute	4500	.1	.5
FML Chute	4400	.1	.5
FML Chute	4300	.1	.5
FML Chute	4225	.1	.5
FML Chute	4220	.1	.5
FML Chute	4215	.1	.5
FML Chute	4210	.1	.5
FML Chute	4206	.1	.5
FML Chute	4204	.1	.5
FML Chute	4202	.1	.5
FML Chute	4200	.1	.5
FML Chute	4198	.1	.5
FML Chute	4196	.1	.5
FML Chute	4194	.1	.5
FML Chute	4192	.1	.5
FML Chute	4190	.1	.5
FML Chute	4188	.1	.5
FML Chute	4186	.1	.5
FML Chute	4184	.1	.5
FML Chute	4182	.1	.5
FML Chute	4175	.1	.5
FML Chute	4170	.1	.5
FML Chute	4160	.1	.5
FML Chute	4150	.1	.5
FML Chute	4140	.1	.5
FML Chute	4130	.1	.5
FML Chute	4120	.1	.5
FML Chute	4110	.1	.5
FML Chute	4100	.1	.5
FML Chute	4000	.1	.5
FML Chute	3000	.1	.5

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
FML Chute	5000	50 CFS	50.00	490.00	490.22	490.98	500.99	0.250200	26.33	1.90	8.90	10.05
FML Chute	5000	100 CFS	100.00	490.00	490.34	491.48	508.27	0.250152	33.98	2.94	9.36	10.68
FML Chute	5000	150 CFS	150.00	490.00	490.43	491.87	514.41	0.250103	39.30	3.82	9.72	11.05
FML Chute	5000	200 CFS	200.00	490.00	490.51	492.21	519.86	0.250072	43.47	4.60	10.04	11.32
FML Chute	5000	250 CFS	250.00	490.00	490.58	492.50	524.82	0.250092	46.96	5.32	10.32	11.52
FML Chute	5000	300 CFS	300.00	490.00	490.65	492.77	529.41	0.250044	49.96	6.00	10.58	11.69
FML Chute	4900	50 CFS	50.00	465.00	465.98	465.98	466.39	0.001647	5.14	9.73	11.91	1.00
FML Chute	4900	100 CFS	100.00	465.00	465.34	466.48	483.26	0.249924	33.97	2.94	9.36	10.67
FML Chute	4900	150 CFS	150.00	465.00	465.43	466.87	489.40	0.249922	39.29	3.82	9.72	11.05
FML Chute	4900	200 CFS	200.00	465.00	465.51	467.21	494.84	0.249919	43.46	4.60	10.04	11.31
FML Chute	4900	250 CFS	250.00	465.00	465.58	467.50	499.80	0.249911	46.95	5.33	10.32	11.52
FML Chute	4900	300 CFS	300.00	465.00	465.65	467.77	504.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4800	50 CFS	50.00	440.00	440.16	440.98	463.50	0.867039	38.77	1.29	8.62	17.67
FML Chute	4800	100 CFS	100.00	440.00	440.34	441.48	458.26	0.249924	33.97	2.94	9.36	10.67
FML Chute	4800	150 CFS	150.00	440.00	440.43	441.87	464.40	0.249922	39.29	3.82	9.72	11.05
FML Chute	4800	200 CFS	200.00	440.00	440.51	442.21	469.85	0.249970	43.47	4.60	10.04	11.32
FML Chute	4800	250 CFS	250.00	440.00	440.58	442.50	474.80	0.249911	46.95	5.33	10.32	11.52
FML Chute	4800	300 CFS	300.00	440.00	440.65	442.77	479.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4700	50 CFS	50.00	415.00	415.25	415.98	423.63	0.167904	23.23	2.15	9.01	8.38
FML Chute	4700	100 CFS	100.00	415.00	415.34	416.48	433.27	0.250000	33.98	2.94	9.36	10.68
FML Chute	4700	150 CFS	150.00	415.00	415.43	416.87	439.41	0.250043	39.29	3.82	9.72	11.05
FML Chute	4700	200 CFS	200.00	415.00	415.51	417.21	444.85	0.249970	43.47	4.60	10.04	11.32
FML Chute	4700	250 CFS	250.00	415.00	415.58	417.50	449.81	0.249956	46.95	5.32	10.32	11.52
FML Chute	4700	300 CFS	300.00	415.00	415.65	417.77	454.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4600	50 CFS	50.00	390.00	390.22	390.98	401.86	0.283536	27.38	1.83	8.87	10.63
FML Chute	4600	100 CFS	100.00	390.00	390.34	391.48	408.27	0.250000	33.98	2.94	9.36	10.68
FML Chute	4600	150 CFS	150.00	390.00	390.43	391.87	414.41	0.250043	39.29	3.82	9.72	11.05
FML Chute	4600	200 CFS	200.00	390.00	390.51	392.21	419.85	0.249970	43.47	4.60	10.04	11.32
FML Chute	4600	250 CFS	250.00	390.00	390.58	392.50	424.82	0.250046	46.95	5.32	10.32	11.52
FML Chute	4600	300 CFS	300.00	390.00	390.65	392.77	429.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4500	50 CFS	50.00	365.00	365.23	365.98	375.54	0.233381	25.76	1.94	8.92	9.73
FML Chute	4500	100 CFS	100.00	365.00	365.34	366.48	383.27	0.250000	33.98	2.94	9.36	10.68
FML Chute	4500	150 CFS	150.00	365.00	365.43	366.87	389.41	0.250043	39.29	3.82	9.72	11.05
FML Chute	4500	200 CFS	200.00	365.00	365.51	367.21	394.85	0.249970	43.47	4.60	10.04	11.32
FML Chute	4500	250 CFS	250.00	365.00	365.58	367.50	399.82	0.250046	46.95	5.32	10.32	11.52
FML Chute	4500	300 CFS	300.00	365.00	365.65	367.77	404.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4400	50 CFS	50.00	340.00	340.22	340.98	351.11	0.254706	26.48	1.89	8.89	10.13
FML Chute	4400	100 CFS	100.00	340.00	340.34	341.48	358.27	0.250000	33.98	2.94	9.36	10.68
FML Chute	4400	150 CFS	150.00	340.00	340.43	341.87	364.41	0.250043	39.29	3.82	9.72	11.05
FML Chute	4400	200 CFS	200.00	340.00	340.51	342.21	369.85	0.249970	43.47	4.60	10.04	11.32
FML Chute	4400	250 CFS	250.00	340.00	340.58	342.50	374.82	0.250046	46.95	5.32	10.32	11.52
FML Chute	4400	300 CFS	300.00	340.00	340.65	342.77	379.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4300	50 CFS	50.00	315.00	315.23	315.98	325.92	0.247365	26.24	1.91	8.90	9.99
FML Chute	4300	100 CFS	100.00	315.00	315.34	316.48	333.27	0.250000	33.98	2.94	9.36	10.68
FML Chute	4300	150 CFS	150.00	315.00	315.43	316.87	339.41	0.250043	39.29	3.82	9.72	11.05
FML Chute	4300	200 CFS	200.00	315.00	315.51	317.21	344.85	0.249970	43.47	4.60	10.04	11.32
FML Chute	4300	250 CFS	250.00	315.00	315.58	317.50	349.82	0.250046	46.95	5.32	10.32	11.52
FML Chute	4300	300 CFS	300.00	315.00	315.65	317.77	354.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4225	50 CFS	50.00	296.25	296.47	297.23	307.24	0.250314	26.34	1.90	8.90	10.05
FML Chute	4225	100 CFS	100.00	296.25	296.59	297.73	314.52	0.250000	33.98	2.94	9.36	10.68
FML Chute	4225	150 CFS	150.00	296.25	296.68	298.12	320.66	0.250043	39.29	3.82	9.72	11.05
FML Chute	4225	200 CFS	200.00	296.25	296.76	298.46	326.10	0.249970	43.47	4.60	10.04	11.32
FML Chute	4225	250 CFS	250.00	296.25	296.83	298.75	331.07	0.250046	46.95	5.32	10.32	11.52
FML Chute	4225	300 CFS	300.00	296.25	296.90	299.02	335.65	0.250003	49.96	6.00	10.58	11.69
FML Chute	4220	50 CFS	50.00	295.00	295.22	295.98	305.99	0.250314	26.34	1.90	8.90	10.05
FML Chute	4220	100 CFS	100.00	295.00	295.34	296.48	313.27	0.250000	33.98	2.94	9.36	10.68
FML Chute	4220	150 CFS	150.00	295.00	295.43	296.87	319.41	0.250043	39.29	3.82	9.72	11.05
FML Chute	4220	200 CFS	200.00	295.00	295.51	297.21	324.85	0.249970	43.47	4.60	10.04	11.32
FML Chute	4220	250 CFS	250.00	295.00	295.58	297.50	329.82	0.250046	46.95	5.32	10.32	11.52
FML Chute	4220	300 CFS	300.00	295.00	295.65	297.77	334.40	0.250003	49.96	6.00	10.58	11.69
FML Chute	4215	50 CFS	50.00	293.75	293.97	294.73	304.74	0.250314	26.34	1.90	8.90	10.05
FML Chute	4215	100 CFS	100.00	293.75	294.09	295.23	312.02	0.250000	33.98	2.94	9.36	10.68
FML Chute	4215	150 CFS	150.00	293.75	294.18	295.62	318.16	0.250043	39.29	3.82	9.72	11.05
FML Chute	4215	200 CFS	200.00	293.75	294.26	295.96	323.60	0.249970	43.47	4.60	10.04	11.32
FML Chute	4215	250 CFS	250.00	293.75	294.33	296.25	328.57	0.250046	46.95	5.32	10.32	11.52
FML Chute	4215	300 CFS	300.00	293.75	294.40	296.52	333.15	0.250003	49.96	6.00	10.58	11.69
FML Chute	4210	50 CFS	50.00	292.50	292.72	293.48	303.49	0.250314	26.34	1.90	8.90	10.05
FML Chute	4210	100 CFS	100.00	292.50	292.84	293.98	310.77	0.250000	33.98	2.94	9.36	10.68
FML Chute	4210	150 CFS	150.00	292.50	292.93	294.37	316.91	0.250043	39.29	3.82	9.72	11.05
FML Chute	4210	200 CFS	200.00	292.50	293.01	294.71	322.35	0.249970	43.47	4.60	10.04	11.32
FML Chute	4210	250 CFS	250.00	292.50	293.08	295.00	327.32	0.250046	46.95	5.32	10.32	11.52
FML Chute	4210	300 CFS	300.00	292.50	293.15	295.27	331.90	0.250003	49.96	6.00	10.58	11.69
FML Chute	4206	50 CFS	50.00	291.50	291.72	292.48	302.49	0.250314	26.34	1.90	8.90	10.05
FML Chute	4206	100 CFS	100.00	291.50	291.84	292.98	309.77	0.250000	33.98	2.94	9.36	10.68
FML Chute	4206	150 CFS	150.00	291.50	291.93	293.37	315.91	0.250043	39.29	3.82	9.72	11.05
FML Chute	4206	200 CFS	200.00	291.50	292.01	293.71	321.33	0.249766	43.46	4.60	10.04	11.31
FML Chute	4206	250 CFS	250.00	291.50	292.08	294.00	326.32	0.250046	46.95	5.32	10.32	11.52
FML Chute	4206	300 CFS	300.00	291.50	292.15	294.27	330.90	0.250003	49.96	6.00	10.58	11.69
FML Chute	4204	50 CFS	50.00	291.00	291.24	291.98	300.54	3.168813	24.47	2.04	8.96	9.03
FML Chute	4204	100 CFS	100.00	291.00	291.35	292.48	307.76	3.483119	32.51	3.08	9.41	10.02
FML Chute	4204	150 CFS	150.00	291.00	291.44	292.87	313.89	3.611811	38.02	3.95	9.78	10.55
FML Chute	4204	200 CFS	200.00	291.00	291.52	293.21	319.31	3.680328	42.30	4.73	10.09	10.89
FML Chute	4204	250 CFS	250.00	291.00	291.59	293.50	324.29	3.729970	45.88	5.45	10.37	11.16
FML Chute	4204	300 CFS	300.00	291.00	291.66	293.77	328.87	3.761746	48.95	6.13	10.63	11.36
FML Chute	4202	50 CFS	50.00	290.50	290.85	291.48	294.95	0.867986	16.24	3.08	9.41	5.00
FML Chute	4202	100 CFS	100.00	290.50	290.97	291.98	299.92	1.358543	24.01	4.16	9.86	6.51
FML Chute	4202	150 CFS	150.00	290.50	291.05	292.37	304.74	1.689934	29.69	5.05	10.22	7.44
FML Chute	4202	200 CFS	200.00	290.50	291.13	292.71	309.32	1.929858	34.22	5.84	10.52	8.09
FML Chute	4202	250 CFS	250.00	290.50	291.20	293.00	313.67	2.115861	38.04	6.57	10.80	8.59
FML Chute	4202	300 CFS	300.00	290.50	291.26	293.27	317.78	2.261709	41.33	7.26	11.05	8.99
FML Chute	4200	50 CFS	50.00	290.00	290.31	290.76	292.68	0.577996	12.36	4.05	13.88	4.03
FML Chute	4200	100 CFS	100.00	290.00	290.40	291.17	295.89	0.980102	18.80	5.32	14.42	5.46
FML Chute	4200	150 CFS	150.00	290.00	290.47	291.48	299.36	1.322610	23.93	6.27	14.81	6.48
FML Chute	4200	200 CFS	200.00	290.00	290.52	291.75	302.89	1.610460	28.22	7.09	15.13	7.27

