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UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

December 20, 2012

UN#12-152

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3,
RAI No. 328, Flooding Protection Requirements

References:

1) Surinder Arora (NRC) to Paul Infanger (UniStar Nuclear Energy), "Final RAI 328 RHEB 6186" email dated November 28, 2011

2) UniStar Nuclear Energy Letter UN#12-044, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Requests for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 325, Information Systems Important to Safety: RAI 325, Information Systems Important to Safety, RAI 328, Flooding Protection Requirements, RAIs 287, 330, RAI 331, RAI 332, RAI 336, Ultimate Heat Sink, RAIs 333, 339, Other Seismic Category I Structures, RAI 337, Initial Plant Test Program - Design Certification and New License Applicants, and RAI 340, Functional Design Qualification and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints, dated May 18, 2012

The purpose of this letter is to respond to the request for additional information (RAI) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated November 28, 2011 (Reference 1). This RAI addresses Flooding Protection Requirements, as discussed in Section

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2.4.10 of the Final Safety Analysis Report (FSAR), as submitted in Part 2 of the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA), Revision 8.

Reference 2 indicated that a response to RAI 328, Question 02.04.10-1 would be provided to the NRC by December 20, 2012. Enclosure 1 provides our response to RAI No. 328, Question 02.04.10-1, and includes revised COLA content. Enclosure 2 provides the COLA impact of the response to RAI 328, Question 02.04.10-1. A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA.

Enclosure 3 provides a table of changes to the CCNPP Unit 3 COLA associated with the RAI 328 response. As identified in the Enclosure 3 table of changes, this response modifies a previously submitted change associated with the CCNPP Unit 3 COLA Revision 5 submittal.

Our response does not include any new regulatory commitments. This letter does not contain any sensitive or proprietary information.

If there are any questions regarding this transmittal, please contact me at (410) 369-1907 or Mr. Wayne A. Massie at (410) 369-1910.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 20, 2012

Mark T. Finley

Enclosures:
1) Response to NRC Request for Additional Information, RAI No. 328, Question 02.04.10-1, Flooding Protection Requirements, Calvert Cliffs Nuclear Power Plant, Unit 3

2) Changes to CCNPP Unit 3 COLA Associated with the Response to RAI No. 328, Question 02.04.10-1, Calvert Cliffs Nuclear Power Plant, Unit 3

3) Table of Changes to CCNPP Unit 3 COLA Associated with the Response to RAI No. 328, Question 02.04.10-1, Calvert Cliffs Nuclear Power Plant, Unit 3

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Laura Quinn-Willingham, NRC Environmental Project Manager, U.S. EPR COL Application
Amy Snyder, NRC Project Manager, U.S. EPR DC Application, (w/o enclosures)
Patricia Holahan, Acting Deputy Regional Administrator, NRC Region II, (w/o enclosures)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2,
David Lew, Deputy Regional Administrator, NRC Region I (w/o enclosures)

Enclosure 1

Response to NRC Request for Additional Information, RAI No. 328, Question 02.04.10-1, Flooding Protection Requirements Calvert Cliffs Nuclear Power Plant, Unit 3

RAI No 328

Question 02.04.10-1

In accordance with 10 CFR 52.79(a)(1)(iii) and General Design Criteria (GDC) 2, the ultimate heat sink (UHS) must be able to withstand natural phenomena without the loss of function. The U.S. Evolutionary Power Reactor (EPR) Final Safety Analysis Report (FSAR) Section 2.4.10 states that "[a] COL applicant that references the U.S. EPR design certification will use site-specific information to compare the location and elevations of safety-related facilities, and of structures and components required for protection of safety-related facilities, with the estimated static and dynamic effects of the design basis flood conditions." Further, EPR FSAR Section 2.4.12 states that "[a] COL applicant that references the U.S. EPR design certification will provide site-specific information ... to establish the effects of groundwater on plant structures." Because the UHS makeup water intake structure and the associated safety-related piping system that provides water to the UHS cooling tower basins from 72 hours to 30 days post-accident is outside the scope of the U.S. EPR design certification, the NRC staff requests that the COL applicant provide quantified information in the CCNPP FSAR (e.g., pipe burial depth, pipe layout figures, etc) demonstrating that the UHS system and associated safety-related piping system are protected from adverse effects of natural phenomena including flooding from local intense precipitation, storm surge, tsunami, ice formation, and groundwater (dynamic/hydrostatic forces, scour, freezing, sedimentation, etc).

Response

The CCNPP Unit 3 UHS makeup water system is comprised of the Unit 3 inlet located in the Units 1 & 2 intake forebay, two intake pipes, the UHS makeup water intake structure, common forebay, and four UHS makeup water pipes that deliver water from the intake structure to the Essential Service Water Buildings (ESWBs).

In response to this RAI question, the potential effects of the following natural phenomena on the Ultimate Heat Sink (UHS) makeup water system are evaluated:

- Scour due to flooding from local intense precipitation
- Scour due to storm surge flooding
- Scour due to tsunami flooding
- Ice formation/freezing
- Dynamic/hydrostatic forces
- Sedimentation

The effect of groundwater on the site-specific Seismic Category I structures including the UHS makeup water intake, forebay and buried piping is addressed in FSAR 3.8.4.

CCNPP Unit 3 FSAR Figure 3.8-3 provides a schematic site plan of Seismic Category I buried utilities (underground piping). As discussed in FSAR Subsection 3.8.4.1.9, two buried intake pipes run from the CCNPP Unit 3 inlet area to the CCNPP Unit 3 forebay (FSAR Figure 2.4-49). Four UHS makeup water pipes emanate from the UHS makeup water intake structure and terminate at the ESWBs. These pipes run within the utility corridor as shown in FSAR Figure 3.8-3, and pass under the main Haul Road which runs in the East-West (plant north) direction adjacent to the North (plant north) side of the CCNPP Unit 3 power block.

The placement of the buried pipes is discussed in FSAR Section 3.8.4. As shown in the updated COLA FSAR Appendix 3E, Figure 3E-7 and Figure 3E-8, prepared in response to

RAI No. 333, Question 03.08.04-29[1]., the burial depth (depth measured from pipe centerline to grade elevation) of the two intake pipes varies from 25 ft at the Unit 3 inlet to 27 ft at the Unit 3 forebay. For the four UHS makeup water pipes within the utility corridor from the Unit 3 intake structure to the ESWBs, the burial depth is 6 ft-9 in. The pipes are buried well below the frost line depth, which is about 2 ft for the area (Response Reference a), to prevent any freezing problem.

The protections provided for these buried pipes against each of the above stated natural phenomena are discussed below:

SCOUR DUE TO FLOODING FROM LOCAL INTENSE PRECIPITATION

A hydrologic and hydraulic analysis is performed to evaluate the impacts of the local intense precipitation, also referred to as the local Probable Maximum Precipitation (PMP) event, on the UHS makeup water system. The flood flow velocities were estimated to determine the scour potential and the required protection for the buried piping. The underground UHS makeup water piping is buried within the utility corridor along the Haul Road as shown in FSAR Figure 3.8-3.

FSAR Subsection 2.4.2 describes the methodologies and procedures to determine the effects of local intense precipitation on the CCNPP Unit 3 site. The design basis for the local intense precipitation event is the all-season 1-square mile (or point) PMP as obtained from the U.S. National Weather Service (NWS) Hydro-meteorological Report Number 51 (Response Reference b) and Report Number 52 (Response Reference c). FSAR Table 2.4-18 presents the 1 square mile PMP depths for various durations at the CCNPP site.

The runoff analysis is performed assuming that underground storm drains and culverts within the contributing drainage areas are clogged and not functioning during the local PMP storm event. The Natural Resources Conservation Service (NRCS) (formerly known as the Soil Conservation Service) methodologies and the U.S. Army Corps of Engineers (USACE) computer program HEC-HMS are used to determine peak discharges in the drainage swales. Water surface elevations and flow velocities along the flow paths during the PMP event are determined using the USACE computer program HEC-RAS.

The general layout of CCNPP Unit 3, Haul Road, utility corridor, the UHS makeup water intake and the Unit 3 forebay are shown in Figure 1 (Enclosure 2, Figure 2.4-7A). There are two storm water swales located on both sides of the Haul Road that run in the southwest to northeast direction and discharge into the Chesapeake Bay as shown in Figures 2 (Enclosure 2, Figure 2.4-7B) and 3 (Enclosure 2, Figure 2.4-7C). The southeast swale is about 1,810 ft long, the upper reach of which drains to a stormwater catch basin as shown in Figure 2 and the lower reach starts at approximately 100 ft downstream. The northwest swale is about 1,220 ft long, and there is a stretch of about 650 ft between the upper and lower reaches where there is no well-defined channel. The utility corridor begins downstream of the stormwater catch basin and runs along the south edge of the Haul Road and then crosses the Haul Road approximately 125 ft downstream of the junction box (Figure 3). The swales are trapezoidal in shape with a bottom width of 3 ft, side slopes of

[1] UniStar Nuclear Energy Letter UN#12-104, from Mark T. Finley to Document Control Desk, U.S. NRC; Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 333, Other Seismic Category I Structures, dated December 20, 2012

3(H):1(V) and an average depth of 3 ft. The swales have an average slope of 3.5% and are initially designed to be protected with grass and stabilization matting.

The contributing drainage areas for the runoff in the swales are delineated from the topography contours, as shown in Figure 4 (Enclosure 2, Figure 2.4-7D). A total drainage area of 174.28 ac (0.2723 mi^2), of which 50.26 ac (0.0785 mi^2) from the Unit 3 Power block and 124.02 ac (0.1938 mi^2) from Units 1 & 2 and the Haul Road, drains to the two swales, which eventually discharge to the Chesapeake Bay.

The NRCS method as described in the TR-55 Manual (Response Reference d) was used to estimate the times of concentration (Tc) for the various sub-basins. To account for non-linearity effects during extreme flood condition, the computed Tc was reduced by 25%, in accordance with guidance from EM-1110-2-1417 of USACE (Response Reference e). The lag time, estimated as 60% of Tc, and the local intense precipitation depths presented in FSAR Table 2.4-18, were input to the HEC-HMS computer model (Response Reference e). American Nuclear Society, ANSI/ANS-2.8-1992 standard (Response Reference f) requires that, prior to the PMP event, an event equivalent to the 40% PMP has occurred, with 3 to 5 dry days between the events, leaving the ground saturated. To simulate saturated ground conditions, all areas are conservatively assumed to be impervious, and a NRCS runoff curve number of 98 for impervious surfaces, regardless of the soil type, was used in the model. The NRCS dimensionless unit hydrograph option for the developments of the peak discharges from the various sub-basins in HEC-HMS was utilized. The hydrographs are routed through the reaches using lag method. A schematic of the HEC-HMS model is given in Figure 5 (Enclosure 2, Figure 2.4-7E) and the resulting peak discharges for the sub-basins and model junctions are presented in Table 1 (Enclosure 2, Table 2.4-17A).

Water surface elevations and flow velocities at the swales for the PMP flood event are determined using the USACE computer program HEC-RAS (Response Reference g). The two swales and the Haul Road are modeled as one single river channel. The Haul Road centerline is used as the river line and 37 cross-sections representing both swales are defined along the flow path, as shown in Figure 6 (Enclosure 2, Figure 2.4-7F). The HEC-RAS model cross sections are delineated from the topographic contours and have spacing varying from 35 ft to 92.6 ft. Additional cross sections, as needed, are created with HEC-RAS, by linearly interpolating cross sections between the developed cross sections. The effects of buildings are represented in the model using ineffective areas.

Manning's roughness coefficient "n" for both swales and over bank areas are estimated based on values described in Table 5-6 of Chow's Open-Channel Hydraulics (Response Reference h). Swale linings consist of grass and stabilization matting for which a Manning's n value of 0.04 is selected, in accordance with the Maryland Department of Environment's (MDE) Standard and Specifications for Soil Erosion and Sediment Control Manual (Response Reference i). Area cover for over bank areas consists of grass, grass with stabilization matting, wooded, pavement and water, which are assigned Manning's n values as summarized in Table 2 (Enclosure 2, Table 2.4-17B).

The swales discharge to Chesapeake Bay at the downstream end. The swales have a fairly steep gradient with an average slope of 3.5%. The PMP flow is modeled for a mixed flow regime, which requires the specification of downstream and upstream boundary conditions. There is no known hydraulic control in the upstream, therefore, a normal depth condition is specified for the upstream boundary. At the downstream end where the swales discharge into the Chesapeake Bay, the elevation drops off significantly. As such, a critical depth condition is specified for the downstream boundary. The boundary conditions used in the HEC-RAS model are summarized in Table 3 (Enclosure 2, Table 2.4-17C).