FML Chute	4200	250 CFS	250.00	290.00	290.57	291.99	306.39	1.851131	31.91	7.83	15.43	7.89
FML Chute	4200	300 CFS	300.00	290.00	290.62	292.21	309.82	2.054209	35.16	8.53	15.70	8.40
FML Chute	4198	50 CFS	50.00	290.00	291.26	290.76	291.36	0.004652	2.52	19.82	19.54	0.44
FML Chute	4198	100 CFS	100.00	290.00	290.53	291.17	293.48	0.373613	13.77	7.26	15.20	3.51
FML Chute	4198	150 CFS	150.00	290.00	290.59	291.48	295.84	0.589034	18.39	8.16	15.55	4.48
FML Chute	4198	200 CFS	200.00	290.00	290.64	291.75	298.40	0.789548	22.35	8.95	15.86	5.24
FML Chute	4198	250 CFS	250.00	290.00	290.69	291.99	301.04	0.971954	25.82	9.68	16.13	5.87
FML Chute	4198	300 CFS	300.00	290.00	290.73	292.21	303.72	1.136831	28.92	10.37	16.39	6.41
FML Chute	4196	50 CFS	50.00	290.00	291.25		291.35	0.004810	2.55	19.59	19.47	0.45
FML Chute	4196	100 CFS	100.00	290.00	290.68	291.17	292.39	0.163054	10.49	9.53	16.07	2.40
FML Chute	4196	150 CFS	150.00	290.00	290.72	291.48	294.10	0.301701	14.75	10.17	16.31	3.29
FML Chute	4196	200 CFS	200.00	290.00	290.76	291.75	296.00	0.436547	18.37	10.89	16.57	3.99
FML Chute	4196	250 CFS	250.00	290.00	290.80	291.99	298.02	0.564262	21.55	11.60	16.83	4.57
FML Chute	4196	300 CFS	300.00	290.00	290.84	292.21	300.13	0.687054	24.45	12.27	17.07	5.08
FML Chute	4194	50 CFS	50.00	290.00	291.23		291.34	0.004982	2.58	19.36	19.40	0.46
FML Chute	4194	100 CFS	100.00	290.00	291.80	291.17	291.96	0.005042	3.20	31.24	22.78	0.48
FML Chute	4194	150 CFS	150.00	290.00	290.86	291.48	293.10	0.163928	12.04	12.46	17.13	2.49
FML Chute	4194	200 CFS	200.00	290.00	290.89	291.75	294.57	0.257977	15.40	12.98	17.32	3.13
FML Chute	4194	250 CFS	250.00	290.00	290.92	291.99	296.16	0.350291	18.37	13.61	17.53	3.67
FML Chute	4194	300 CFS	300.00	290.00	290.96	292.21	297.85	0.441518	21.07	14.24	17.74	4.14
FML Chute	4192	50 CFS	50.00	290.00	291.22		291.33	0.005160	2.61	19.13	19.33	0.46
FML Chute	4192	100 CFS	100.00	290.00	291.78		291.95	0.005172	3.23	30.96	22.70	0.49
FML Chute	4192	150 CFS	150.00	290.00	292.21	291.48	292.42	0.005182	3.64	41.24	25.28	0.50
FML Chute	4192	200 CFS	200.00	290.00	291.02	291.75	293.65	0.157016	13.02	15.36	18.12	2.49
FML Chute	4192	250 CFS	250.00	290.00	291.04	291.99	294.93	0.225868	15.83	15.79	18.26	3.00
FML Chute	4192	300 CFS	300.00	290.00	291.07	292.21	296.32	0.294959	18.37	16.33	18.44	3.44
FML Chute	4190	50 CFS	50.00	290.00	291.21		291.32	0.002884	2.76	18.87	19.25	0.47
FML Chute	4190	100 CFS	100.00	290.00	291.77		291.94	0.002881	3.44	30.54	22.60	0.50
FML Chute	4190	150 CFS	150.00	290.00	292.19		292.41	0.002883	3.89	40.70	25.15	0.51
FML Chute	4190	200 CFS	200.00	290.00	292.55	291.77	292.81	0.002884	4.24	50.02	27.28	0.52
FML Chute	4190	250 CFS	250.00	290.00	291.15	292.01	294.31	0.085151	14.57	17.83	18.92	2.54
FML Chute	4190	300 CFS	300.00	290.00	291.17	292.23	295.52	0.114969	17.11	18.23	19.05	2.96
FML Chute	4188	50 CFS	50.00	289.99	291.20		291.31	0.002999	2.64	18.91	19.26	0.47
FML Chute	4188	100 CFS	100.00	289.99	291.76		291.93	0.003001	3.27	30.62	22.62	0.49
FML Chute	4188	150 CFS	150.00	289.99	292.19		292.40	0.003001	3.68	40.81	25.17	0.51
FML Chute	4188	200 CFS	200.00	289.99	292.55		292.79	0.002998	3.99	50.16	27.31	0.52
FML Chute	4188	250 CFS	250.00	289.99	291.20	291.99	293.94	0.075880	13.27	18.83	19.24	2.36
FML Chute	4188	300 CFS	300.00	289.99	291.22	292.20	295.03	0.104249	15.67	19.14	19.33	2.78
FML Chute	4186	50 CFS	50.00	289.99	291.20		291.31	0.003000	2.64	18.91	19.26	0.47
FML Chute	4186	100 CFS	100.00	289.99	291.76		291.92	0.003001	3.27	30.62	22.61	0.49
FML Chute	4186	150 CFS	150.00	289.99	292.18		292.39	0.003001	3.68	40.81	25.17	0.51
FML Chute	4186	200 CFS	200.00	289.99	292.54		292.79	0.002998	3.99	50.16	27.31	0.52
FML Chute	4186	250 CFS	250.00	289.99	291.29	291.98	293.57	0.058292	12.12	20.62	19.79	2.09
FML Chute	4186	300 CFS	300.00	289.99	291.29	292.20	294.57	0.083984	14.55	20.62	19.78	2.51
FML Chute	4184	50 CFS	50.00	289.98	291.19		291.30	0.003000	2.64	18.91	19.26	0.47
FML Chute	4184	100 CFS	100.00	289.98	291.75		291.92	0.003001	3.27	30.62	22.61	0.49
FML Chute	4184	150 CFS	150.00	289.98	292.18		292.39	0.003001	3.68	40.81	25.17	0.51
FML Chute	4184	200 CFS	200.00	289.98	292.53		292.78	0.002997	3.99	50.17	27.31	0.52
FML Chute	4184	250 CFS	250.00	289.98	292.84	291.98	293.12	0.002997	4.24	58.92	29.17	0.53
FML Chute	4184	300 CFS	300.00	289.98	291.36	292.19	294.19	0.067522	13.49	22.23	20.27	2.27
FML Chute	4182	50 CFS	50.00	289.98	291.19		291.29	0.003000	2.64	18.91	19.26	0.47
FML Chute	4182	100 CFS	100.00	289.98	291.75		291.91	0.003001	3.27	30.62	22.61	0.49
FML Chute	4182	150 CFS	150.00	289.98	292.17		292.38	0.003001	3.68	40.81	25.17	0.51
FML Chute	4182	200 CFS	200.00	289.98	292.53		292.77	0.002997	3.99	50.17	27.31	0.52
FML Chute	4182	250 CFS	250.00	289.98	292.84		293.12	0.002997	4.24	58.92	29.17	0.53
FML Chute	4182	300 CFS	300.00	289.98	291.44	292.19	293.86	0.053993	12.48	24.03	20.79	2.05
FML Chute	4175	50 CFS	50.00	289.96	291.16		291.27	0.003000	2.64	18.91	19.26	0.47
FML Chute	4175	100 CFS	100.00	289.96	291.72		291.89	0.003001	3.27	30.62	22.61	0.49
FML Chute	4175	150 CFS	150.00	289.96	292.15		292.36	0.003001	3.68	40.81	25.17	0.51
FML Chute	4175	200 CFS	200.00	289.96	292.51		292.75	0.002997	3.99	50.17	27.31	0.52
FML Chute	4175	250 CFS	250.00	289.96	292.82		293.10	0.002997	4.24	58.92	29.17	0.53
FML Chute	4175	300 CFS	300.00	289.96	293.09	292.17	293.40	0.003000	4.46	67.21	30.83	0.53
FML Chute	4170	50 CFS	50.00	289.94	291.15		291.26	0.003000	2.64	18.91	19.26	0.47
FML Chute	4170	100 CFS	100.00	289.94	291.71		291.87	0.003001	3.27	30.62	22.61	0.49
FML Chute	4170	150 CFS	150.00	289.94	292.14		292.35	0.003001	3.68	40.81	25.17	0.51
FML Chute	4170	200 CFS	200.00	289.94	292.49		292.74	0.002997	3.99	50.17	27.31	0.52
FML Chute	4170	250 CFS	250.00	289.94	292.80		293.08	0.002997	4.24	58.92	29.17	0.53
FML Chute	4170	300 CFS	300.00	289.94	293.08		293.39	0.003000	4.46	67.21	30.83	0.53
FML Chute	4160	50 CFS	50.00	289.91	291.12		291.23	0.003000	2.64	18.91	19.26	0.47
FML Chute	4160	100 CFS	100.00	289.91	291.68		291.84	0.003002	3.27	30.62	22.61	0.49
FML Chute	4160	150 CFS	150.00	289.91	292.11		292.32	0.003001	3.68	40.81	25.17	0.51
FML Chute	4160	200 CFS	200.00	289.91	292.46		292.71	0.002997	3.99	50.17	27.31	0.52
FML Chute	4160	250 CFS	250.00	289.91	292.77		293.05	0.002997	4.24	58.92	29.17	0.53
FML Chute	4160	300 CFS	300.00	289.91	293.05		293.36	0.003000	4.46	67.21	30.83	0.53
FML Chute	4150	50 CFS	50.00	289.88	291.09		291.20	0.003000	2.64	18.91	19.26	0.47
FML Chute	4150	100 CFS	100.00	289.88	291.65		291.81	0.003002	3.27	30.62	22.61	0.49
FML Chute	4150	150 CFS	150.00	289.88	292.08		292.29	0.003001	3.68	40.81	25.17	0.51
FML Chute	4150	200 CFS	200.00	289.88	292.43		292.68	0.002997	3.99	50.17	27.31	0.52
FML Chute	4150	250 CFS	250.00	289.88	292.74		293.02	0.002996	4.24	58.93	29.17	0.53
FML Chute	4150	300 CFS	300.00	289.88	293.02		293.33	0.003000	4.46	67.21	30.83	0.53
FML Chute	4140	50 CFS	50.00	289.85	291.06		291.17	0.003000	2.64	18.91	19.26	0.47
FML Chute	4140	100 CFS	100.00	289.85	291.62		291.78	0.003002	3.27	30.62	22.61	0.49
FML Chute	4140	150 CFS	150.00	289.85	292.05		292.26	0.003001	3.68	40.81	25.17	0.51
FML Chute	4140	200 CFS	200.00	289.85	292.40		292.65	0.002997	3.99	50.17	27.31	0.52
FML Chute	4140	250 CFS	250.00	289.85	292.71		292.99	0.002996	4.24	58.93	29.17	0.53
FML Chute	4140	300 CFS	300.00	289.85	292.99		293.30	0.003000	4.46	67.21	30.83	0.53
FML Chute	4130	50 CFS	50.00	289.82	291.03		291.14	0.003000	2.64	18.91	19.26	0.47
FML Chute	4130	100 CFS	100.00	289.82	291.59		291.75	0.003002	3.27	30.62	22.61	0.49
FML Chute	4130	150 CFS	150.00	289.82	292.02		292.23	0.003001	3.68	40.81	25.17	0.51
FML Chute	4130	200 CFS	200.00	289.82	292.37		292.62	0.002997	3.99	50.17	27.31	0.52
FML Chute	4130	250 CFS	250.00	289.82	292.68		292.96	0.002996	4.24	58.93	29.17	0.53
FML Chute	4130	300 CFS	300.00	289.82	292.96		293.27	0.003000	4.46	67.21	30.83	0.53
FML Chute	4120	50 CFS	50.00	289.79	291.00		291.11	0.003000	2.64	18.91	19.26	0.47
FML Chute	4120	100 CFS	100.00	289.79	291.56		291.72	0.003002	3.27	30.62	22.61	0.49
FML Chute	4120	150 CFS	150.00	289.79	291.99		292.20	0.003001	3.68	40.81	25.17	0.51
FML Chute	4120	200 CFS	200.00	289.79	292.34		292.59	0.002997	3.99	50.17	27.31	0.52
FML Chute	4120	250 CFS	250.00	289.79	292.65		292.93	0.002996	4.24	58.93	29.17	0.53
FML Chute	4120	300 CFS	300.00	289.79	292.93		293.24	0.003000	4.46	67.21	30.83	0.53

FML Chute	4110	50 CFS	50.00	289.76	290.97		291.08	0.003000	2.64	18.91	19.26	0.47
FML Chute	4110	100 CFS	100.00	289.76	291.53		291.69	0.003003	3.27	30.61	22.61	0.49
FML Chute	4110	150 CFS	150.00	289.76	291.96		292.17	0.003002	3.68	40.81	25.17	0.51
FML Chute	4110	200 CFS	200.00	289.76	292.31		292.56	0.002996	3.99	50.17	27.31	0.52
FML Chute	4110	250 CFS	250.00	289.76	292.62		292.90	0.002996	4.24	58.93	29.17	0.53
FML Chute	4110	300 CFS	300.00	289.76	292.90		293.21	0.003000	4.46	67.21	30.83	0.53
FML Chute	4100	50 CFS	50.00	289.73	290.94		291.05	0.003000	2.64	18.91	19.26	0.47
FML Chute	4100	100 CFS	100.00	289.73	291.50		291.66	0.003003	3.27	30.61	22.61	0.49
FML Chute	4100	150 CFS	150.00	289.73	291.93		292.14	0.003002	3.68	40.81	25.17	0.51
FML Chute	4100	200 CFS	200.00	289.73	292.28		292.53	0.002996	3.99	50.17	27.31	0.52
FML Chute	4100	250 CFS	250.00	289.73	292.59		292.87	0.002996	4.24	58.93	29.17	0.53
FML Chute	4100	300 CFS	300.00	289.73	292.87		293.18	0.003000	4.46	67.21	30.83	0.53
FML Chute	4000	50 CFS	50.00	289.43	290.64		290.75	0.002994	2.64	18.92	19.26	0.47
FML Chute	4000	100 CFS	100.00	289.43	291.20	290.60	291.36	0.003007	3.27	30.60	22.61	0.50
FML Chute	4000	150 CFS	150.00	289.43	291.63	290.91	291.84	0.003003	3.68	40.80	25.17	0.51
FML Chute	4000	200 CFS	200.00	289.43	291.98	291.18	292.23	0.002993	3.98	50.19	27.32	0.52
FML Chute	4000	250 CFS	250.00	289.43	292.29		292.57	0.002993	4.24	58.95	29.18	0.53
FML Chute	4000	300 CFS	300.00	289.43	292.57		292.88	0.003001	4.46	67.21	30.83	0.53
FML Chute	3000	50 CFS	50.00	286.43	287.64	287.19	287.75	0.003001	2.64	18.91	19.26	0.47
FML Chute	3000	100 CFS	100.00	286.43	288.20	287.60	288.36	0.003002	3.27	30.62	22.61	0.49
FML Chute	3000	150 CFS	150.00	286.43	288.63	287.91	288.84	0.003004	3.68	40.80	25.17	0.51
FML Chute	3000	200 CFS	200.00	286.43	288.98	288.18	289.23	0.003001	3.99	50.14	27.31	0.52
FML Chute	3000	250 CFS	250.00	286.43	289.29	288.42	289.57	0.003000	4.24	58.90	29.17	0.53
FML Chute	3000	300 CFS	300.00	286.43	289.57	288.64	289.88	0.003004	4.47	67.18	30.82	0.53

PROPEX
GEOSYNTHETICS

Pyramat® Turf Reinforcement Mat

Technical Data Sheet

Roll Sizes - 8.5 ft x 90 ft, 85 sq yd (2.6m x 27.4m, 8.44 sq m)

PYRAMAT high performance turf reinforcement mat (HPTRM) is a three-dimensional, lofty, woven polypropylene geotextile that is available in green or tan which is specially designed for erosion control applications on steep slopes and vegetated waterways. The matrix is composed of polypropylene monofilament yarns featuring X3® technology woven into a uniform configuration of resilient pyramid-like projections. The material exhibits very high interlock and reinforcement capacity with both soil and root systems, demonstrates superior UV resistance, and enhances seedling emergence.

PYRAMAT conforms to the property values listed below[1] and is manufactured at a Propex facility having achieved ISO 9001:2000 certification. Propex performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP).

PRODUCT TEST DATA

Property	Test Method	MARV[2]
Physical		
Mass Per Unit Area	ASTM D-6566	13.5 oz sq yd (455 g sq m)
Thickness	ASTM D-6525	.4 in (10.2 mm)
Light Penetration (% Passing)	ASTM D-6567	10% (10%)
Color	Visual	Green, Tan
Mechanical		
Tensile Strength (Grab)	ASTM D-6818	4000 x 3000 lbs/ft (58.4 x 43.8 kN/m)
Elongation	ASTM D-6818	65% max (65% max)
Resiliency	ASTM D-6524	80% (80%)
Flexibility	ASTM D-6575	.534 in/lbs (615000 mg-cm) avg
Endurance		
UV Resistance @ 6000 hrs	ASTM D-4355	90% (90%)
Performance		
Velocity[3] (Vegetated)	Large Scale	25 ft/sec (7.6 m/sec)
Shear Stress[3] (Vegetated)	Large Scale	15 lbs sq ft (718 Pa)
Manning's "n"[4] (Unvegetated)	Calculated	.028 (.028)
Seedling Emergence	ECTC Draft Method #4	296% (296%)

NOTES

1. The property values listed are effective 08/2006 and are subject to change without notice.
2. MARV indicates minimum average roll value calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed the value reported.
3. Maximum permissible velocity and shear stress has been obtained through vegetated testing programs featuring specific soil types, vegetation classes, flow conditions, and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact Propex for further information.
4. Calculated as typical values from large-scale flexible channel lining test programs with a flow depth of 6 to 12 inches.

Distributed by:

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Phone: (607) 729-5111 (800) 659-5111 Fax: (607) 729-5158

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Type	Thickness m ft	Size mm	d_{50} m ft	velocity m/s ft/sec	velocity m/s ft/sec
Reno mattress	0.15 - 0.17	70 - 100	0.085	3.5	4.2
		70 - 150	0.110	4.2	4.5
	0.23 - 0.25	70 - 100	0.085	3.6	5.5
		70 - 150	0.120	4.5	6.1
	0.30	70 - 120	0.100	4.2	5.5
		100 - 150	0.125	5.0	6.4
Gabions	0.50 1.64	100 - 200	0.150 0.49	5.8 19	7.6 25
		120 - 250	0.190 0.62	6.4 21	8.0 26

Where the revetment has to be placed under water the thickness of the Reno mattress remains the same since it can be launched from a pontoon whereas rip rap has to be increased by 50% [12, 13, 49, 50, 51].

The big reduction in the revetment thickness, which is achieved using Reno mattress instead of rip rap, is of economic significance in protection projects in large rivers, given the same area of work, and, therefore, the quantity of material used.

2.2 Semi permeable and impermeable linings with sand asphalt mastic.

a) General characteristics of sand asphalt mastic grouted Reno mattress.

The combination of the stone filled Reno mattress and sand asphalt mastic has the characteristics of both gabion work and asphalt concrete. The addition of bituminous mastic to the Reno mattress produces a structure which combines the properties and performance of both materials. The mattress retains its flexibility, while the density of the filling is increased and therefore the efficiency of the protection. If all the voids between the stones in the layer are filled and the surface of the mattress covered, the lining will be completely impervious. The mastic also protects the wire mesh against corrosion and from abrasion by transported material.

The wire mesh reinforces the grouted stone layer and gives it strength in tension. Hence, the thickness of the combined structure can be considerably less than that of ordinary mastic grouted stone to withstand the same stresses. The resulting saving in bitumen and aggregate, and the increased flexibility due to the reduced thickness, have given rise to extensive use of this type of lining for protection in a variety of waterways.

b) Mix design of sand asphalt mastic.

To avoid excessive detail, only the fundamental data on mix design is given here. For fuller information, reference should be made to the specific publications listed in the bibliography [5, 6].

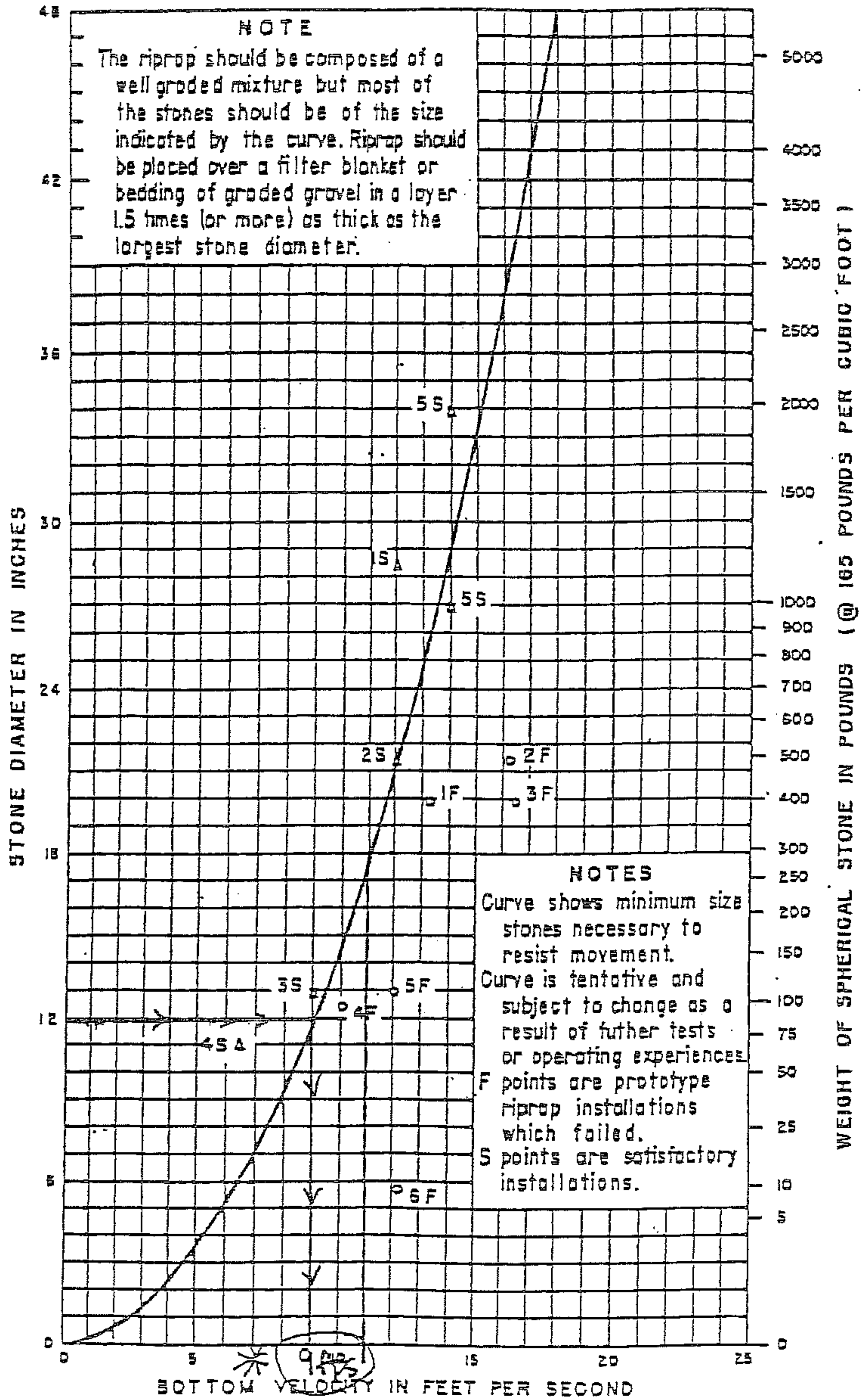


FIGURE 165.—Curve to determine maximum stone size in riprap mixture.

SOURCE: HYDRAULIC DESIGN OF STILLING BASINS AND ENERGY DISSIPATORS. US DEPT OF THE INTERIOR - BUREAU OF LAND RECLAMATION, 1964.

Required: Determine the maximum drainage area for 24-inch and 36-inch diameter letdown pipes using the BCAP computer program.

Method:

1. Determine the maximum flow for 24-inch and 36-inch diameter letdown pipes on the 20% side slope.
2. Determine the maximum drainage areas for the flows calculated in Step 1.

Reference:

1. State of Texas, Department of Transportation, Bridge Division, Hydraulic Manual, March 2004.

Note: The pipe letdown analysis has been performed using "Broken-Back" Culvert Analysis Program (BCAP) which is available from the Federal Highway Administration Web Page:
http://www.dor.state.ne.us/roadway-design/ [follow link to downloadable files and info]

The program was developed to analyze culverts with changing slopes.

Solution:

1. Determine the maximum flow for 24-inch and 36-inch diameter letdown pipes on the 20% side slope.

The following pages include the program outputs for the 24-in diameter culvert and 36-in diameter culvert. Pages IIIF-F-2-27 and IIIF-F-2-32 include rating tables that show if the hydraulic jump occurs within the pipe or not [YES/NO]. The results also include pipe outlet velocity for each flow rate as well as the tailwater depth and velocity in the channel ("Tailwater Velocity").

The flow ratings are used to calculate the maximum allowable top dome drainage area for each pipe size analyzed (Step 2). The maximum flow rate that has hydraulic jump within the culvert is used for allowable drainage area calculations on page IIIF-F-2-36. The computer program does not have corrugated plastic pipe option; therefore, the corrugated metal pipe option has been used with a Manning's Coefficient of 0.024.

The pipe design was analyzed using 10-feet of runout with a -2.5 percent slope at the toe of the 20 percent side slope (See Figures on pages IIIF-F-2-30 and IIIF-F-2-35).