Based on the hydraulic simulations, the range of flow velocities in the swales that are primarily grass-lined with stability matting is from 5.1 ft/s to 20.5 ft/s. The lower part of the swales has velocities greater than 10 ft/s. These values are higher than the permissible velocity of 8.5 ft/s for channels lined with grass and stability matting (Response Reference i) and will lead to potential erosion and scouring. In order to protect the UHS pipeline from potential scouring during a PMP event, two options are evaluated: (a) use of check dams on the swales to reduce the flow velocities, and (b) use of concrete lining to protect the swales from scouring due to the high flow velocities.

The effectiveness of check dams to slow down the scouring velocities are simulated with a HEC-RAS model that assumes that the swales are lined with grass and stabilization matting, for which a Manning's n value of 0.04 is assigned. Check dams of 1 ft wide and heights varying from 0.8 ft to 3 ft are placed at a nominal spacing of 60 ft. The top of the check dams are selected to be no higher than the edge of the Haul Road so as to avoid overtopping the road during regular, more frequent, storm events. Due to the high PMP flood flow and resulting high flooding stage along the swales, the relatively low profile of the check dam is found to be ineffective in reducing the flow velocities. The predicted flow velocities remain significantly higher than 8.5 ft/s, the permissible velocity for grass-lined channel with stabilization matting.

For the range of flow velocities, it is determined that the drainage swales, as well as the Haul Road, need to be lined with concrete to resist the erosive forces. A HEC-RAS model simulation is conducted with a Manning's n of 0.013 for the channel representing concrete lining for the swales. The predicted velocities range from 5.5 to 24.2 ft/s, which are within the permissible velocity of 30 ft/s or more for concrete lined channels. Table 4 (Enclosure 2, Table 2.4-17D) provides the summary results of the maximum water surface elevation and channel velocities for the PMP event. Figure 7 (Enclosure 2, Figure 2.4-7G) shows the water surface profile.

As part of the stormwater management design, stone check dams that are nominally 2 ft in height and spaced at 40 ft apart will be placed on the concrete lined swales to reduce the flow velocities during more frequent and regular storm events.

Beyond the utility corridor along the Haul Road, the four UHS makeup water pipes will continue toward the power block until ESWBs as shown in FSAR Figure 3.8-4. Within the power block, erosion and scour over the buried piping is not expected due to the site grading being of mild slope and resulting low velocities along drainage swale and channels. For the section of makeup water pipe crossing between the Unit 3 flood wall and the northwest edge of Unit 3 power block (Figure 1), concrete lining over the pipeline crossing will be provided as a conservative measure to resist scour.

SCOUR DUE TO STORM SURGE FLOODING

Probable maximum surge and seiche flooding on the Chesapeake Bay as a result of the probable maximum hurricane (PMH) is discussed in FSAR Section 2.4.5. The probable maximum storm surge (PMSS) water level is estimated to be at Elevation 17.6 ft (5.35 m)

NGVD 29 at the CCNPP Unit 3 site. Wave action from coincident winds associated with the storm surge produce a wave run-up height of 16.3 ft (4.96 m) NGVD 29 above the PMSS resulting in a maximum flood level of Elevation 33.9 ft (10.31 m) NGVD 29 at the CCNPP Unit 3 UHS makeup water intake area.

The grade elevation of the UHS makeup intake structure area is at Elevation 10.0 ft (3.0 m) NGVD 29 and the UHS makeup water intake structure will experience flooding as a result of the PMH, as described in FSAR Section 2.4.5. The PMSS and coincident wave run-up water level at the CCNPP Unit 3 site produce the highest potential water levels on the Chesapeake Bay and become the design basis flood elevation for the CCNPP Unit 3 UHS makeup intake structure area. The UHS makeup water intake structure is provided with flood protection measures such as water tight doors, roof vents, and piping and conduit penetrations. Flood protection measures are discussed in FSAR Section 2.4.10. The two buried intake pipes from the Unit 3 inlet area to the UHS makeup water intake structure, and the four buried ESW makeup water pipelines from the UHS makeup water intake to the power block will be fully protected against scour due to hurricane induced storm surge events.

Scour Protection for Safety-Related Intake Pipes

The equivalent cube length for the median rock size (D_{n50}) for riprap protection along the shoreline covering the safety-related intake pipes and surrounding the UHS Intake Structure is calculated as approximately 3.28 ft (1 meter (m)). The D_{n50} was calculated according to the methods given in the USACE Coastal Engineering Manual (CEM). This analysis follows a conservative approach of sizing the riprap which would remain stable on the 3 horizontal to 1 vertical (3H:1V) slope behind the UHS Intake Structure during the peak PMSS water level and wave conditions. A significant wave height of 10.9 ft (3.31 m) was used for this analysis. Riprap size based on this condition is conservative for scour protection over the buried intake pipes due to the following reasons:

- According to Figure 10 (Enclosure 2, Figure 2.4-49A), the slope behind the UHS Intake Structure is steeper than the shoreline below, where the intake pipes are buried. This steeper slope will need a larger riprap size for a given wave condition.
- The maximum significant wave height, which occurs at the peak PMH wave level, is larger than the maximum wave height that could occur for intermediate water levels where the wave would break at the shoreline near the buried intake pipes.

The additional design details for placement of the riprap are given on Figure 11 (Enclosure 2, Figure 2.4-49B) on the slope behind the UHS makeup water intake structure and over the buried intake pipes and UHS makeup water pipes from the intake structure and along the shoreline.

SCOUR DUE TO TSUNAMI FLOODING

FSAR Section 2.4.6 describes the derivation of the probable maximum tsunami (PMT) water level. The maximum water level associated with a PMT at the CCNPP Unit 3 site is 3.8 ft (1.2 m) NGVD 29. This is much lower than the flood level due to the PMH and thus the potential scour due to tsunami is enveloped by the potential scour due to storm surge (Item 2 above).

ICE FORMATION/FREEZING

The Unit 3 inlet area is sheltered from the Chesapeake Bay by the existing Units 1 & 2 forebay baffle wall and the new Unit 3 sheet pile wall. Due to the submerged entrance of water under the existing baffle wall, surface ice in the Chesapeake Bay has no effect on the cooling water supply at the Unit 3 makeup water intake pipe inlets. A further discussion on the formation of surface ice and the potential for an ice jam can be found in FSAR Section 2.4.7. In addition, as described in this response, the intake piping from Unit 3 inlet and piping from UHS makeup water intake structure to ESWBs are buried below the frost line and will not be subject to ice formation and freezing.

DYNAMIC/HYDROSTATIC FORCES

The static and dynamic flood forces that the CCNPP Unit 3 UHS makeup water intake structure will encounter during a PMH event include: the static water pressure from the maximum flood elevation, uplift pressures on the pump deck as well as uplift pressures on the entire intake structure, and dynamic wave forces on the structure walls and roof. A detailed description of these forces and other design basis loadings including seismic loadings, and the structural measures incorporated to withstand them, is found in FSAR Section 3.8.

The CCNPP Unit 3 UHS makeup water intake structure is offset from the Chesapeake Bay shoreline as shown on Figure 9. Makeup water to the CCNPP Unit 3 common forebay is conveyed from the Chesapeake Bay via two safety-related buried intake pipes. The intake pipes withdraw water from Chesapeake Bay in an inlet area protected by the existing Units 1 and 2 intake baffle wall and a sheet pile wall, as shown on Figure 8. The bottom elevation within the inlet area is maintained at an elevation of approximately -26 ft (-6.1 m). At Unit 3 inlet area, the new sheet pile wall is designed to withstand the maximum significant wave height of 10.9 ft (3.31 m). The water level was conservatively set such that the top of the wave aligned with the top of the sheet pile wall, thus maximizing the impact force from the wave. The resulting hydrodynamic pressure diagram for the Sheet Pile Wall is shown in Figure 10.

In conclusion, the new Unit 3 sheet pile wall is designed to withstand the dynamic/hydrostatic forces. The UHS makeup water pipes are buried and will not be impacted by the dynamic/hydrostatic forces.

SEDIMENTATION

During a storm surge event, the wave runup on the shoreline could overtop the site grade of 10 ft NGVD 29 at the UHS makeup water intake area. The overtopping waves could bring sediment and debris into the Unit 3 common forebay (shown in FSAR Figure 2.4-49) which has a top of wall elevation at 11.5 ft NGVD 29. To prevent ingress of sediment or debris, a cover system will be provided for the Unit 3 forebay, as shown in Figure 12 (Enclosure 2, Figure 2.4-49C).

As described in FSAR 2.4.10, the entrance of the intake pipes that withdraw water from Chesapeake Bay are in an inlet area protected by the existing Units 1and 2 intake baffle wall and a sheet pile wall which are illustrated in FSAR Figure 2.4-49. The bottom elevation within the inlet area is maintained at an elevation of approximately -26 ft (6.1 m). The inlets are protected by a security barrier and bars that will be designed to withstand probable maximum hurricane (PMF) conditions. The security barrier and bars include a raking mechanism and extends from the deck elevation of approximately 11.5 ft (3.5 m) to an elevation of approximately -20 ft (6.1 m) near the intake pipe inlet offering protection from debris and water-borne projectiles. In addition, suspended sediments flowing toward the CCNPP Unit 3 intakes would travel through the opening underneath the Units 1 and 2 forebay baffle wall and would likely deposit in the CCNPP Unit 3 inlet area sheltered by the baffle wall and the sheet pile wall. Because the inlets are elevated about 10 ft (3.05 m) above the bed elevation, blockage of intake pipes due to sedimentation is highly unlikely.

The effects of sediment and debris on UHS makeup water system from tsunami flooding are negligible as described in FSAR Subsections 2.4.6.9 and 2.4.6.10.

RESPONSE REFERENCES

a) Calvert County Code, Section R301, July, 2011.

b) U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Hydrometeorological Report No. 51, *Probable Maximum Precipitation Estimates, United States East of the 105th Meridian,* June 1978.

c) U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Hydrometeorological Report No. 52, *Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian,* August 1982.

d) U.S. Department of Agriculture, Soil Conservation Service (now known as Natural Resources Conservation Service), Technical Release 55, *Urban Hydrology for Small Watershed,* June 1986.

e) U.S. Army Corps of Engineers, EM 1110-2-1417, *Flood-Runoff Analysis*, August 1994.U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-HMS, Hydrologic Modeling System, Version 3.5, August 2010.

f) American Nuclear Society, ANSI/ANS-2.8-1992, *Determining Design Basis Flooding at Power Reactor Sites*, July 1992.

g) U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS, River Analysis System, Version 4.1.0, January 2010.

h) Chow, Ven Te, Open-Channel Hydraulics, 1959.

i) Maryland Department of the Environment Water Management Administration (MDE), Maryland Standards and Specifications for Soil Erosion and Sediment Control, December 2011.

Table 1 PMP Peak Discharges

Hydrologic Element	Drainage Area	Time of Concentration	Peak Discharge	Time of Peak*	Volume
	(mi^2)	(min)	(cfs)	ddmmmyyyy, hh:mm	(in)
Subbasin-1	0.0436	14.4	1068.9	15Aug2012, 00:40	18.24
Junction-1	0.0436	-	1068.9	15Aug2012, 00:40	18.24
Reach-1	0.0436	-	1068.9	15Aug2012, 00:40	18.24
Subbasin-2	0.0234	8.1	641.2	15Aug2012, 00:35	18.24
Junction-2	0.067	-	1695.2	15Aug2012, 00:40	18.24
Reach-2	0.067	-	1695.2	15Aug2012, 00:40	18.24
Subbasin-3	0.0255	6.3	831.2	15Aug2012, 00:35	18.24
Junction-3	0.0925	-	2306.3	15Aug2012, 00:40	18.24
Reach-3	0.0925	-	2306.3	15Aug2012, 00:40	18.24
Subbasin-4	0.0288	10.8	783.2	15Aug2012, 00:40	18.24
Junction-4	0.1213	-	3089.5	15Aug2012, 00:40	18.24
Subbasin-5	0.0176	6.3	573.7	15Aug2012, 00:35	18.24
Junction-5	0.1389	-	3511.2	15Aug2012, 00:40	18.24
Subbasin-6	0.0318	11.7	847.6	15Aug2012, 00:40	18.24
Subbasin-61	0.0203	5.4	727.1	15Aug2012, 00:35	18.24
Junction-6	0.0521	-	1376.7	15Aug2012, 00:35	18.24
Subbasin-8	0.0028	5.0	103.2	15Aug2012, 00:35	18.24
Junction-7	0.1938	-	4900.4	15Aug2012, 00:35	18.24

* The PMP storm control specifications are arbitrarily set to start on 15 August 2012, 00:00 and end on 15 August 2012, 06:00.

Table 2 Manning's n values

Surface Cover	Selected Manning's n-values
Asphalt	0.016
Channel Lining (grass with soil stabilization)	0.04
Grass with Soil Stabilization	0.04
Short Grass	0.03
Trees	0.1

Table 3 HEC-RAS Model Boundary Conditions

Boundary	Model Boundary Condition
Upstream	Normal Depth (0.057 ft/ft)
Downstream	Critical Depth

Table 4 Maximum water surface elevations and channel velocities

Cross Section	Profile	Cumulative Q	Channel Invert Elevation (NGVD 29)	Water Surface Elevation (NGVD 29)	Critical Water Surface Elevation (NGVD 29)	Channel Velocity	Channel Froude Number
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	
2351	PMP	21.4	77.5	77.8	78.2	11.4	3.8
2316	PMP	42.8	76.0	76.7	77.3	11.3	2.8
2261	PMP	64.2	74.0	74.9	75.5	12.5	2.8
2206	PMP	85.6	72.0	73.0	73.8	13.7	2.9
2152	PMP	107	70.0	71.1	72.0	14.7	3.0
2098	PMP	128.4	68.0	69.2	70.1	15.6	3.1
2043	PMP	149.8	66.0	67.3	68.3	16.4	3.2
1989	PMP	171.2	64.0	65.4	66.4	17.1	3.2
1935	PMP	192.6	62.0	63.5	64.6	17.8	3.3
1853	PMP	300.7	59.0	60.8	62.4	18.7	3.1
1799	PMP	408.8	57.0	59.1	60.8	19.5	3.0
1744	PMP	516.9	55.2	57.8	59.1	19.9	2.9
1690	PMP	625	53.6	56.3	57.4	20.0	3.6
1636	PMP	733.1	52.0	54.7	55.7	18.9	3.7
1581	PMP	3930.7	50.0	52.0	53.4	21.0	2.9
1528	PMP	4038.8	48.0	51.7	52.9	18.2	3.0

Table 4 Maximum water surface elevations and channel velocities							
Cross Section	Profile	Cumulative Q	Channel Invert Elevation (NGVD 29)	Water Surface Elevation (NGVD 29)	Critical Water Surface Elevation (NGVD 29)	Channel Velocity	Channel Froude Number
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	
1470	PMP	4146.9	48.0	50.3	51.6	18.1	2.5
1417*	PMP	4255	45.5	48.2	49.7	19.6	2.8
1362*	PMP	4363.1	41.6	46.0	48.0	21.1	2.8
1326*	PMP	4471.2	40.0	44.8	46.7	21.8	2.8
1271*	PMP	4492.6	38.0	42.2	44.1	23.4	3.4
1209*	PMP	4514	36.0	40.2	42.1	23.6	3.4
1148*	PMP	4535.4	34.0	38.2	40.1	23.7	3.4
1086*	PMP	4556.8	32.0	36.2	38.1	23.8	3.4
1024*	PMP	4578.2	30.0	34.2	36.1	23.9	3.5
962*	PMP	4599.6	28.0	32.2	34.1	24.0	3.5
900*	PMP	4621	26.0	30.2	32.2	24.0	3.5
838*	PMP	4642.4	24.0	28.2	30.2	24.1	3.5
776*	PMP	4663.8	22.0	26.2	28.2	24.1	3.5
715*	PMP	4685.2	20.0	24.2	26.2	24.2	3.5
653*	PMP	5280.3	18.0	22.2	23.9	21.0	3.1
589*	PMP	5301.7	16.0	21.1	22.2	15.5	1.8
498*	PMP	5323.1	14.0	18.2	19.7	17.9	2.1
405*	PMP	8061.5	10.0	20.8	16.6	5.5	0.4
350*	PMP	8095.9	10.0	17.9	17.9	13.8	1.0
293*	PMP	8130.3	8.0	12.6	14.7	21.8	2.2
203*	PMP	8164.7	6.5	10.1	12.2	22.8	2.7

*Cross sections where UHS makeup water pipes will be buried underneath.

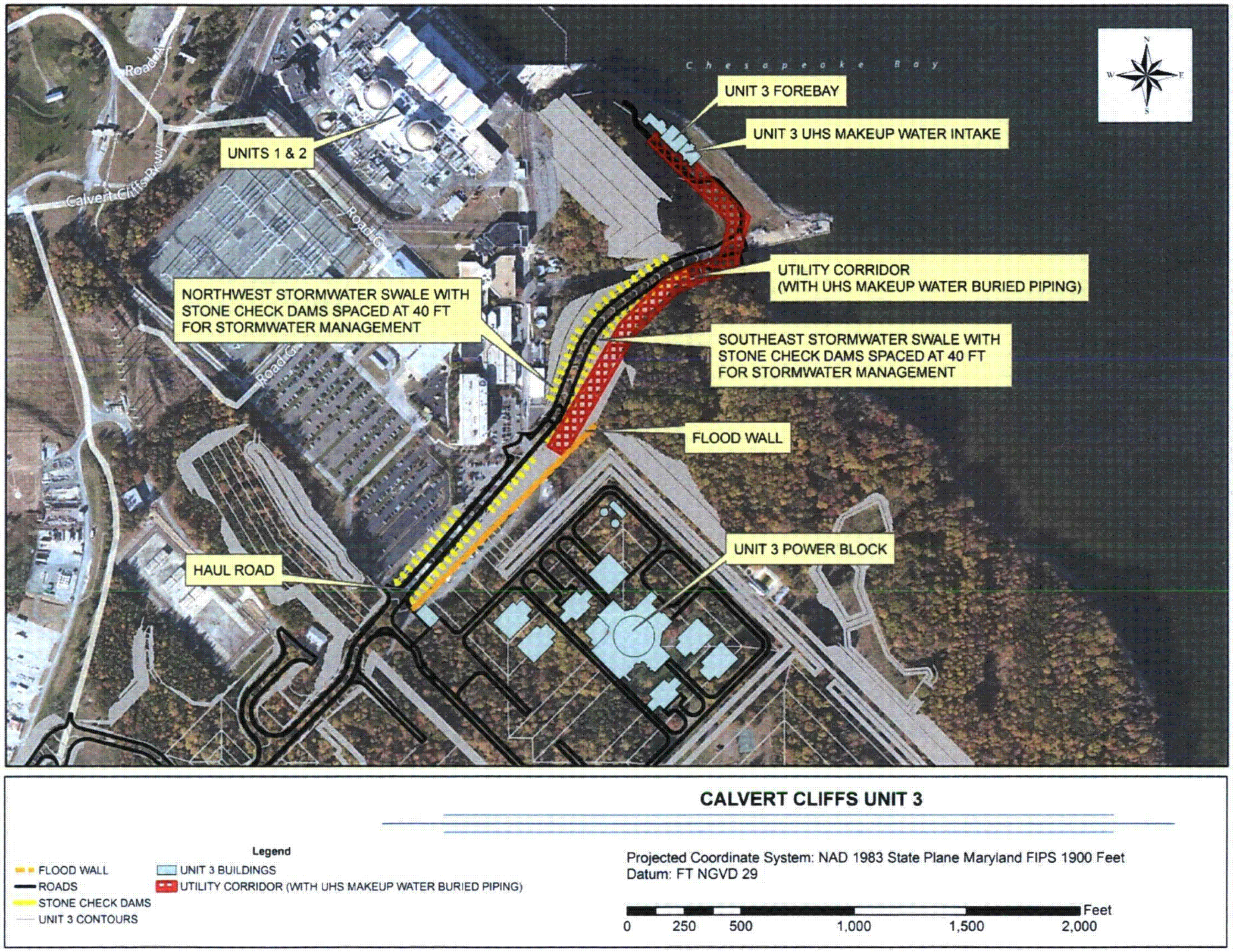


Figure 1 - Calvert Cliffs Unit 3 Utility Corridor (with UHS Makeup Water Buried Piping)