Results:

Q24 =	23.0	cfs	maximum allowable flow in 24-in-dia pipe
Q36 =	26.0	cfs	maximum allowable flow in 36-in-dia pipe

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06 / 17 / 2011

DISCHARGE DATA

Minimum:	15.00 cfs
Design Discharge:	23.00 cfs
Maximum:	25.00 cfs
Number of Barrels:	1

TAILWATER DATA

Type:	Downstream
Channel Shape:	Trapezoid
Left Side Slope:	3 H:1V
Right Side Slope:	3 H:1V
Bottom Width:	6 ft
Bottom Slope:	0.0001 ft/ft
Roughness Coefficient:	0.04

CULVERT DATA

Type:	Circular Pipe
Pipe Diameter:	2 ft
Culvert Material:	Corr. Metal Pipe
Inlet Type:	Mitered to Conform to Slope
Roughness Coefficient:	0.024
Outlet Section Roughness Coeff.:	0.024
Inlet Section Slope:	0.04 ft/ft
Steep Section Slope:	0.2 ft/ft
Outlet Section Slope:	-0.025 ft/ft

CULVERT PROFILE DATA

Type:	Double Broken-Back
Inlet Station:	1490.00 ft
Inlet Elevation:	510.80 ft
Upper Break Station:	1510.00 ft
Upper Break Elevation:	510.00 ft
Lower Break Station:	1760.00 ft
Lower Break Elevation:	460.00 ft
Outlet Station:	1770.00 ft
Outlet Elevation:	460.25 ft

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

Project: Camelot
Station or Location: Lewisville, TX
Date: 06/17/2011

Discharge cfs	Headwater Depth ft	Inlet Control Elevation ft	Break Control Elevation ft	Critical Depth ft	Outlet Depth ft	Outlet Velocity ft/s	Outlet Froude Number	Tailwater Depth ft	Tailwater Velocity ft/s	Hydraulic Jump
16.0	2.52	513.32	513.02	1.41	.74	15.14	3.6	2.45	.49	YES
17.0	2.69	513.49	513.14	1.46	.78	15.12	3.5	2.51	.50	YES
18.0	2.88	513.68	513.27	1.50	.80	15.34	3.5	2.59	.50	YES
19.0	3.07	513.87	513.39	1.54	.82	15.67	3.5	2.65	.51	YES
20.0	3.27	514.07	513.53	1.58	.85	15.85	3.5	2.71	.52	YES
21.0	3.48	514.28	513.67	1.62	.88	15.89	3.4	2.77	.53	YES
22.0	3.71	514.51	513.81	1.66	.90	16.05	3.4	2.83	.54	YES
23.0	3.94	514.74	513.95	1.69	.93	16.19	3.3	2.89	.54	YES
24.0	4.18	514.98	514.10	1.73	.95	16.43	3.3	2.95	.55	YES
25.0	4.43	515.23	514.23	1.77	.97	16.66	3.3	3.01	.55	YES

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06/17/2011

CULVERT DATA

Discharge:	23.0 cfs
Shape:	Circular
Material:	Corr. Metal Pipe
Size:	1-2.0 ft x 2.0 ft
Inlet Type:	Mitered to Conform to Slope

WATER SURFACE PROFILE

Inlet Depth:	1.69 ft
Inlet Velocity:	8.11 ft/s
Upper Break Depth:	1.54 ft
Upper Break Velocity:	8.86 ft/s
Lower Break Depth:	0.90 ft
Lower Break Velocity:	16.77 ft/s
Depth at End of Hydraulic Jump:	2.00 ft
Velocity at End of Hydraulic Jump:	16.19 ft/s
Depth at End of Hydraulic Jump:	2.89 ft
Velocity at End of Hydraulic Jump:	0.54 ft/s

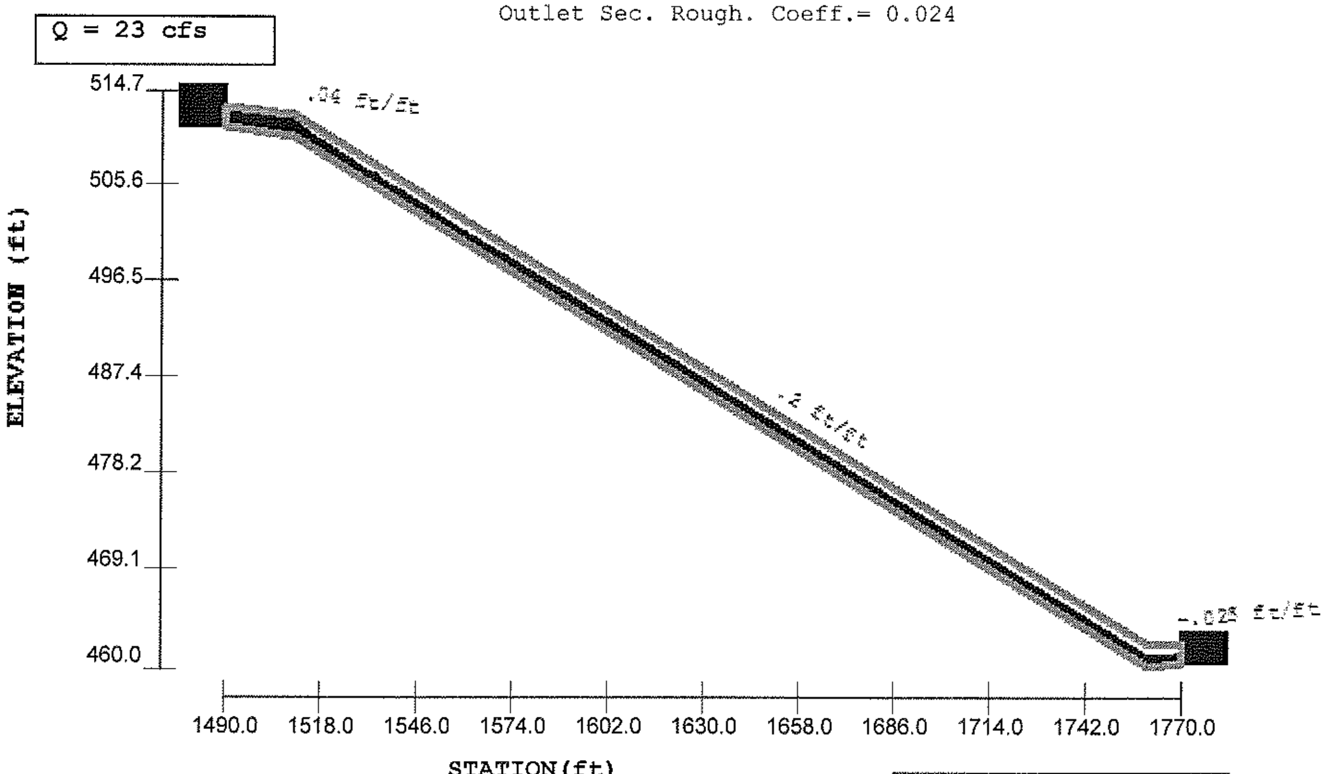
OUTPUT DATA

Head Water Depth:	3.94 ft
Inlet Control Elevation:	514.74 ft
Break Control Elevation:	513.95 ft
Critical Depth:	1.69 ft
Tailwater Depth:	2.89 ft
Hydraulic Jump?	YES
Jump Station:	271.24 ft
Jump Length:	18.59 ft
Outlet Depth:	0.93 ft
Outlet Velocity:	16.19 ft/s
Outlet Froude No.:	3.3

Project: Camelot **Location: Lewisville, TX** **Date: 06/17/**

Circle Pipe Culvert
Diameter=2 ft
Culvert Material: Corr. Metal Pipe

Inlet Type
Mitered to Conform to Slope
Rough. Coeff.= 0.024
Outlet Sec. Rough. Coeff.= 0.024



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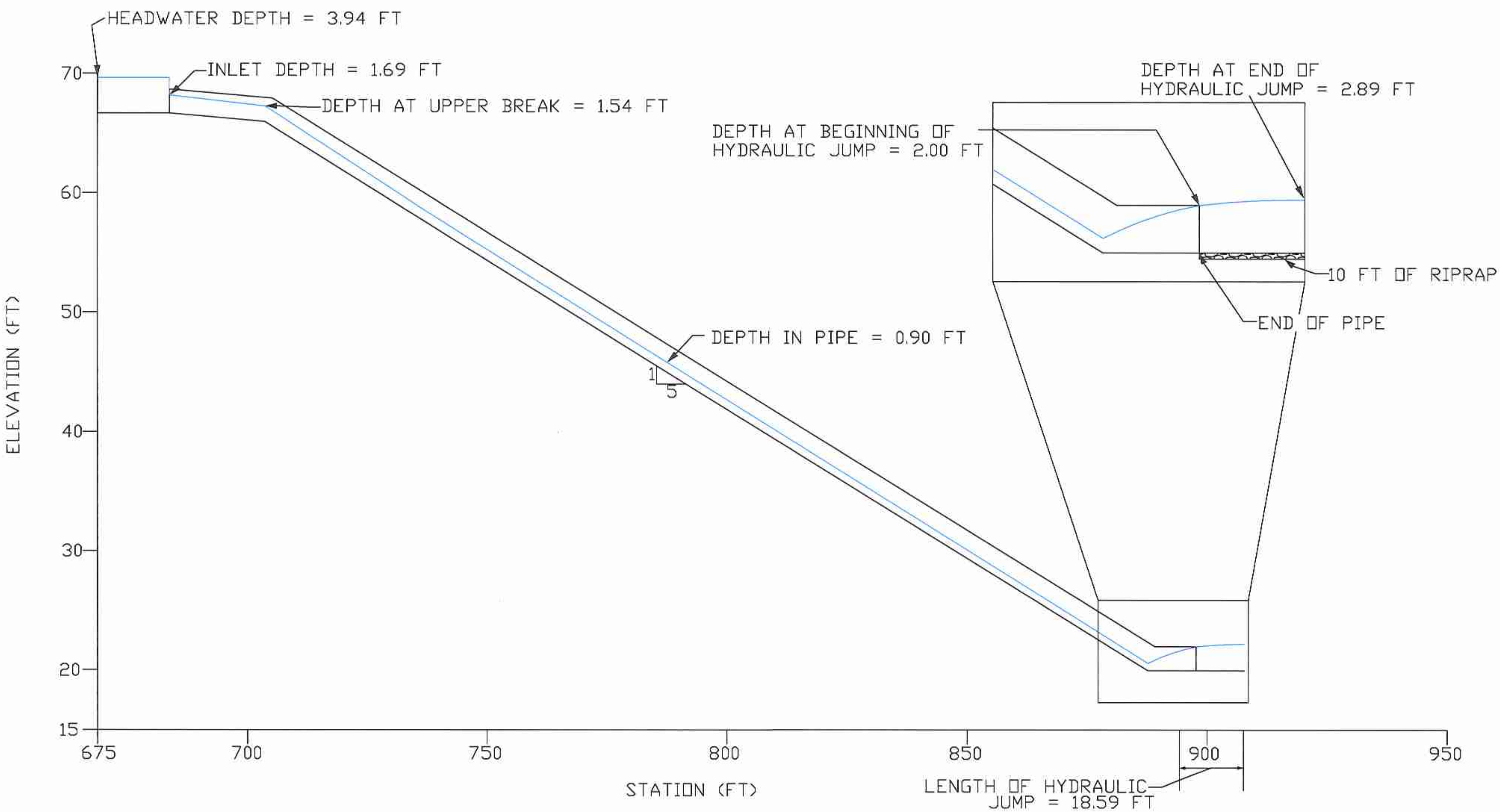
WATER SURFACE PROFILE



NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06 / 17 / 2011

DISCHARGE DATA

Minimum:	20.00 cfs
Design Discharge:	26.00 cfs
Maximum:	30.00 cfs
Number of Barrels:	1

TAILWATER DATA

Type:	Downstream
Channel Shape:	Trapezoid
Left Side Slope:	3 H:1V
Right Side Slope:	3 H:1V
Bottom Width:	6 ft
Bottom Slope:	0.0001 ft/ft
Roughness Coefficient:	0.04

CULVERT DATA

Type:	Circular Pipe
Pipe Diameter:	3 ft
Culvert Material:	Corr. Metal Pipe
Inlet Type:	Mitered to Conform to Slope
Roughness Coefficient:	0.024
Outlet Section Roughness Coeff.:	0.024
Inlet Section Slope:	0.04 ft/ft
Steep Section Slope:	0.2 ft/ft
Outlet Section Slope:	-0.025 ft/ft

CULVERT PROFILE DATA

Type:	Double Broken-Back
Inlet Station:	1490.00 ft
Inlet Elevation:	510.80 ft
Upper Break Station:	1510.00 ft
Upper Break Elevation:	510.00 ft
Lower Break Station:	1760.00 ft
Lower Break Elevation:	460.00 ft
Outlet Station:	1770.00 ft
Outlet Elevation:	460.25 ft