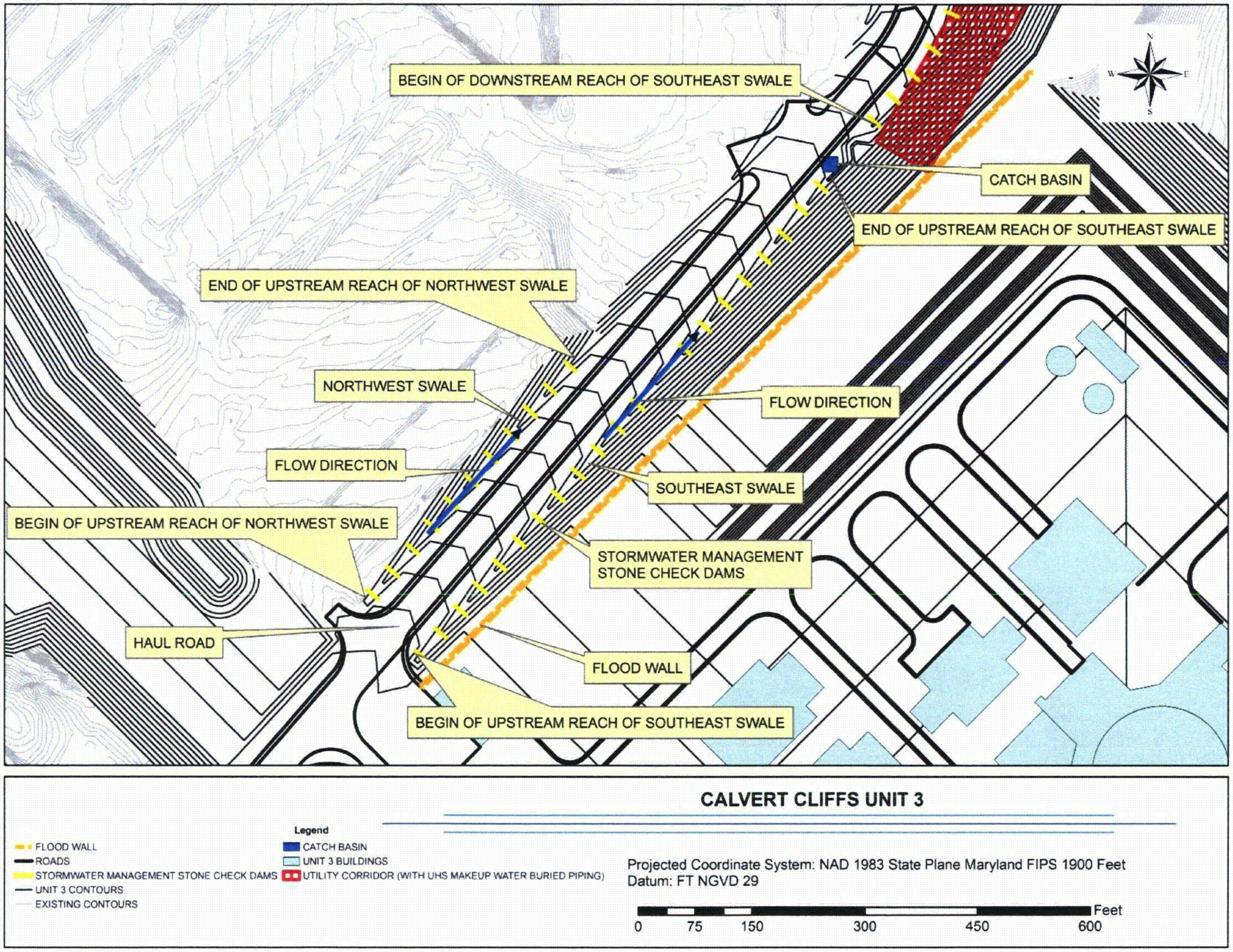


Figure 2 - Upstream Reach of Haul Road Swales

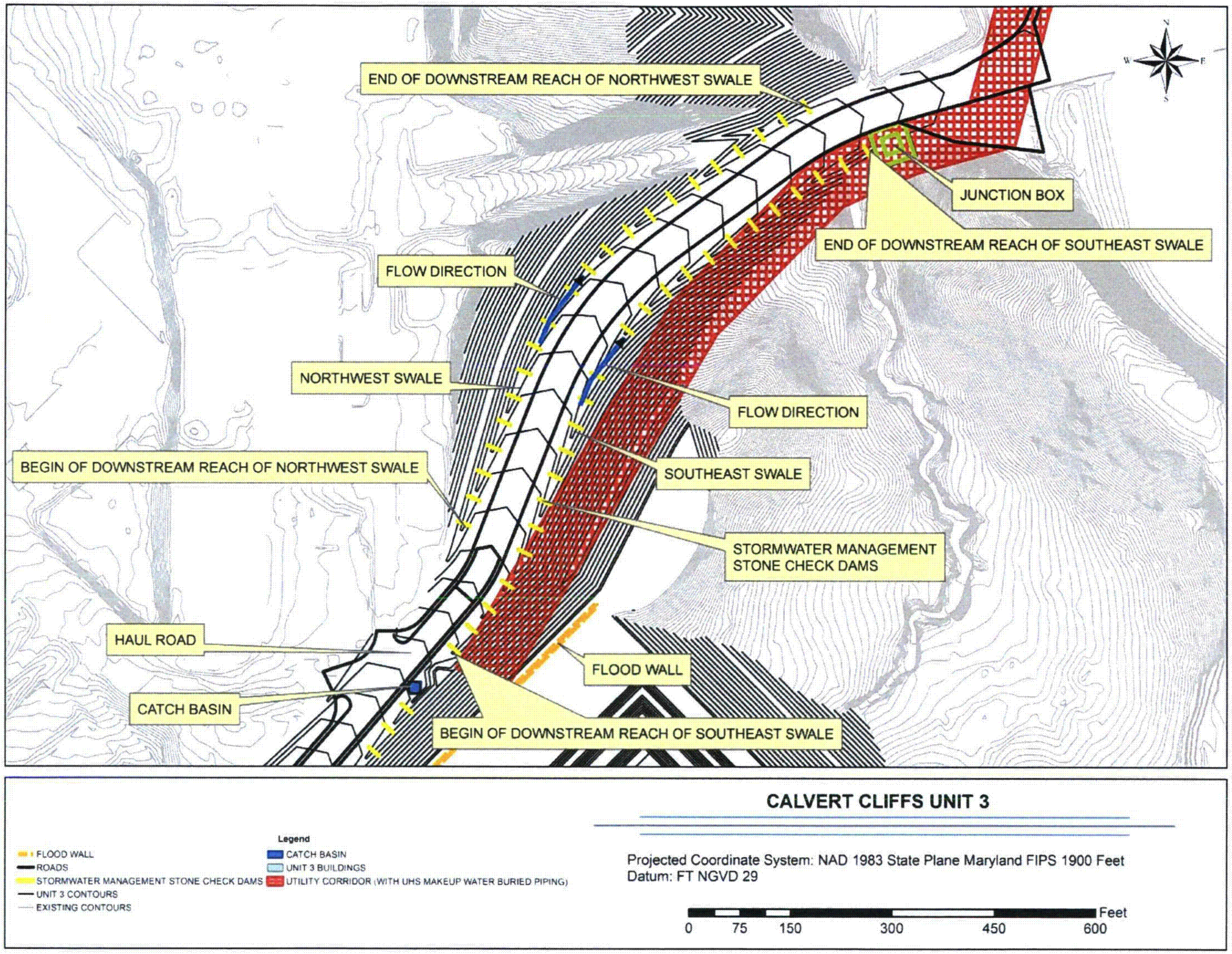


Figure 3 - Downstream Reach of Haul Road Swales

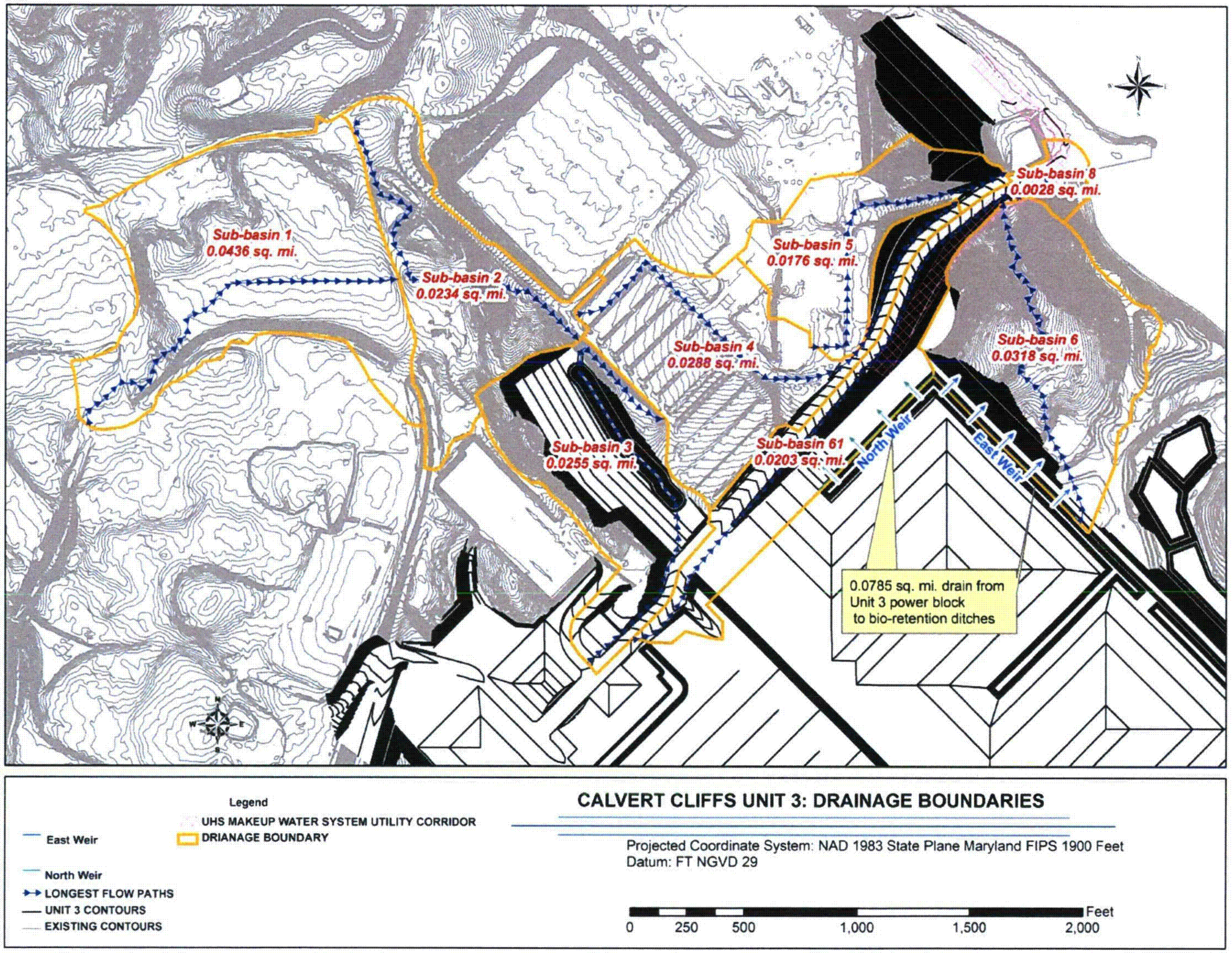


Figure 4 - Local Drainage Boundaries

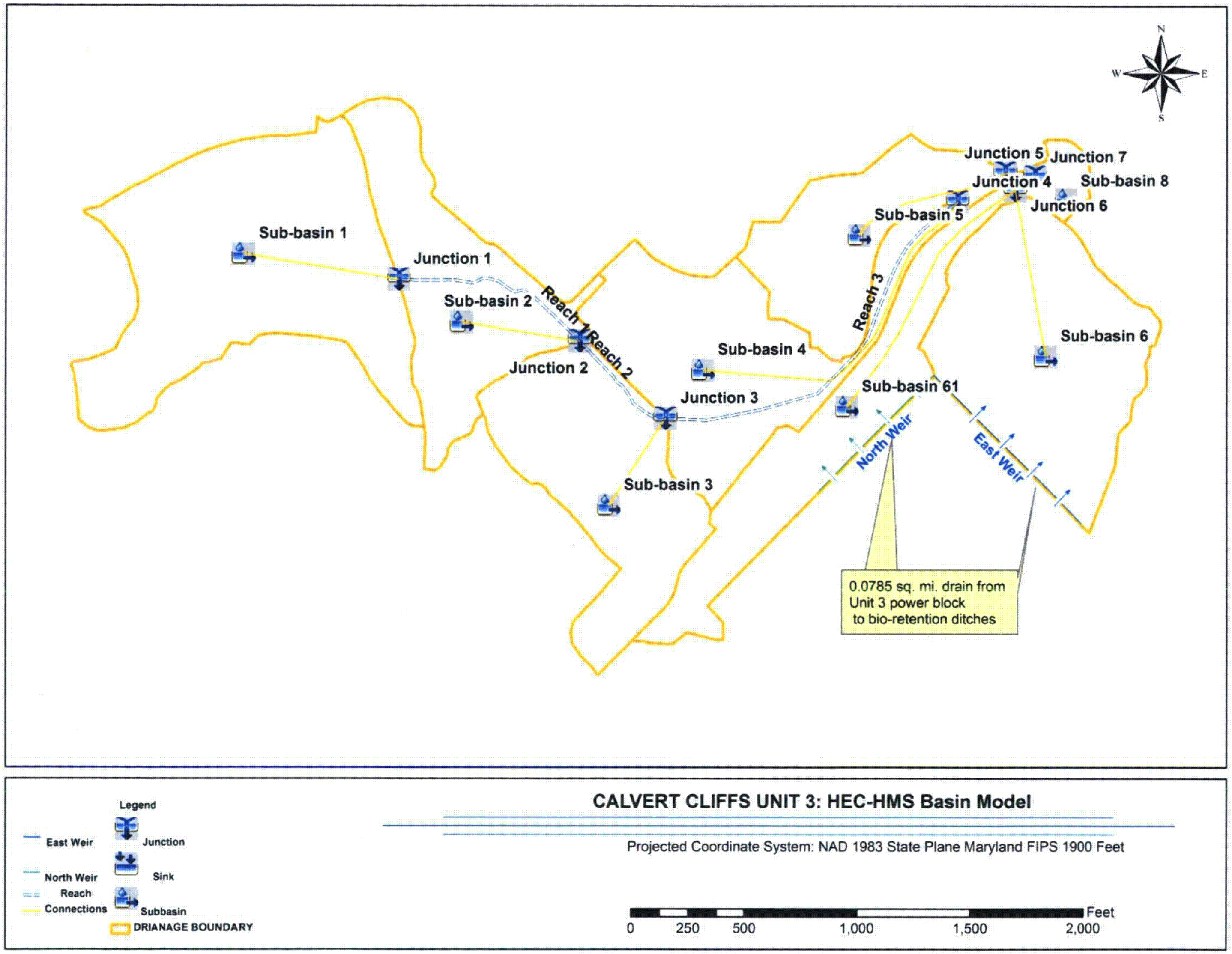


Figure 5 - HEC-HMS Basin Model

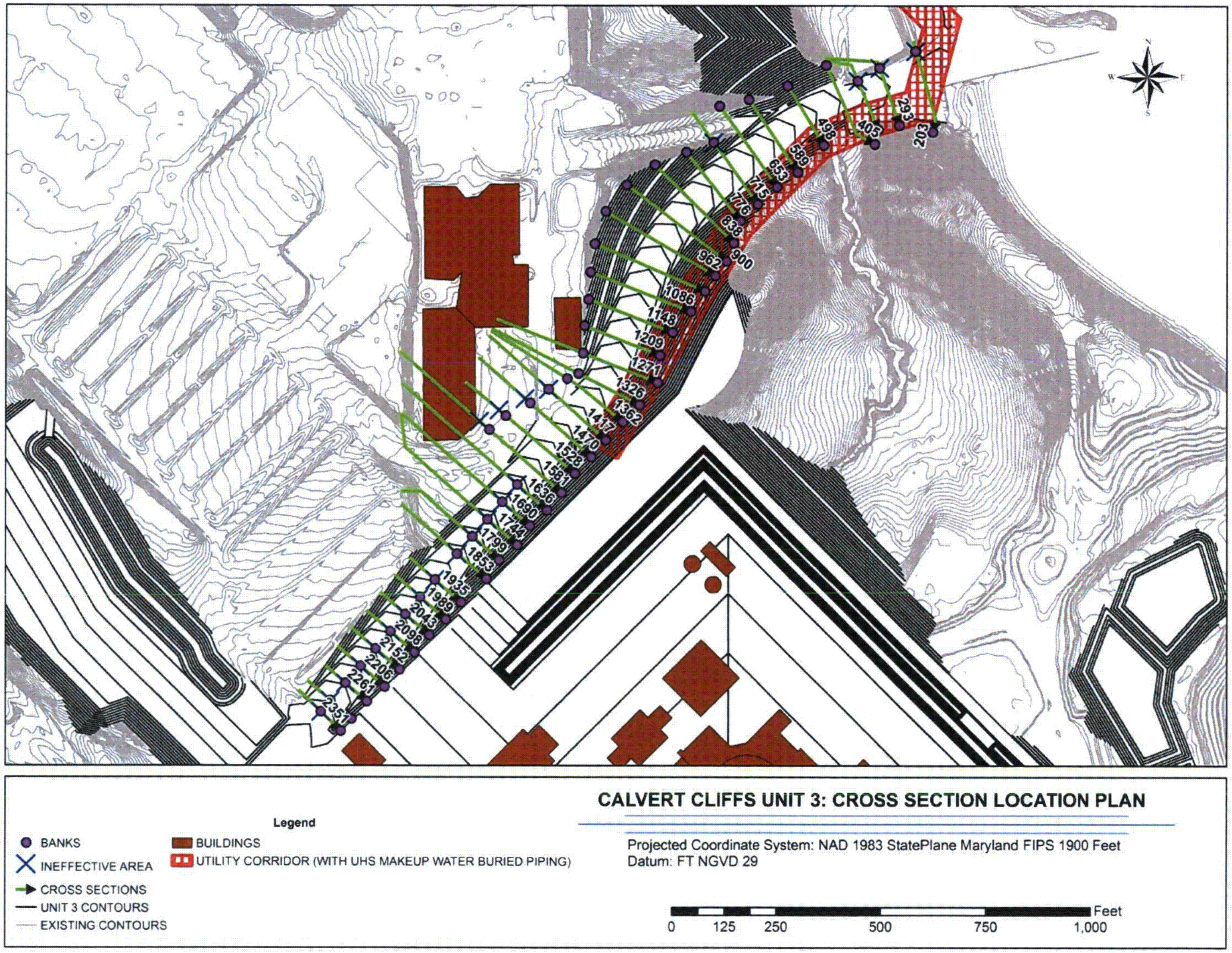


Figure 6 - HEC-RAS Cross Section Location Plan

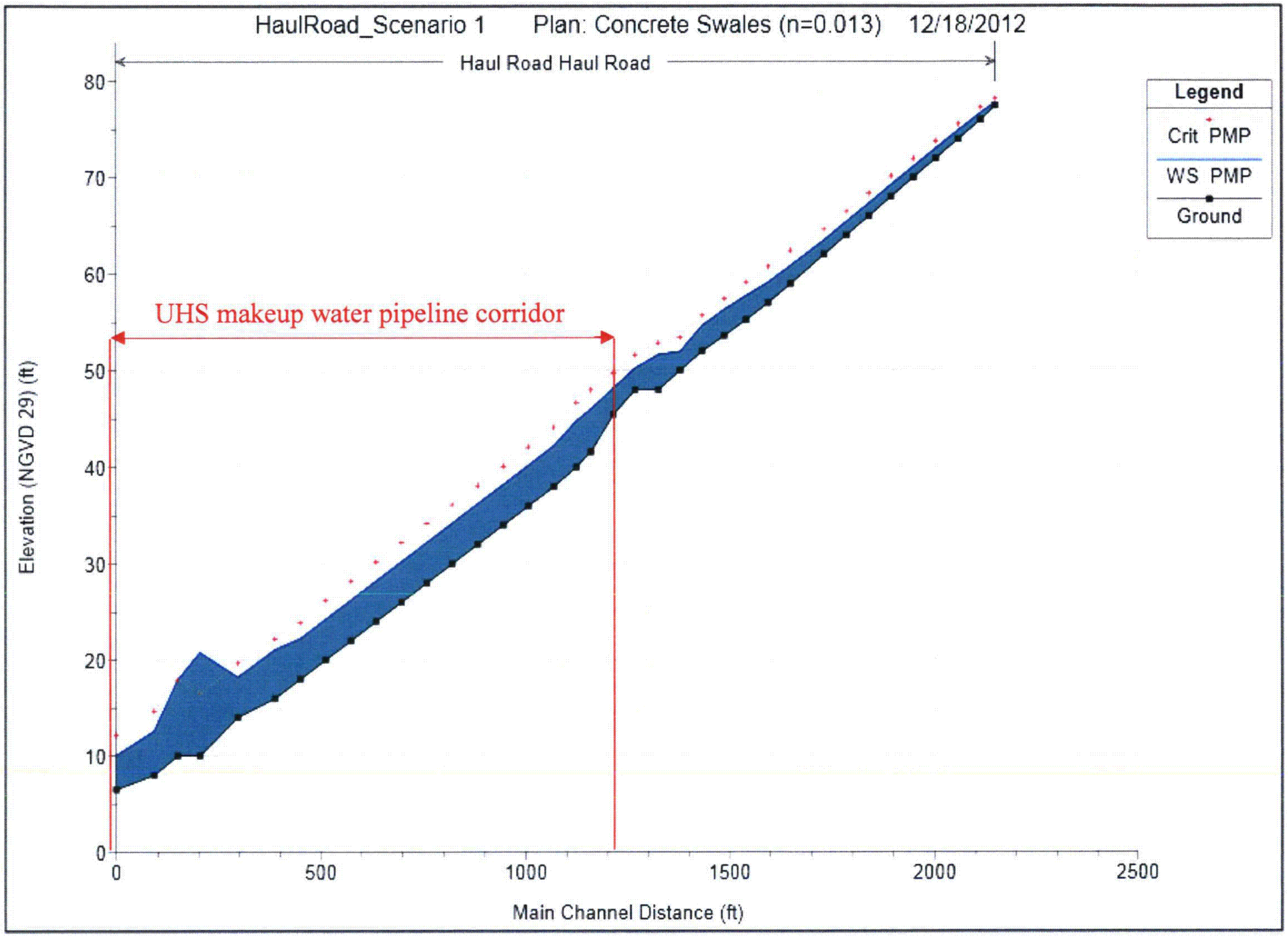


Figure 7 - Water Surface Profile Plot for Concrete Lined Swales

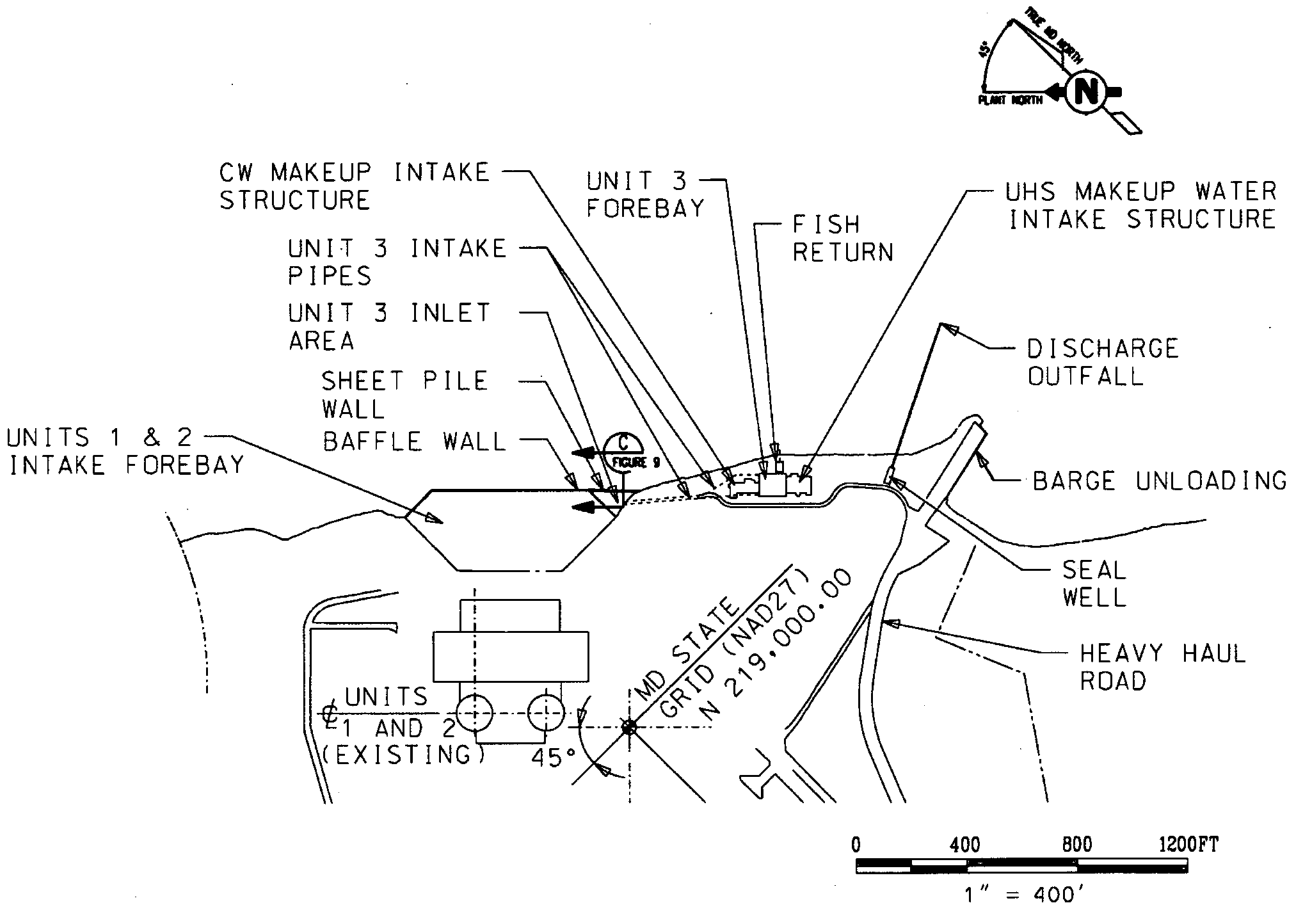


Figure 8 - UHS Makeup Water System Layout

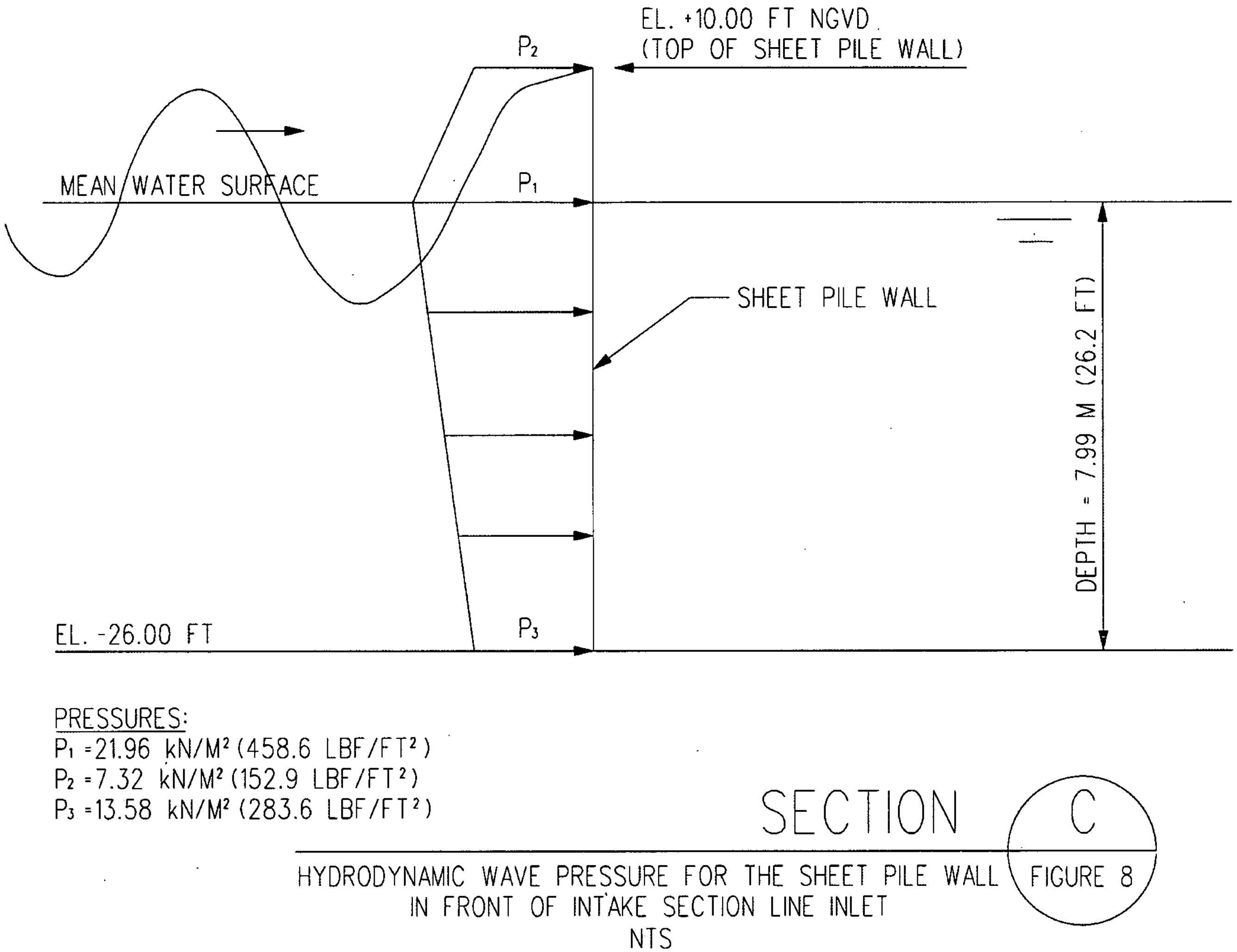


Figure 9 - Hydrodynamic Wave Pressures on Sheet Pile Wall

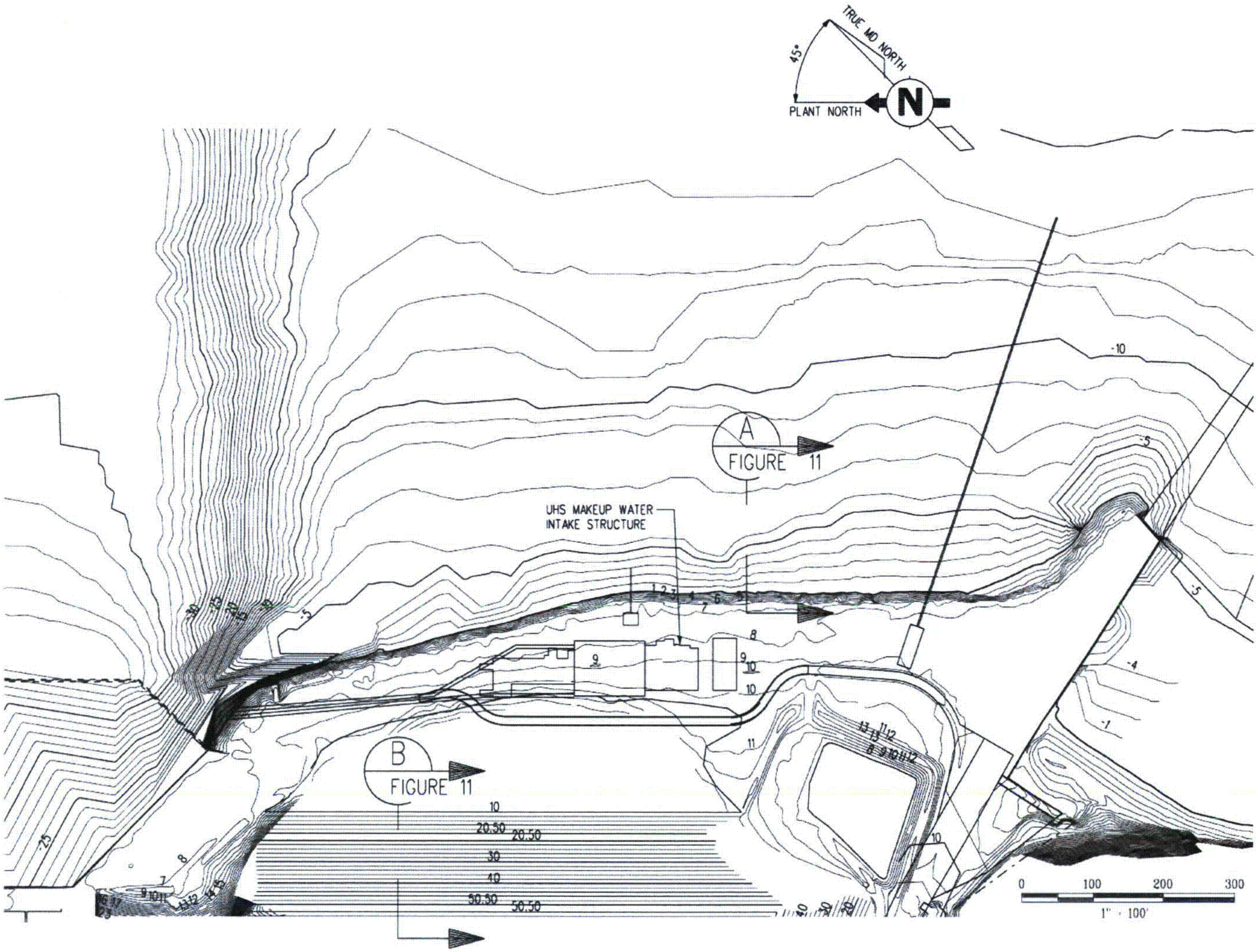
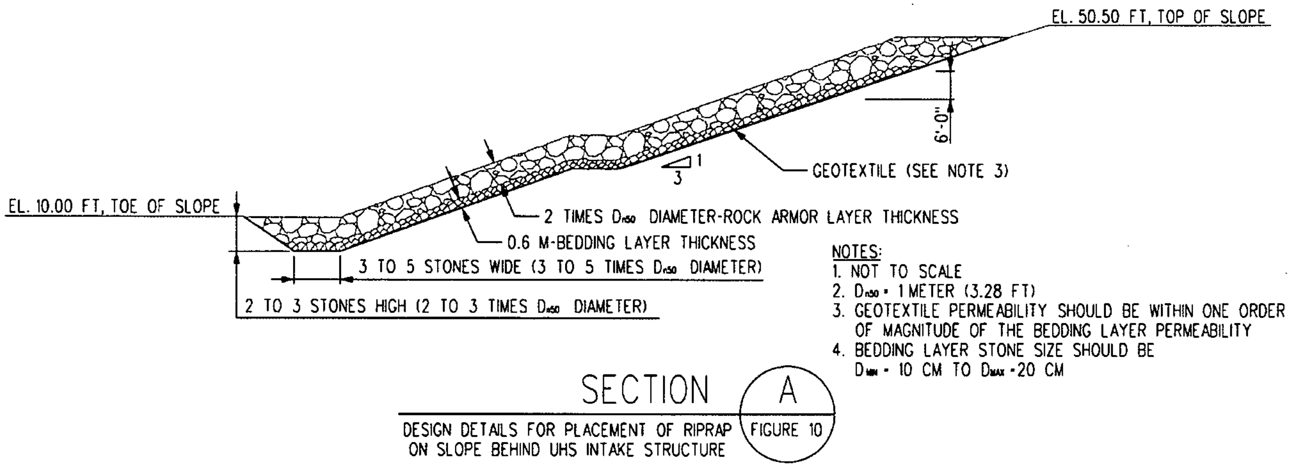


Figure 10 - Shoreline Area and Bathymetry



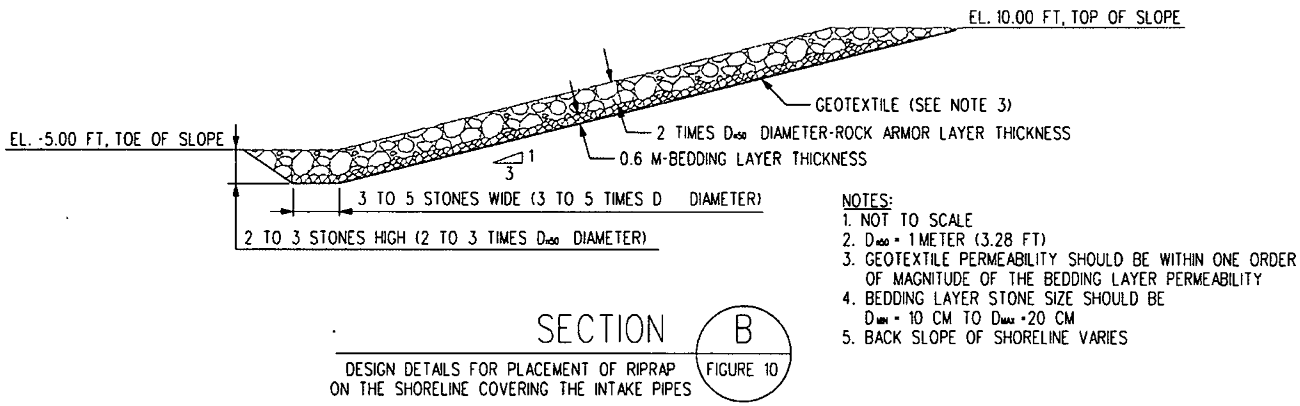


Figure 11 - Riprap Protection

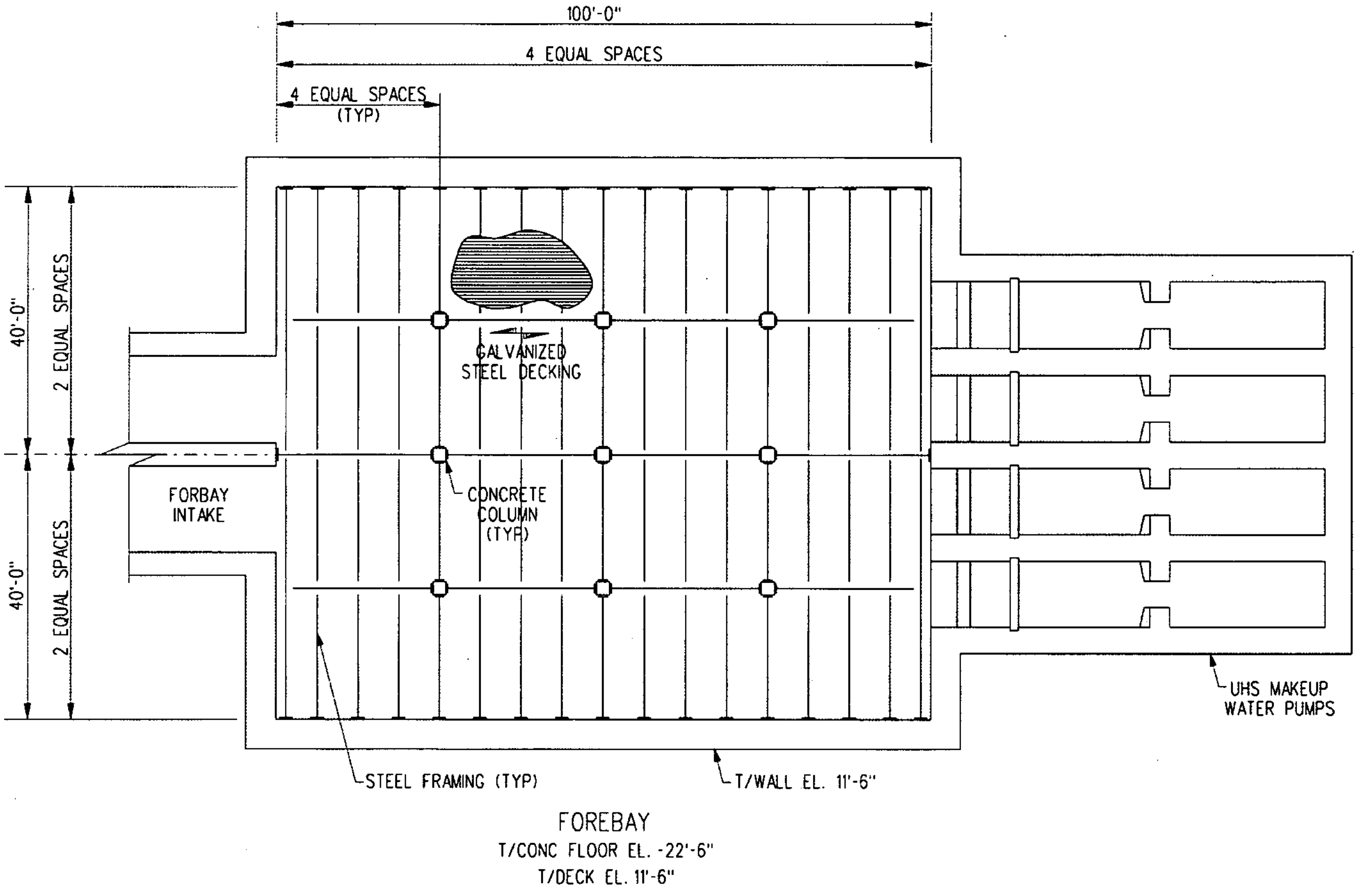


Figure 12 - Unit 3 Forebay Cover.

Enclosure 2

Changes to CCNPP Unit 3 COLA Associated with the Response to RAI No. 328, Question 02.04.10-1, Calvert Cliffs Nuclear Power Plant, Unit 3

COLA Impact

CCNPP Unit 3 COLA Part 2, FSAR Section 2.4, has been updated has been updated as follows (NOTE: Tables and Figures will be re-numbered as appropriate in Revision 9 of the CCNPP Unit 3 COLA):

2.4.2.2 Flood Design Considerations

...

The maximum water level due to local intense precipitation or the local probable maximum precipitation (PMP) is estimated and discussed in Section 2.4.2.3. The maximum water level in the CCNPP Unit 3 power block area, due to a local PMP, is at Elevation 81.5 ft (24.8 m). This water level becomes the design basis flood elevation for all safety-related facilities in the power block area. All safety-related building entrances in the power block are located above this elevation. ~~The effects of local intense precipitation at the UHS makeup water intake are not estimated since the design basis flood elevation from the PMH will completely submerge this area.~~

All safety-related facilities are located in the power block area with the exception of the Ultimate Heat Sink (UHS) makeup water intake structure. The CCNPP Unit 3 UHS makeup water intake structure and the makeup water intake for the Circulating Water System (CWS) are located on the Chesapeake Bay shore southeast of the CCNPP Units 1 and 2 intake structure, as shown in Figure 2.4-49. Two buried intake pipes run from the CCNPP Unit 3 inlet area to the CCNPP Unit 3 common forebay. Four UHS makeup water pipes emanate from the UHS makeup water intake structure and terminate at the Essential Service Water Buildings (ESWBs). These pipes are buried within the utility corridor as shown in Figure 3.8-3, and pass under the Haul Road which runs in the East-West (Plant North) direction adjacent to the North side of the CCNPP Unit 3 power block. The impact of PMP flow on the UHS makeup water system is discussed in Subsection 2.4.2.3.