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06/17/2011

Discharge cfs	Headwater Depth ft	Inlet Control Elevation ft	Break Control Elevation ft	Critical Depth ft	Outlet Depth ft	Outlet Velocity ft/s	Outlet Froude Number	Tailwater Depth ft	Tailwater Velocity ft/s	Hydraulic Jump
21.0	2.41	512.97	513.21	1.46	.73	15.89	4.0	2.77	.53	YES
22.0	2.45	513.03	513.25	1.50	.74	16.22	4.1	2.83	.54	YES
23.0	2.50	513.09	513.30	1.53	.76	16.34	4.0	2.89	.54	YES
24.0	2.54	513.15	513.34	1.56	.78	16.43	4.0	2.95	.55	YES
25.0	2.59	513.21	513.39	1.59	.80	16.52	4.0	3.01	.55	YES
26.0	2.63	513.27	513.43	1.63	.82	16.60	3.9	3.07	.56	YES
27.0	2.68	513.33	513.48	1.66	.82	17.24	4.1	3.11	.57	YES
28.0	2.73	513.39	513.53	1.69	.84	17.28	4.0	3.17	.57	YES
29.0	2.77	513.46	513.57	1.72	.86	17.32	4.0	3.23	.57	YES
30.0	2.82	513.52	513.62	1.75	.88	17.35	3.9	3.27	.58	YES

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO	
Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06/17/2011

CULVERT DATA	
Discharge:	26.0 cfs
Shape:	Circular
Material:	Corr. Metal Pipe
Size:	1-3.0 ft x 3.0 ft
Inlet Type:	Mitered to Conform to Slope

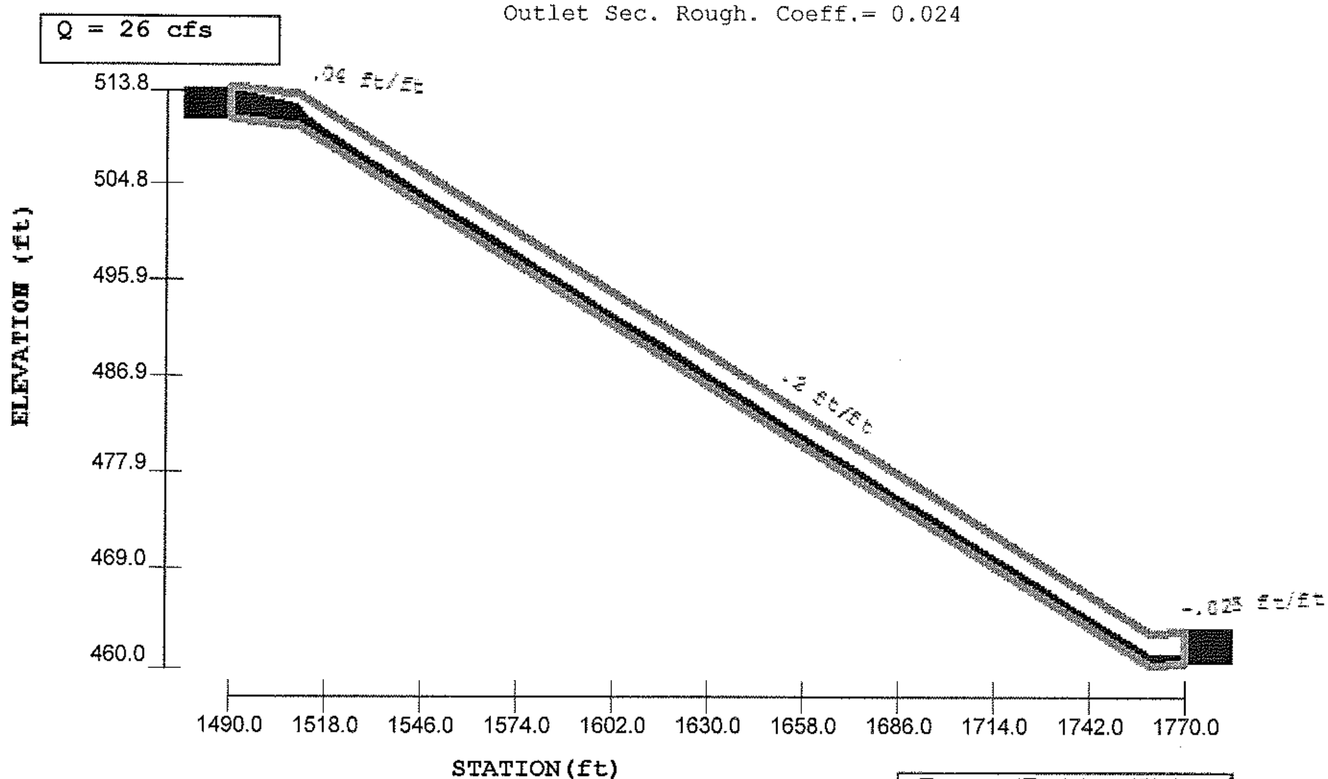
WATER SURFACE PROFILE	
Inlet Depth:	2.70 ft
Inlet Velocity:	3.88 ft/s
Upper Break Depth:	1.63 ft
Upper Break Velocity:	6.64 ft/s
Lower Break Depth:	0.82 ft
Lower Break Velocity:	16.60 ft/s
Depth at End of Hydraulic Jump:	3.00 ft
Velocity at End of Hydraulic Jump:	16.60 ft/s
Depth at End of Hydraulic Jump:	3.07 ft
Velocity at End of Hydraulic Jump:	0.56 ft/s

OUTPUT DATA	
Head Water Depth:	2.63 ft
Inlet Control Elevation:	513.27 ft
Break Control Elevation:	513.43 ft
Critical Depth:	1.63 ft
Tailwater Depth:	3.07 ft
Hydraulic Jump?	YES
Jump Station:	270.00 ft
Jump Length:	19.36 ft
Outlet Depth:	0.82 ft
Outlet Velocity:	16.60 ft/s
Outlet Froude No.:	3.9

Project: Camelot   Location: Lewisville, TX   Date: 06/17/

Circle Pipe Culvert
Diameter=3 ft
Culvert Material: Corr. Metal Pipe

Inlet Type
Mitered to Conform to Slope
Rough. Coeff.= 0.024
Outlet Sec. Rough. Coeff.= 0.024



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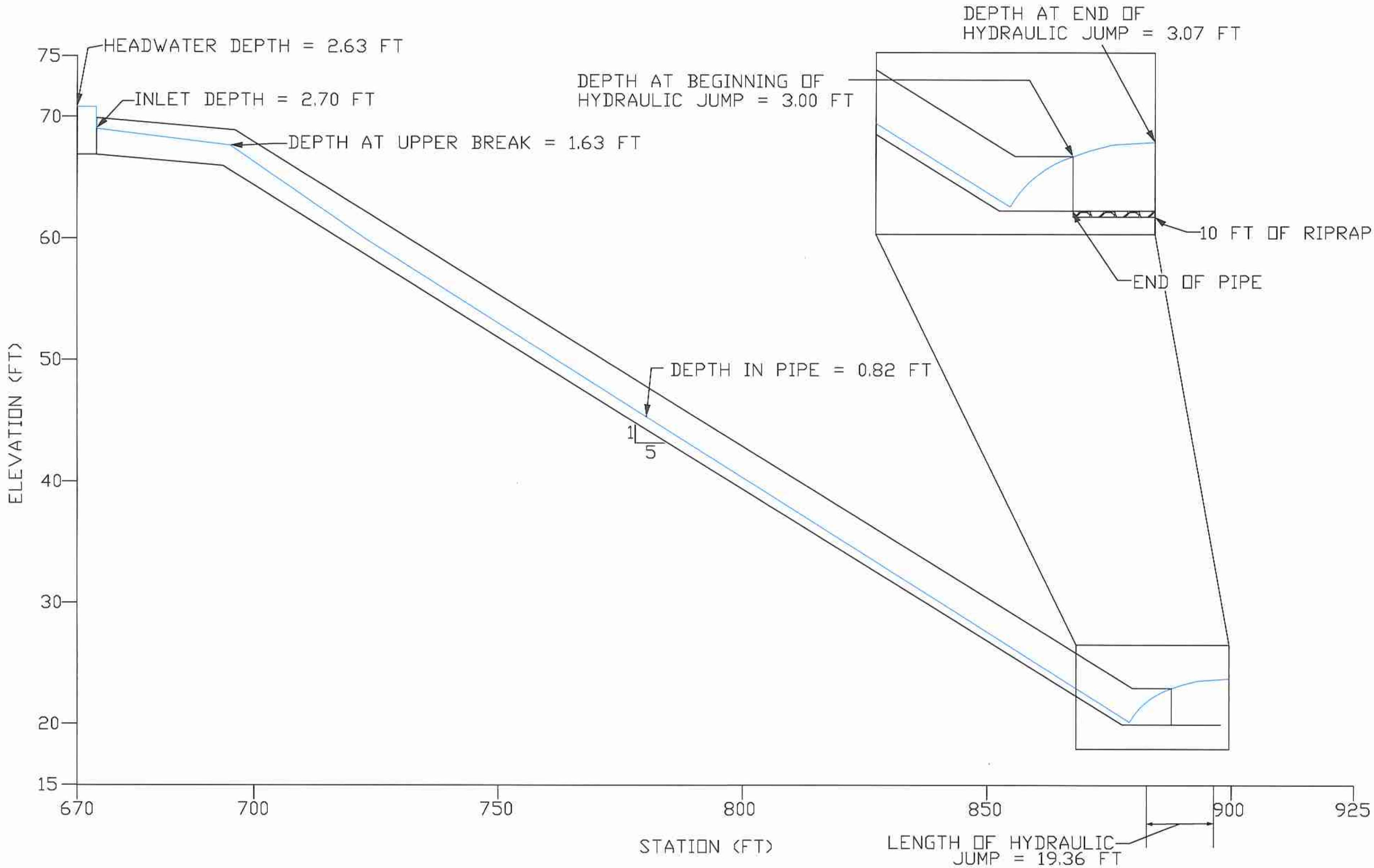
WATER SURFACE PROFILE



2. Determine the maximum drainage areas for the flows calculated in Step 1.

$Q = CIA$

Where: $C = 0.8$ (runoff coefficient, Ref 1.)
$I =$ intensity, in/hr
$A =$ drainage area, ac

$$I = \frac{b}{(t_c + d)^e}$$

$b = 90$
$d = 8.5$
$e = 0.781$

From Ref. 1, for Denton County
25-year storm event

t_c is assumed to be 10 min.

$I = 9.22$ in/hr

$A = Q / (CI)$

Pipe Diameter (in)	Flow (cfs)	Area (ac)
24	23.0	3.1
36	26.0	3.5

Conclusion: The maximum allowable drainage area for a 24-inch diameter letdown pipe is 3.1 acres for each inlet and for a 36-inch diameter letdown pipe is 3.5 acres for each inlet. The minimum berm height is 3 feet for a 24-inch diameter pipe and 4 feet for 36-inch diameter pipe. (Figure 3 details indicate 1 foot berm above the pipe).

Required: Determine the riprap size and dimensions for 24-inch and 36-inch diameter letdown pipes using riprap apron design provided by the Reference 1.

Method:

1. Determine the hydraulic conditions at the outlet of 24-inch and 36-inch diameter letdown pipes using the hydraulic design developed using the BCAP computer simulation.
2. Determine the riprap size and apron dimensions for each pipe letdown

Reference:

1. U.S. Department of Transportation - Federal Highway Administration. Hydraulic Engineering Circular No. 14, Third Edition. *Hydraulic Design of Energy Dissipators for Culverts and Channels*. Publication No. FHWA-NHI-06-086, July 2006.

Solution:

1. Determine the hydraulic parameters from pages IIIF-F-2-28 (pipe diameter 24-inches) and IIIF-F-2-33 (pipe diameter 36-inches):

Parameter	Symbol	24-inch Dia. Culvert	36-inch Dia. Culvert
Design flow rate, cfs	Q	23.0	26.0
Pipe Diameter, ft	D	2	3
Depth at the pipe outlet, ft	y_n	0.93	0.82
Adjusted culvert rise, ft	D'	1.465	1.91
Tailwater Depth[1], ft	TW	2	3

[1]Tailwater depth is the pipe diameter when the calculated tailwater depth is higher per Reference 1.

$$D_{50} = 0.2 \times D\left[\frac{Q}{\sqrt{g} \times D^{2.5}}\right]^{4/3} \times \left[\frac{D}{TW}\right]$$ Eq. 10.4 (page 10-17 of Ref. 1)

$$D' = \frac{D + y_n}{2}$$ Eq. 10.5 (page 10-17 of Ref. 1)

D_{50} = Riprap size in feet

Riprap Classes and Apron Dimensions[1]

Class	D_{50} (in)	Apron Length[2] (ft)	Apron Depth (ft)
1	5	4xD'	$3.5xD_{50}$
2	6	4xD'	$3.3xD_{50}$
3	10	5xD'	$2.4xD_{50}$
4	14	6xD'	$2.2xD_{50}$
5	20	7xD'	$2.0xD_{50}$
6	22	8xD'	$2.0xD_{50}$

[1]This table has been reproduced from Table 10.1 included on page 10-18 of Reference 1.

[2]D' is the culvert rise.

Design Parameter	24-inch Dia. Culvert	36-inch Dia. Culvert
D_{50}, calculated, inches =	4.7	2.6
D_{50}, selected, inches =	5	5
Apron Length, calculated, feet =	5.86	7.64
Apron Length, selected, feet =	10	10
Apron Depth, calculated, inches =	17.5	17.5
Apron Depth, selected, inches =	18	18

Conclusion:

Riprap sizes for pipe diameters of 24-inches and 36-inches are selected conservatively. The calculated apron length is increased to 10 feet in the design. The apron depth used is higher than the calculated apron depth. Therefore, the design of the pipe letdown outlet energy dissipater calculations are acceptable and channels at the pipe outlets will be stable.