...

2.4.2.3 Effects of Local Intense Precipitation

2.4.2.3.1 Effects of Local Intense Precipitation on CCNPP Unit 3 Power Block Area

...

Based on the CCNPP Unit 3 power block grading, entrance locations, and peak PMP water levels in the site ditches, all safety-related facility entrances, except for the UHS makeup intake structure, are located above peak PMP ditch water levels and PMP sheet flows are prevented from reaching safety-related entrances.

2.4.2.3.2 Effects of Local Intense Precipitation on CCNPP Unit 3 UHS Makeup Water System

A hydrologic and hydraulic analysis is performed to evaluate the impacts of the local intense precipitation event on the UHS makeup water system. The makeup water system consists of the inlet, two intake pipes, the UHS makeup water intake structure, common forebay and four UHS makeup water pipes that deliver water from the intake structure to the Essential Service Water Buildings (ESWBs). The impact of the local intense precipitation event on the buried piping is discussed in the following. Primarily, the flow velocities along the utility corridor adjacent to the Haul Road, as shown in Figure 3.8-3, are evaluated to assess the scour potential and need for protection. The flooding protection and associated impacts on other components of the UHS makeup water system are discussed in Section 2.4.10.

Subsection 2.4.2.3.1 discusses the methodologies and procedures to determine the effects of local intense precipitation on the CCNPP Unit 3 site. The design basis for the local intense precipitation is the all season 1 square mile (or point) PMP as obtained from the U.S. National Weather Service (NWS) Hydro-meteorological Report Number 51 (NOAA, 1978) and Report Number 52 (NOAA, 1982). Table 2.4-18 presents the 1 square mile PMP for various durations at the CCNPP site.

The runoff analysis is performed assuming underground storm drains and culverts within the contributing drainage areas are clogged and not functioning during the PMP storm event. The Natural Resources Conservation Service (NRCS)(formerly known as the Soil Conservation Service) methodologies and the U.S. Army Corps of Engineers computer program HEC-HMS are used to determine peak discharges in the drainage swales. Water surface elevations and flow velocities along the flow paths during the PMP event are determined using the USACE computer program HEC-RAS.

The general layout of CCNPP Unit 3, Haul Road, utility corridor, the UHS makeup water intake and the Unit 3 forebay are shown in Figure 2.4-7A. There are two storm water swales located on both sides of the Haul Road that run in the southwest to northeast direction and discharge into the Chesapeake Bay as shown in Figure 2.4-7B and Figure 2.4-7C. The southeast swale is about 1,810 ft long, the upper reach of which drains to a stormwater catch basin, as shown in Figure 2.4-7B, and the lower reach starts at approximately 100 ft downstream. The northwest swale is about 1,220 ft long, and there is a stretch of about 650 ft between the upper and lower reaches where there is no well-defined channel. The utility corridor begins downstream of the stormwater catch basin and runs along the south edge of the Haul Road and then crosses the Haul Road approximately 125 ft downstream of the junction box, as shown in Figure 2.4-7C. The swales are trapezoidal in shape with a bottom width of 3 ft, side slopes of 3(H):1(V), and an average depth of 3 ft. The swales have an average slope of 3.5% and are initially designed to be protected with grass and stabilization matting.

The contributing drainage areas for the runoff in the swales are delineated from the topographic contours, as shown in Figure 2.4-7D. A total drainage area of 174.28 ac (0.2723 mi^2), of which 50.26 ac (0.0785 mi^2) from the Unit 3 Power block and 124.02 ac (0.1938 mi^2) from Units 1 & 2 and the Haul Road, drains to the two swales, which eventually discharge to the Chesapeake Bay. The drainage areas for the sub-basins are presented in Table 2.4-17A.

The NRCS method as described in the TR-55 Manual (USDA, 1986) was used to estimate the times of concentration (Tc) for the various sub-basins. To account for non-linearity effects during extreme flood condition, the computed Tc was reduced by 25% in accordance with guidance from EM-1110-2-1417 of USACE (USACE, 1994). The lag time, estimated as 60% of Tc, and the local intense precipitation depths presented in Table 2.4-18, were input to the HEC-HMS computer model (USACE, 2010a). American Nuclear Society, ANSI/ANS-2.8-1992 standard (ANS, 1992) requires that, prior to the PMP event, an event equivalent to the 40% PMP has occurred, with 3 to 5 dry days between the events, leaving the ground saturated. To simulate saturated ground conditions, all areas are conservatively assumed to be impervious, and a NRCS runoff curve number of 98 for impervious surfaces, regardless of the soil type, was used in the model. The NRCS dimensionless unit hydrograph option for the developments of the peak discharges from the various sub-basins in HEC-HMS was utilized. The hydrographs are routed through the reaches using lag method. A schematic of the HEC-HMS model is given in Figure 2.4-7E and the resulting peak discharges for the sub-basins and model junctions are presented in Table 2.4-17A.

Water surface elevations and flow velocities at the swales for the PMP flood event are determined using the USACE computer program HEC-RAS (USACE, 2010). The two swales and the Haul Road are modeled as one single river channel. The Haul Road centerline is used as the river line and 37 cross-sections representing both swales are defined along the flow path, as shown in in Figure 2.4-7F. The HEC-RAS model cross sections are delineated from the topographic contours and have spacing varying from 35 ft to 92.6 ft. Additional cross sections, as needed, are created with HEC-RAS, by linearly interpolating cross sections between the developed cross sections. The effects of buildings are represented in the model using ineffective areas.

Manning's roughness coefficient "n" for both swales and over bank areas are estimated based on values described in Table 5-6 of Chow's Open-Channel Hydraulics (Chow, 1959). Swale linings consist of grass and stabilization matting for which a Manning's n value of 0.04 is selected, in accordance with the Maryland Department of Environment's (MDE) Standard and Specifications for Soil Erosion and Sediment Control Manual (MDE, 2011). Area cover for over bank areas consists of grass, grass with stabilization matting, wooded, pavement and water, which are assigned Manning's n values as summarized in Table 2.4-17B.

The swales discharge to Chesapeake Bay at the downstream end. The swales have a fairly steep gradient with an average slope of 3.5%. The PMP flow is modeled for a mixed flow regime, which requires the specification of downstream and upstream boundary conditions. There is no known hydraulic control in the upstream, therefore, a normal depth condition is specified for the upstream boundary. At the downstream end where the swales discharge into the Chesapeake Bay, the elevation drops off significantly. As such, a critical depth condition is specified for the downstream boundary. The boundary conditions used in the HEC-RAS model are summarized in Table 2.4-17C.

Based on the hydraulic simulations, the range of flow velocities in the swales that are primarily grass-lined with stability matting is from 5.1 ft/s to 20.5 ft/s. The lower part of the swales has velocities greater than 10 ft/s. These values are higher than the permissible velocity of 8.5 ft/s for channels lined with grass and stability matting (MDE, 2011) and will lead to potential erosion and scouring. In order to protect the UHS pipeline from potential scouring during a PMP event, two options are evaluated: (a) use of check dams on the swales to reduce the flow velocities, and (b) use of concrete lining to protect the swales from scouring due to the high flow velocities.

The effectiveness of check dams to slow down the scouring velocities are simulated with a HEC-RAS model that assumes that the swales are lined with grass and stabilization matting, for which a Manning's n value of 0.04 is assigned. Check dams of 1 ft wide and heights varying from 0.8 ft to 3 ft are placed at a nominal spacing of 60 ft. The top of the check dams are selected to be no higher than the edge of the Haul Road so as to avoid overtopping the road during regular, more frequent, storm events. Due to the high PMP flood flow and resulting high flooding stage along the swales, the relatively low profile of the check dam is found to be ineffective in reducing the flow velocities. The predicted flow velocities remain significantly higher than 8.5 ft/s, the permissible velocity for grass-lined channel with stabilization matting.

For the range of flow velocities, it is determined that the drainage swales, as well as the Haul Road, need to be lined with concrete to resist the erosive forces. A HEC-RAS model simulation is conducted with a Manning's n of 0.013 for the channel representing concrete lining for the swales. The predicted velocities range from 5.5 to 24.2 ft/s, which are within the permissible velocity of 30 ft/s or more for concrete lined channels. Table 2.4-17D provides the summary results of the maximum water surface elevation and channel velocities for the PMP event. Figure 2.4-7G shows the water surface profile.

As part of the stormwater management design, stone check dams that are nominally 2 ft in height and spaced at 40 ft apart will be placed on the concrete lined swales to reduce the flow velocities during more frequent and regular storm events.

Beyond the utility corridor along the Haul Road, the four UHS makeup water pipes will continue toward the power block until ESWBs as shown in Figure 3.8-4. Within the power block, erosion and scour over the buried piping is not expected due to the site grading being of mild slope and resulting low velocities along drainage swale and channels. For the section of makeup water pipe crossing between the Unit 3 flood wall and the northwest edge of Unit 3 power block (Figure 2.4-7A), concrete lining over the pipeline crossing will be provided as a conservative measure to resist scour.

Flood protection measures are required for the CCNPP Unit 3 UHS makeup water intake structure. The grade level at the UHS makeup water intake structure location is at Elevation 10.0 ft (3.0 m). The maximum flood level at the intake location is Elevation 33.2 ft (10.11 m) as a result of the surge, wave heights, and wave run-up associated with the probable maximum hurricane (PMH) as discussed in Section 2.4.5. Thus, the UHS makeup water intake structure would experience flooding during a PMH and flood protection measures are required.

The general arrangement of the UHS makeup water intake area is described in Section 9.2.5. Flood protection for the UHS makeup water intake structure, as described in Section 2.4.10, will consist of structural measures to withstand the static and dynamic flooding forces as well as water proofing measures to prevent the flooding of the interior of the structures where pump motors and electrical or other equipment associated with the operation of the intake are located.

2.4.2.4 References

ANS, 1992. Determining Design Basis Flooding at Power Reactor Sites, ANSI/ANS-2.8-1992, American National Standard Institute/American Nuclear Society, July 1992.

Chow, 1959. Open-Channel Hydraulics, V. Chow, 1959.

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NOAA, 1978. Probable Maximum Precipitation Estimates - United States East of the 105th Meridian, Hydrometeorological Report Number 51, National Oceanic and Atmospheric Administration, June 1978.

NOAA, 1982. Application of Probable Maximum Precipitation Estimates – United States East of the 105th Meridian, Hydrometeorological Report Number 52, National Oceanic and Atmospheric Administration, August 1982.

...

USACE, 2010. HEC-RAS, River Analysis System, Version 4.1.0, U.S. Army Corps of Engineers, Hydrologic Engineering Center, January 2010.

USACE, 2010a. HEC-HMS, Hydrologic Modeling System, Version 3.5.0, U.S. Army Corps of Engineers, Hydrologic Engineering Center, August 2010.

USACE, 2006b. HEC-HMS User's Manual, U.S. Army Corps of Engineers, Hydrologic Engineering Center, April 2006.

USDA, 1986. Urban Hydrology for Small Watersheds, Technical Release 55, U.S. Department of Agriculture, Soil Conservation Service, June 1986.}

...

2.4.10 Flooding Protection Requirements

...

The CCNPP Unit 3 UHS makeup water intake structure is offset from the Chesapeake Bay shoreline as shown on Figure 2.4-49. Makeup water to the CCNPP Unit 3 common forebay is conveyed from the Chesapeake Bay via two safety-related buried intake pipes. The intake pipes withdraw water from Chesapeake Bay in an inlet area protected by the existing Units 1 and 2 intake baffle wall and a sheet pile wall, as shown on Figure 2.4-49. The bottom elevation within the inlet area is maintained at an elevation of approximately -26 ft (6.1 m). The inlets of the intake pipes are protected by a security barrier and bars that will be designed to withstand PMH conditions. The security barrier and bars includes raking mechanism and extends from the deck elevation of approximately 11.5 ft (3.5 m) to an elevation of approximately -20 ft (6.1 m) near the intake pipe inlet. The Unit 3 inlet area is protected by the sheet pile wall against the PMH condition. The static and dynamic flood forces on the sheet pile wall is also discussed in Section 3.8. The shoreline near the UHS makeup water intake structure ~~is~~ and buried UHS makeup water intake piping are protected against the PMH and coincident wind-wave conditions. The additional design details for the placement of riprap protecting the UHS buried intake pipes, UHS makeup water intake discharge pipes, and the area behind the UHS intake area are shown in Figures 2.4-7A, 2.4-49A and 2.4-49B.