Required: Determine the maximum drainage area for 24-inch and 36-inch diameter letdown pipes using the BCAP computer program.

Method:
1. Determine the maximum flow for 24-inch and 36-inch diameter letdown pipes on the 25% side slope.
2. Determine the maximum drainage areas for the flows calculated in Step 1.

Reference:
1. State of Texas, Department of Transportation, Bridge Division, Hydraulic Manual, March 2004.

Note: The pipe letdown analysis has been performed using "Broken-Back" Culvert Analysis Program (BCAP) which is available from the Federal Highway Administration Web Page:
http://www.dor.state.ne.us/roadway-design/ [follow link to downloadable files and info]

The program was developed to analyze culverts with changing slopes.

Solution:
1. Determine the maximum flow for 24-inch and 36-inch diameter letdown pipes on the 25% side slope.

The following pages include the program outputs for the 24-in dia culvert and 36-in diameter culvert. Pages IIIF-F-2-41 and IIIF-F-2-46 include rating tables that show if the hydraulic jump occurs within the pipe or not [YES/NO]. The results also include pipe outlet velocity for each flow rate as well as the tailwater depth and velocity in the channel ("Tailwater Velocity").

The flow ratings are used to calculate the maximum allowable top dome drainage area for each pipe size analyzed (Step 2). The maximum flow rate that has hydraulic jump within the culvert is used for allowable drainage area calculations on page IIIF-F-2-50. The computer program does not have corrugated plastic pipe option; therefore, the corrugated metal pipe option has been used with a Manning's Coefficient of 0.024.

The pipe design was analyzed using 10-feet of runout with a -2.5 percent slope at the toe of the 25 percent sideslope (See Figures on pages IIIF-F-2-44 and IIIF-F-2-49).

Results:

Q24 =	16.0	cfs	maximum allowable flow in 24-in-dia pipe
Q36 =	21.0	cfs	maximum allowable flow in 36-in-dia pipe

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06 / 17 / 2011

DISCHARGE DATA

Minimum:	10.00 cfs
Design Discharge:	16.00 cfs
Maximum:	20.00 cfs
Number of Barrels:	1

TAILWATER DATA

Type:	Downstream
Channel Shape:	Trapezoid
Left Side Slope:	3 H:1V
Right Side Slope:	3 H:1V
Bottom Width:	6 ft
Bottom Slope:	0.0001 ft/ft
Roughness Coefficient:	0.04

CULVERT DATA

Type:	Circular Pipe
Pipe Diameter:	2 ft
Culvert Material:	Corr. Metal Pipe
Inlet Type:	Mitered to Conform to Slope
Roughness Coefficient:	0.024
Outlet Section Roughness Coeff.:	0.024
Inlet Section Slope:	0.04 ft/ft
Steep Section Slope:	0.25 ft/ft
Outlet Section Slope:	-0.025 ft/ft

CULVERT PROFILE DATA

Type:	Double Broken-Back
Inlet Station:	1490.00 ft
Inlet Elevation:	510.80 ft
Upper Break Station:	1510.00 ft
Upper Break Elevation:	510.00 ft
Lower Break Station:	1710.00 ft
Lower Break Elevation:	460.00 ft
Outlet Station:	1720.00 ft
Outlet Elevation:	460.25 ft

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06/17/2011

Discharge cfs	Headwater Depth ft	Inlet Control Elevation ft	Break Control Elevation ft	Critical Depth ft	Outlet Depth ft	Outlet Velocity ft/s	Outlet Froude Number	Tailwater Depth ft	Tailwater Velocity ft/s	Hydraulic Jump
11.0	1.83	512.63	512.48	1.17	.62	13.41	3.6	2.03	.45	YES
12.0	1.95	512.75	512.58	1.22	.65	13.55	3.5	2.13	.45	YES
13.0	2.08	512.88	512.69	1.27	.69	13.66	3.4	2.21	.47	YES
14.0	2.22	513.02	512.80	1.32	.72	13.75	3.4	2.29	.48	YES
15.0	2.36	513.16	512.91	1.37	.74	14.33	3.5	2.37	.48	YES
16.0	2.52	513.32	513.02	1.41	.77	14.48	3.4	2.45	.49	YES
17.0	2.69	513.49	513.14	1.46	.80	14.49	3.3	2.51	.50	YES
18.0	2.88	513.68	513.27	1.50	.83	14.72	3.3	2.59	.50	YES
19.0	3.07	513.87	513.39	1.54	.86	14.82	3.2	2.65	.51	YES
20.0	3.27	514.07	513.53	1.58	.89	14.91	3.2	2.71	.52	YES

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06/17/2011

CULVERT DATA

Discharge:	16.0 cfs
Shape:	Circular
Material:	Corr. Metal Pipe
Size:	1-2.0 ft x 2.0 ft
Inlet Type:	Mitered to Conform to Slope

WATER SURFACE PROFILE

Inlet Depth:	1.41 ft
Inlet Velocity:	6.75 ft/s
Upper Break Depth:	1.19 ft
Upper Break Velocity:	8.24 ft/s
Lower Break Depth:	0.70 ft
Lower Break Velocity:	16.33 ft/s
Depth at End of Hydraulic Jump:	2.00 ft
Velocity at End of Hydraulic Jump:	14.48 ft/s
Depth at End of Hydraulic Jump:	2.45 ft
Velocity at End of Hydraulic Jump:	0.49 ft/s

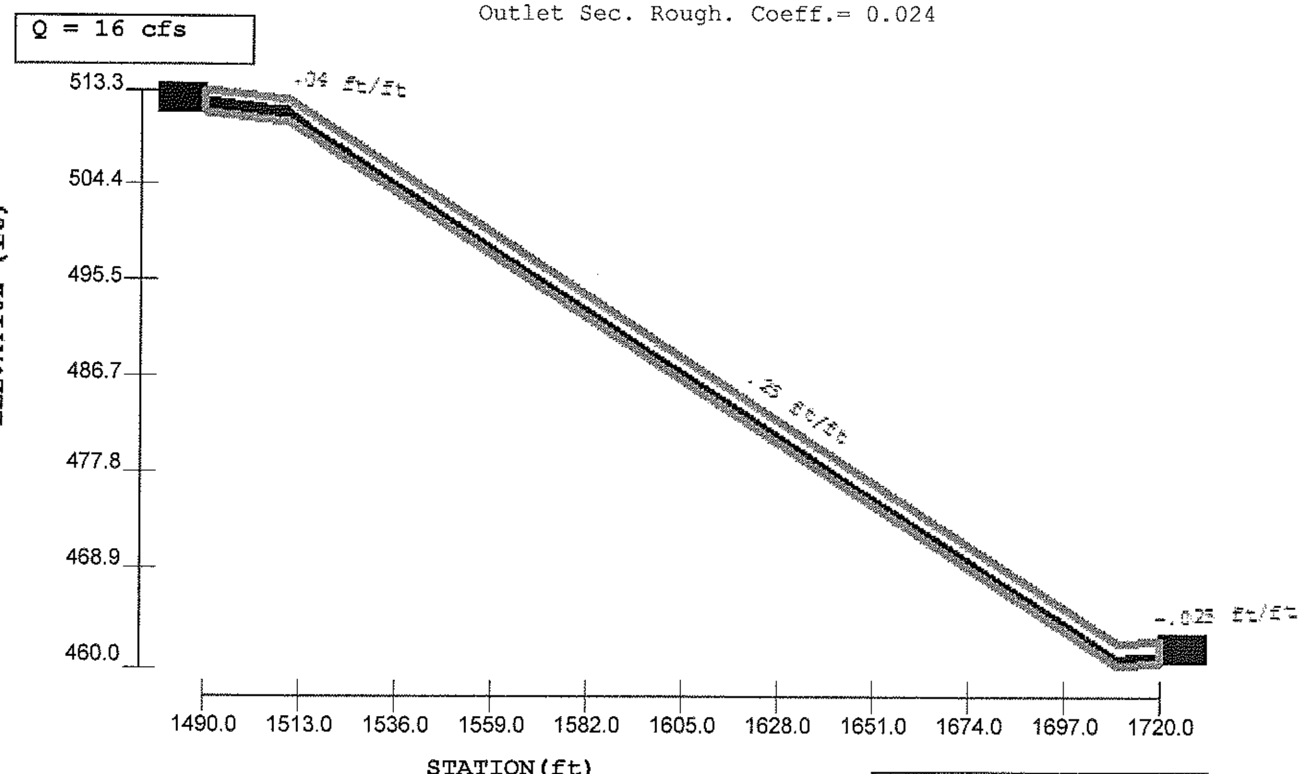
OUTPUT DATA

Head Water Depth:	2.52 ft
Inlet Control Elevation:	513.32 ft
Break Control Elevation:	513.02 ft
Critical Depth:	1.41 ft
Tailwater Depth:	2.45 ft
Hydraulic Jump?	YES
Jump Station:	223.58 ft
Jump Length:	15.64 ft
Outlet Depth:	0.77 ft
Outlet Velocity:	14.48 ft/s
Outlet Froude No.:	3.4

Project: Camelot **Location: Lewisville, TX** **Date: 06/17/**

Circle Pipe Culvert
Diameter=2 ft
Culvert Material: Corr. Metal Pipe

Inlet Type
Mitered to Conform to Slope
Rough. Coeff.= 0.024
Outlet Sec. Rough. Coeff.= 0.024



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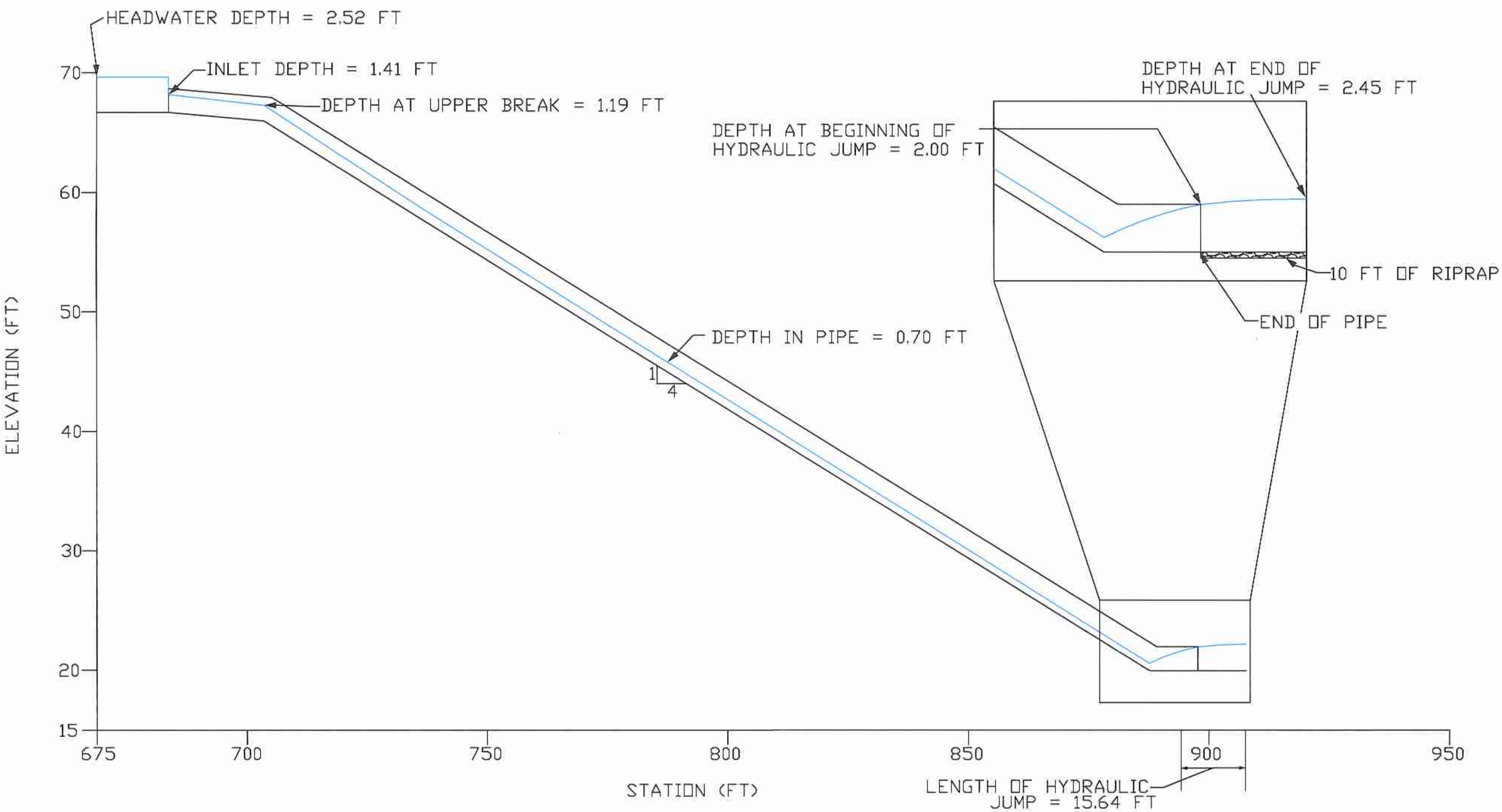
WATER SURFACE PROFILE



NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO

Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06 / 17 / 2011

DISCHARGE DATA

Minimum:	20.00 cfs
Design Discharge:	21.00 cfs
Maximum:	30.00 cfs
Number of Barrels:	1

TAILWATER DATA

Type:	Downstream
Channel Shape:	Trapezoid
Left Side Slope:	3 H:1V
Right Side Slope:	3 H:1V
Bottom Width:	6 ft
Bottom Slope:	0.0001 ft/ft
Roughness Coefficient:	0.04

CULVERT DATA

Type:	Circular Pipe
Pipe Diameter:	3 ft
Culvert Material:	Corr. Metal Pipe
Inlet Type:	Mitered to Conform to Slope
Roughness Coefficient:	0.024
Outlet Section Roughness Coeff.:	0.024
Inlet Section Slope:	0.04 ft/ft
Steep Section Slope:	0.25 ft/ft
Outlet Section Slope:	-0.025 ft/ft

CULVERT PROFILE DATA

Type:	Double Broken-Back
Inlet Station:	1490.00 ft
Inlet Elevation:	510.80 ft
Upper Break Station:	1510.00 ft
Upper Break Elevation:	510.00 ft
Lower Break Station:	1710.00 ft
Lower Break Elevation:	460.00 ft
Outlet Station:	1720.00 ft
Outlet Elevation:	460.25 ft

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

Project: Camelot
Station or Location: Lewisville, TX
Date: 06/17/2011

Discharge cfs	Headwater Depth ft	Inlet Control Elevation ft	Break Control Elevation ft	Critical Depth ft	Outlet Depth ft	Outlet Velocity ft/s	Outlet Froude Number	Tailwater Depth ft	Tailwater Velocity ft/s	Hydraulic Jump
21.0	2.41	512.97	513.21	1.46	.72	16.10	4.1	2.77	.53	YES
22.0	2.45	513.03	513.25	1.50	.75	15.92	4.0	2.83	.54	YES
23.0	2.50	513.09	513.30	1.53	.77	16.19	4.0	2.89	.54	YES
24.0	2.54	513.15	513.34	1.56	.78	16.43	4.0	2.95	.55	YES
25.0	2.59	513.21	513.39	1.59	.80	16.67	4.0	3.01	.55	YES
26.0	2.63	513.27	513.43	1.63	.83	16.46	3.9	3.07	.56	YES
27.0	2.68	513.33	513.48	1.66	.85	16.39	3.8	3.11	.57	YES
28.0	2.73	513.39	513.53	1.69	.86	16.72	3.8	3.17	.57	YES
29.0	2.77	513.46	513.57	1.72	.87	17.04	3.9	3.23	.57	YES
30.0	2.82	513.52	513.62	1.75	.91	16.69	3.7	3.27	.58	YES

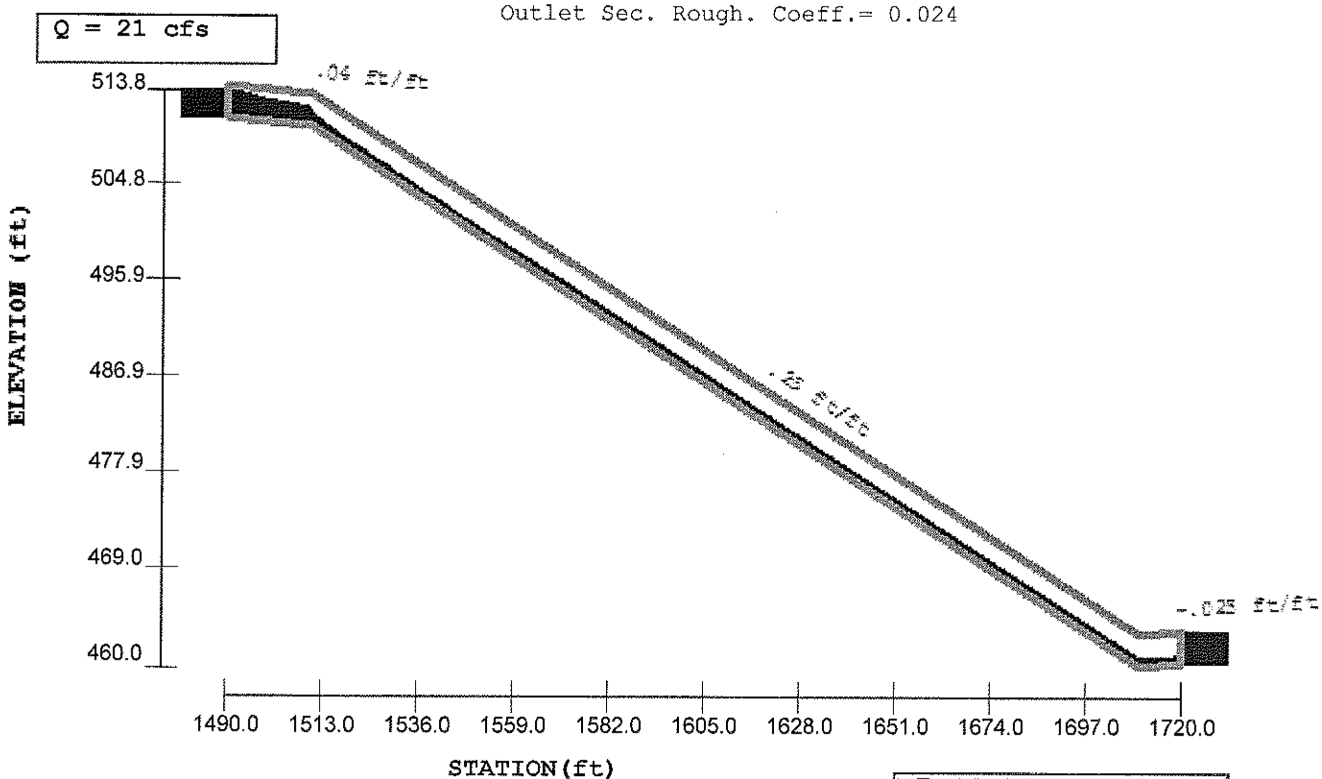
NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO	
Project:	Camelot
Station or Location:	Lewisville, TX
Date:	06/17/2011
CULVERT DATA	
Discharge:	21.0 cfs
Shape:	Circular
Material:	Corr. Metal Pipe
Size:	1-3.0 ft x 3.0 ft
Inlet Type:	Mitered to Conform to Slope
WATER SURFACE PROFILE	
Inlet Depth:	2.49 ft
Inlet Velocity:	3.35 ft/s
Upper Break Depth:	1.46 ft
Upper Break Velocity:	6.14 ft/s
Lower Break Depth:	0.69 ft
Lower Break Velocity:	17.10 ft/s
Depth at End of Hydraulic Jump:	2.77 ft
Velocity at End of Hydraulic Jump:	16.10 ft/s
Depth at End of Hydraulic Jump:	2.77 ft
Velocity at End of Hydraulic Jump:	0.53 ft/s
OUTPUT DATA	
Head Water Depth:	2.41 ft
Inlet Control Elevation:	512.97 ft
Break Control Elevation:	513.21 ft
Critical Depth:	1.46 ft
Tailwater Depth:	2.77 ft
Hydraulic Jump?	YES
Jump Station:	222.06 ft
Jump Length:	17.81 ft
Outlet Depth:	0.72 ft
Outlet Velocity:	16.10 ft/s
Outlet Froude No.:	4.1

Project: Camelot Location: Lewisville, TX Date: 06/17/

Circle Pipe Culvert
Diameter=3 ft
Culvert Material: Corr. Metal Pipe

Inlet Type
Mitered to Conform to Slope
Rough. Coeff.= 0.024
Outlet Sec. Rough. Coeff.= 0.024



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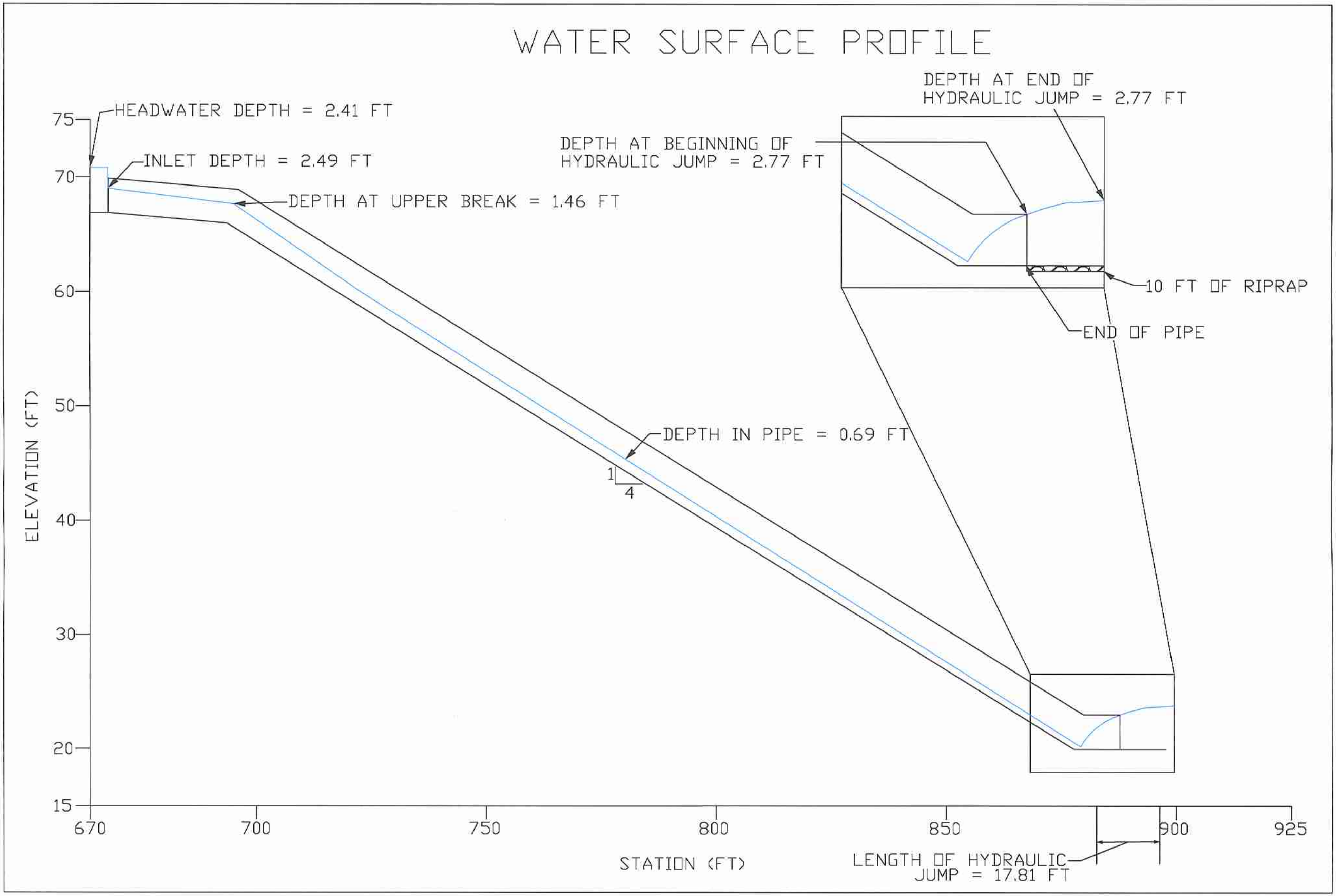

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2. Determine the maximum drainage areas for the flows calculated in Step 1.

$$Q = CIA$$

Where: C= 0.8 (runoff coefficient, Ref 1.)
I = intensity, in/hr
A= drainage area, ac

$$I = \frac{b}{(t_c + d)^e}$$

b = 90 From Ref. 1, for Denton County
d = 8.5 25-year storm event
e = 0.781
t_c is assumed to be 10 min.

I = 9.22 in/hr

$$A = Q / (CI)$$

Pipe Diameter (in)	Flow (cfs)	Area (ac)
24	16.0	2.2
36	21.0	2.8

Conclusion: The maximum allowable drainage area for a 24-inch diameter letdown pipe is 2.2 acres for each inlet and for a 36-inch diameter letdown pipe is 2.8 acres for each inlet. The minimum berm height is 3 feet for a 24-inch diameter pipe and 4 feet for 36-inch diameter pipe. (Figure 3 details indicate 1 foot berm above the pipe).

Required: Determine the Riprap size and Dimensions for 24-inch and 36-inch diameter letdown pipes using Riprap Apron Design provided by the Reference 1.

Method:

1. Determine the hydraulic conditions at the outlet of 24-inch and 36-inch diameter letdown pipes using the hydraulic design developed using the BCAP computer simulation.
2. Determine the riprap size and apron dimensions for each pipe letdown

Reference:

1. U.S. Department of Transportation - Federal Highway Administration. Hydraulic Engineering Circular No. 14, Third Edition. *Hydraulic Design of Energy Dissipators for Culverts and Channels*. Publication No. FHWA-NHI-06-086, July 2006.

Solution:

1. Determine the hydraulic parameters from pages IIIF-F-2-42 (pipe diameter 24-inches) and IIIF-F-2-47 (pipe diameter 36-inches):

Parameter	Symbol	24-inch Dia. Culvert	36-inch Dia. Culvert
Design flow rates, cfs	Q=	16.0	21.0
Pipe Diameters, ft	D=	2	3
Depth at the pipe outlet, ft	y_n=	0.77	0.72
Adjusted culvert rise, ft	D'=	1.385	1.86
Tailwater Depth[1], ft	TW=	2.00	3.00

[1]Tailwater depth is the pipe diameter when the calculated tailwater depth is higher per Reference 1.

$$D_{50} = 0.2 \times D\left[\frac{Q}{\sqrt{g} \times D^{2.5}}\right]^{4/3} \times \left[\frac{D}{TW}\right]$$ Eq. 10.4 (page 10-17 of Ref. 1)

$$D' = \frac{D \times y_n}{2}$$ Eq. 10.5 (page 10-17 of Ref. 1)

D_{50} = Riprap Size in feet

Riprap Classes and Apron Dimensions[1]

Class	D_{50} (in)	Apron Length[2] (ft)	Apron Depth (ft)
1	5	4xD	$3.5xD_{50}$
2	6	4xD	$3.3xD_{50}$
3	10	5xD	$2.4xD_{50}$
4	14	6xD	$2.2xD_{50}$
5	20	7xD	$2.0xD_{50}$
6	22	8xD	$2.0xD_{50}$

[1]This table has been reproduced from Table 10.1 included on page 10-18 of Reference 1.

[2]D is the culvert rise.

Design Parameter	24-inch Dia. Culvert	36-inch Dia. Culvert
D_{50}, calculated, inches =	3.1	2.0
D_{50}, selected, inches =	5	5
Apron Length, calculated, feet =	5.54	7.44
Apron Length, selected, feet =	10	10
Apron Depth, calculated, inches =	17.5	17.5
Apron Depth, selected, inches =	18	18

Conclusion:

Riprap sizes for pipe diameters of 24-inches and 36-inches are selected conservatively. The calculated apron length is increased to 10 feet in the design. The apron depth used is higher than the calculated apron depth. Therefore, the design of the pipe letdown outlet energy dissipater calculations are acceptable and channels at the pipe outlets will be stable.

APPENDIX IIIF-F-3

SEDIMENT CONTROL POND DESIGN

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

2-28-12

Includes Pages IIIF-F-3-1 through IIIF-F-3-7

SEDIMENT CONTROL POND DESIGN

This appendix includes supporting information for the sedimentation pond sizing procedure presented on Sheet IIIF-F-12 (refer to Section 2.2 of the Erosion Control Plan for All Phases of Development). In the event that certain percent ground cover that limits the soil loss to 50/tons/acres/year is not achieved and soil loss is temporarily greater than 50 tons/acre/year, a sedimentation pond will be used along with other structural and non-structural BMPs approved as part of this plan to limit the discharge of eroded soil. The sedimentation pond option is a secondary erosion control option, similar to mulch, wood chips, compost, or straw/hay, and will only be used if the required percent vegetation specification is not met. If the sedimentation pond option is implemented, the swales and letdowns specified will remain in-place. The sedimentation pond option simply allows for the control of sediment while vegetation is being established. The pond design procedure has been developed for reducing discharge of eroded soil to less than the allowable amount for external side slopes (i.e., 50 tons/acre/year) if the required percent vegetation coverage is not obtained soil loss is greater than 50 tons/acre/year. The stormwater sedimentation pond design provided is for a 25-year frequency storm event. This provides for a conservative design because the efficiency of the pond will be higher for more frequent storms (e.g., one year frequency). The example calculation included on pages IIIF-F-3-2 through IIIF-F-3-6 demonstrates that a 0.5-acre detention pond is capable of reducing the discharge of 60 tons/acre/year of soil to less than 50 tons/acre/year of soil from the external slopes for a 20-acre area. A factor has been calculated that will be used to determine the required pond size for a specified external slope area. For a summary of the efficiencies of ponds for various required soil loss reduction amounts, refer to Sheet IIIF-F-12 – Sediment Control Pond Plan as well as the table on page IIIF-F-3-7.

Required: Develop a procedure to size a sedimentation pond to reduce sediment discharge from the external embankment area to 50 tons/acre/year or less.

Method:

1. Determine the 25-year frequency peak flow rate upstream of the sediment control pond using the Rational Method.
2. Calculate the settling velocity of sediment particles using Stokes equation.
3. Calculate the fraction of sediment trapped under dynamic conditions.
4. Calculate the fraction of sediment trapped under quiescent conditions.
5. Calculate the total fraction of sediment trapped under combined conditions.
6. Verify that pond design is adequate to reduce given soil loss to 50 tons/acre/year or less.

Reference:

1. State of Texas, Department of Transportation, Bridge Division, Hydraulic Manual, 3rd Edition, December 1985.
2. Chin, David. A. Water-Resources Engineering. Prentice Hall, Inc., 2000.
3. Haan, C.T., et al. Design Hydrology and Sedimentology for Small Catchments, 1994.
4. Cooperative Studies Section, Hydrologic Serices Division. U.S. Department of Commerce. *Technical Paper No. 40.*

Solution:

1. Determine the 25-year frequency peak flow rate upstream of the sediment control pond.

$$Q = CIA$$

Where:
C= 0.8 (runoff coefficient, Ref. 1)
I = intensity (in/hr)
A= upstream drainage area (ac)

Note: A runoff coefficient of 0.8 is used for all areas regardless of slope.

$$I = \frac{b}{(t_c + d)^e}$$

b = 90
d = 8.5
e = 0.781

From Ref. 1, for Denton County 25-year frequency storm event

t_c is assumed to be 10 min.

I = 9.22 in/hr

A = 20.0 acres

Q = 147.47 cfs

2. Calculate the settling velocity, V_s (ft/hr), of sediment particles using Stokes equation.

$$V_s = \frac{\alpha\,(\rho_s/\rho_w - 1)\,g\phi^2}{18 v_w} \qquad \text{(Ref. 2)}$$

Where:

α = factor that measures the effect of particle shape (assume spherical, $\alpha = 1$)
ρ_s = density of sediment particle (pcf)
ρ_w = density of ambient water (62.4 pcf)
g = gravity (32.2 ft/s^2)
ϕ = particle diameter (ft)
v_w = kinematic viscosity of the ambient water (ft^2/s)

α = 1
ρ_s = 165 pcf
v_w = 1.08E-05 ft^2/s

Particle Class[1]	Percent in Class	Particle Diameter[2] (ft)	Settling Velocity, V_s (ft/hr)
1	10	1.31E-05	0.17
2	20	1.97E-05	0.38
3	30	2.62E-05	0.68
4	20	3.28E-05	1.06
5	20	3.94E-05	1.52
Total	**100**		

[1] Particle class corresponds to particle diameter.

[2] Particle diameter ranges from 4μm to 12μm, which is typical for clay and silt particles.

3. Calculate the fraction of sediment trapped under dynamic conditions.

a. Determine the overflow rate.

$V_c = Q/A_p$ (EPA Pond Performance Model from Ref. 3)

Where:

V_c = overflow rate
A_p = area of sediment control pond (ac)

Q = 147.47 cfs (from Step 2)
A_p = 0.50 acre

V_c = 24.38 ft/hr

b. Determine the fraction of sediment removed.

$F = 1 - (1 + 1/\beta * V_s/V_c)^{-\beta}$ (Ref. 3)

Where:

F = single-storm trapping of sediment
β = turbulence or short-circuiting parameter reflecting non-ideal performance of pond (assume good performance, β = 3)

β = 3

$D_R = L_F [(1/CV_Q^2) / (1/CV_Q^2 - \ln(E_m/L_F))]^{(1/CVQ^{\wedge}2)+1}$ (Ref. 3)

Where:

D_R = long-term dynamic removal fraction for stormwater
L_F = removal ratio for very low flow rates
E_m = mean storm removal fraction
CV_Q = coefficient of variation of flows

L_F = 1
E_m = assume equals single-storm trapping, F
CV_Q = 1.74 (from Table 9B.1, p. 570, Ref. 3)

Table 1 - Summary for Dynamic Conditions

Particle Class	Percent in Class	Particle Diameter (ft)	Settling Velocity, V_s (ft/hr)	Single-storm Trapping, F	Fraction Removed Over All Storms, D_R	Fraction Captured Under Dynamic Conditions, E_D[1]
1	10	1.31E-05	0.17	0.007	0.025	0.25
2	20	1.97E-05	0.38	0.015	0.031	0.62
3	30	2.62E-05	0.68	0.027	0.037	1.11
4	20	3.28E-05	1.06	0.042	0.043	0.87
5	20	3.94E-05	1.52	0.060	0.050	1.00
Total	**100**					**3.8**

[1] E_D is the product of percent in class and D_R.

4. Calculate the fraction of sediment trapped under quiescent conditions.

$$RR = \frac{T_{IA} V_s A_Q}{V_R}$$ (Ref. 3)

$$V_R = RA$$

Where:

RR = removal ratio
T_{IA} = average time interval between storms (hr)
V_s = settling velocity (ft/hr) from Step 2
A_Q = average surface area under quiescent conditions (ft^2)
V_R = mean runoff volume (ft^3)
R = runoff depth for 25-year, 24-hour storm (ft)
A = upstream drainage area (ac)

A_Q = 21,780 ft^2 (assume equal to A_p)
T_{IA} = 108 hrs (from Table 9B.1, p. 570 of Ref. 3)
R = 0.61 ft (Ref. 4)
A = 20.0 ac (from Step 1)

V_R = 529,980 ft^3

Table 2 - Summary for Quiescent Conditions

Particle Class	Percent in Class	Settling Velocity, V_s (ft/hr)	Removal Ratio, RR (ft^3/hr)	Effective Volume Ratio, V_E/V_R[1]	Fraction Removed Under Quiescent Conditions[2]	Fraction Captured Under Quiescent Conditions, E_Q
1	10	0.17	0.75	0.120	0.12	1.20
2	20	0.38	1.69	0.130	0.12	2.40
3	30	0.68	3.00	0.140	0.13	3.90
4	20	1.06	4.68	0.145	0.14	2.80
5	20	1.52	6.74	0.150	0.15	3.00
Total	**100**					**13.3**

[1] Based on Figure 9.29 from Ref. 3, using RR and V_B/V_R.

V_B = reservoir volume = 87,120 ft^3, assuming a 0.5-acre pond with an average depth of 4 feet.

V_B/V_R = 0.164

[2] Based on Figure 9.30 from Ref. 3 with CV_R = 1.74.

5. Calculate the total fraction of sediment trapped under combined conditions, E_T.

$$E_T = 1 - (1 - E_D) * (1 - E_Q)$$ (Ref. 3)

E_T = 16.6 %

Refer to page IIIF-F-3-7 for the total efficiency of ponds for different soil loss reduction amounts.

6. Verify that pond design is adequate to reduce given soil loss to 50 tons/acre/year or less.

   a. Calculate net soil loss (i.e., sediment not captured by pond).

Total Soil Loss =	60.0	tons/ac/yr	
E_T =	16.6	%	(from Step 5)

Net Soil Loss = Total Soil Loss x (1 - E_T/100)

Net Soil Loss = 50.0 tons/ac/yr

Refer to page IIIF-F-3-7 for the net soil loss for different soil loss reduction amounts.

   b. Calculate the required pond size per unit drainage area factor.

Drainge Area =	20.0	acres	(from Step 1)
Pond Area =	0.5	acres	(from Step 3)

Required Pond Size / Unit Drainage Area Factor = 0.025

This factor was calculated using a drainage area of 20 acres and a pond area of 0.5 acres. If a 40-acre drainage area drains to the pond, then a 1.0-acre pond will be required to achieve the above efficiency and net soil loss estimate (40 acres x 0.025 = 1.0 acre). Refer to page IIIF-F-3-7 for the required pond size/unit drainage area factor for different soil loss reduction amounts.

Conclusion:

A 0.5-acre pond will sufficiently capture enough sediment from a 20-acre drainage area so that no more than 50 tons/acre/year of net soil loss occurs on external embankment slopes. If the size of the drainage area changes, this procedure will need to be updated. Refer to the table on page IIIF-F-3-7 for a summary of the pond efficiencies and net soil loss estimates for different soil loss reduction amounts.

Prep By: CRM
Date: 2/21/2012

CAMELOT LANDFILL
1339-351-11-02
SEDIMENT CONTROL POND DESIGN

Chkd By: RCE
Date: 2-28-12

SEDIMENT CONTROL POND SUMMARY

External Slope Area Soil Loss (Tons/Acre/Year)	Percent Efficiency of Pond (Dynamic Conditions)	Percent Efficiency of Pond (Quiescent Conditions)	Total Efficiency of Pond (%)	Net Soil Loss (Tons/Acre/Year)	Pond Area Required Per Unit Drainage Area[1]	50 Tons/Acre/Year or Less?
60	3.8	13.3	16.6	50.0	0.025	YES
70	4.6	25.5	28.9	49.8	0.040	YES
80	5.4	34.0	37.6	49.9	0.060	YES
90	6.0	41.5	45.0	49.5	0.075	YES
100	7.2	46.4	50.3	49.7	0.110	YES
200	13.3	71.2	75.0	49.9	0.300	YES

[1] This factor multiplied by a given drainage area will give the required pond size to achieve the efficiencies shown in the table.