In addition to protection of structures against static, dynamic, and erosive forces, the pump house area of the CCNPP Unit 3 UHS makeup water intake structure must remain protected from flooding and the intrusion of water. Thus, these structures including any access are designed to be water tight. Structural walls and roofs will be designed with water stops at all construction joints to prevent leakage.

Any pipe, pump shaft, or other conduit penetrations through walls, floors and roofs will be sealed with water tight fittings. All access to these spaces will be provided with water tight doors or water tight hatches. The water tight measures will also be designed for the static and dynamic flood forces resulting from the PMH water levels and wave forces. Locations of the doors and hatches are provided on figures in Section 9.2.5. Doors and hatches will open outward and will be closed during normal plant operation.

Since all water-tight doors and hatches for the CCNPP Unit 3 UHS makeup water intake structure will be closed during normal operations, no special operating procedures or shutdown technical specifications will be necessary to ensure that flood protection measures are in place when Chesapeake Bay flood water levels associated with the PMH occur.}

In addition, to protect the Unit 3 forebay from ingress of sediment and debris, the top of the forebay will be fully covered, as shown in Figure 2.4-49C.

Finally, the flood protection measures protecting the UHS makeup water pipeline along the utility corridor are described in detail in Section 2.4.2.3.2, with concrete lining pavement against the potential scour due to local PMP along the Haul Road and UHS makeup water pipeline.

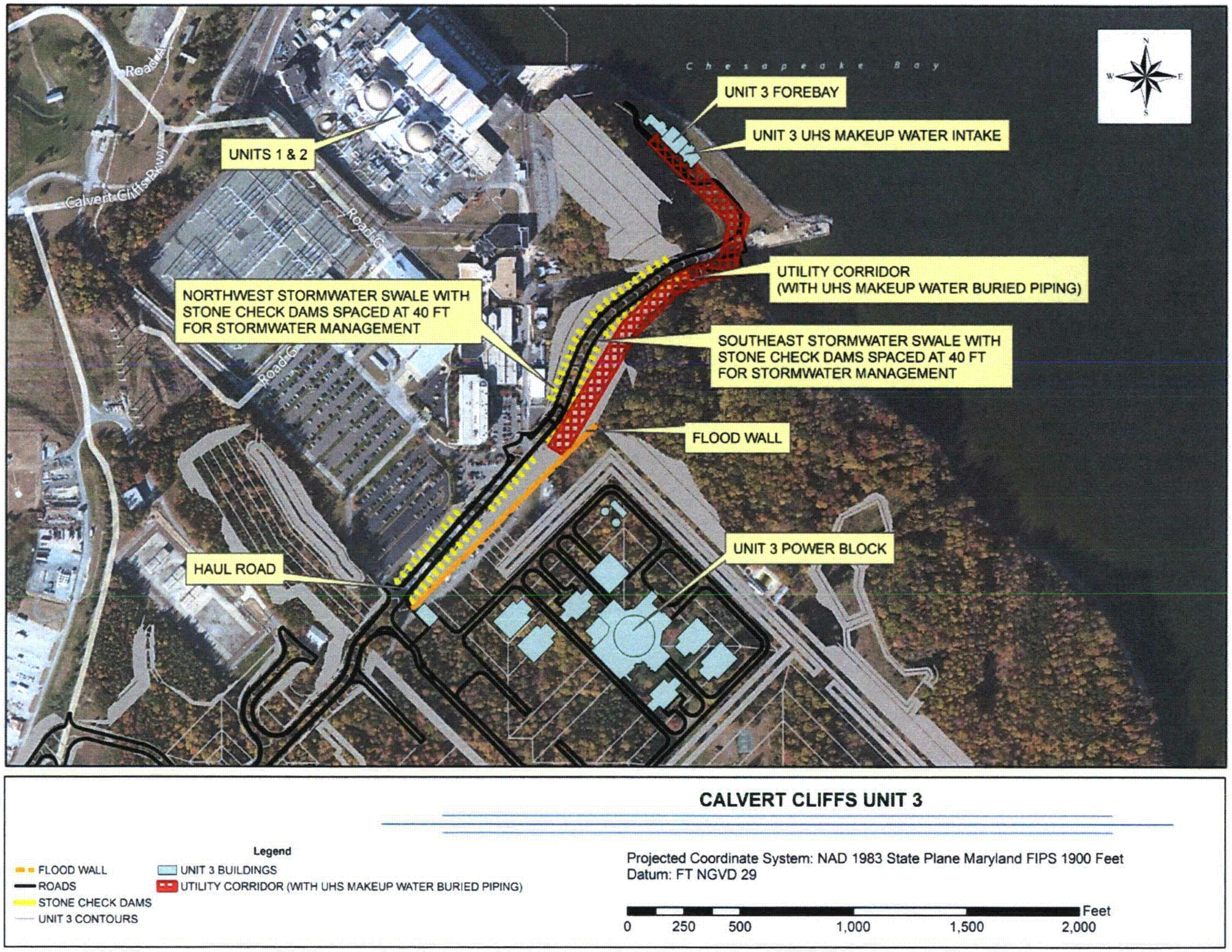


Figure 2.4-7A Calvert Cliffs Unit 3 Utility Corridor (with UHS Makeup Water Buried Piping)

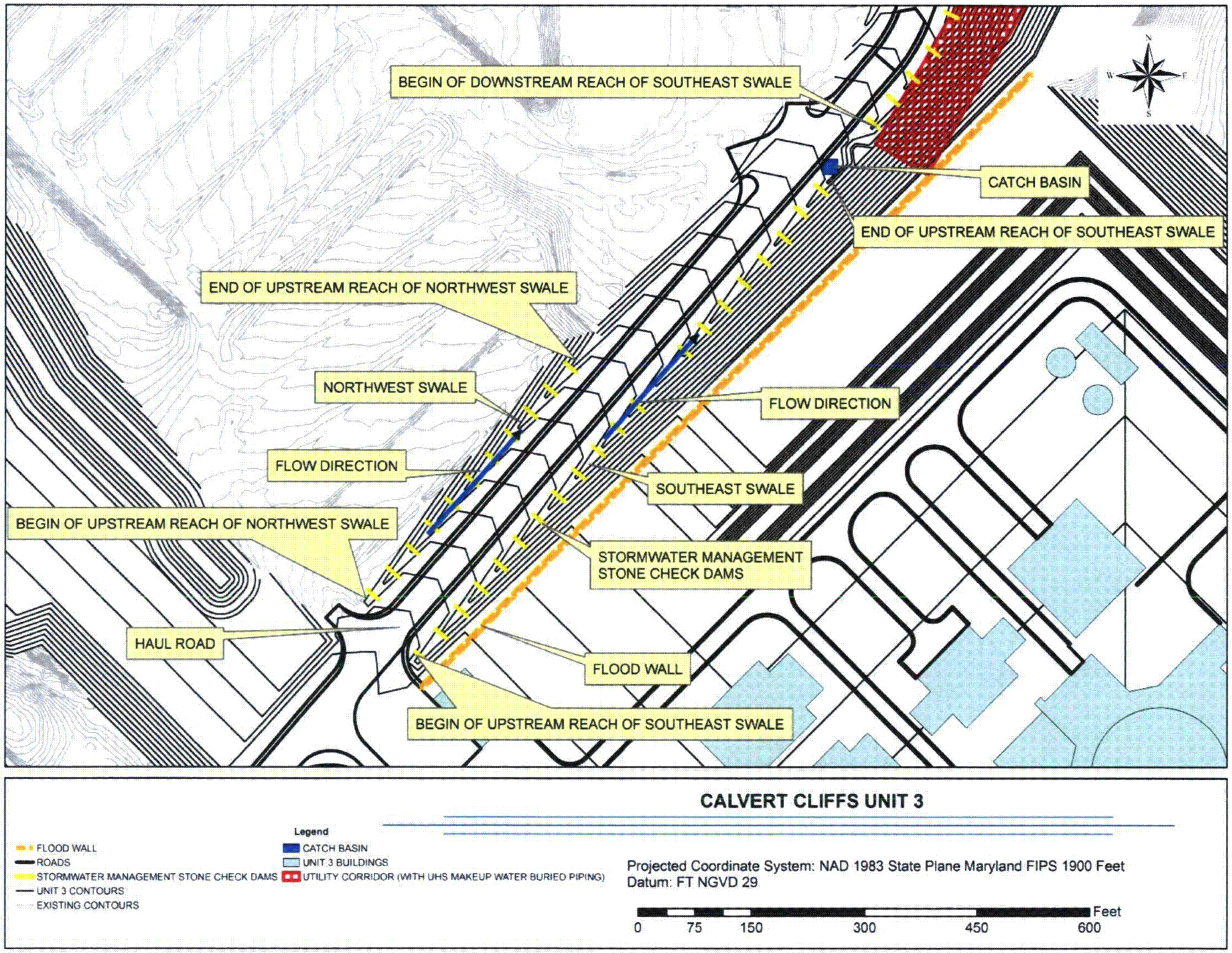


Figure 2.4-7B Upstream Reach of Haul Road Swales

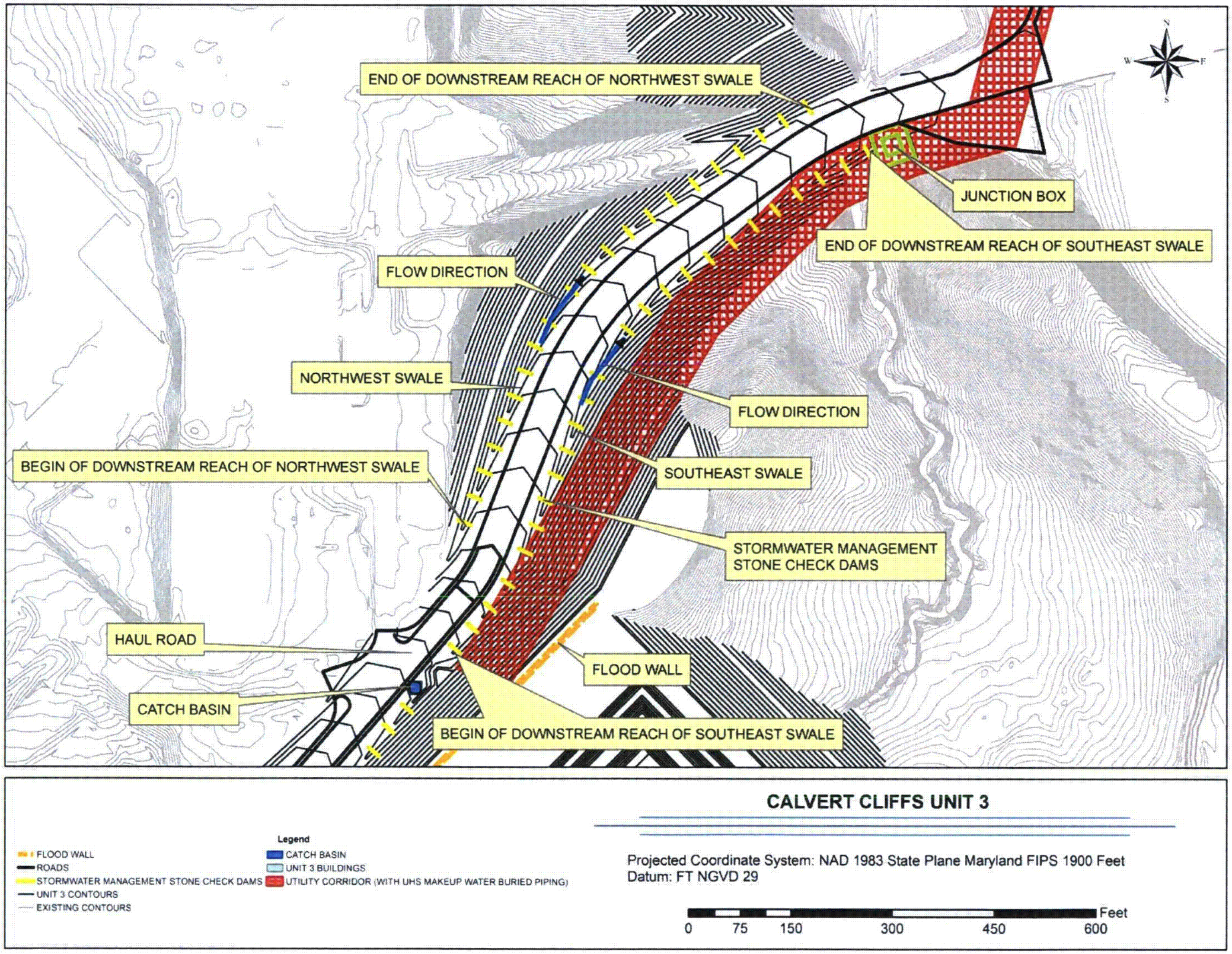


Figure 2.4-7C Downstream Reach of Haul Road Swales

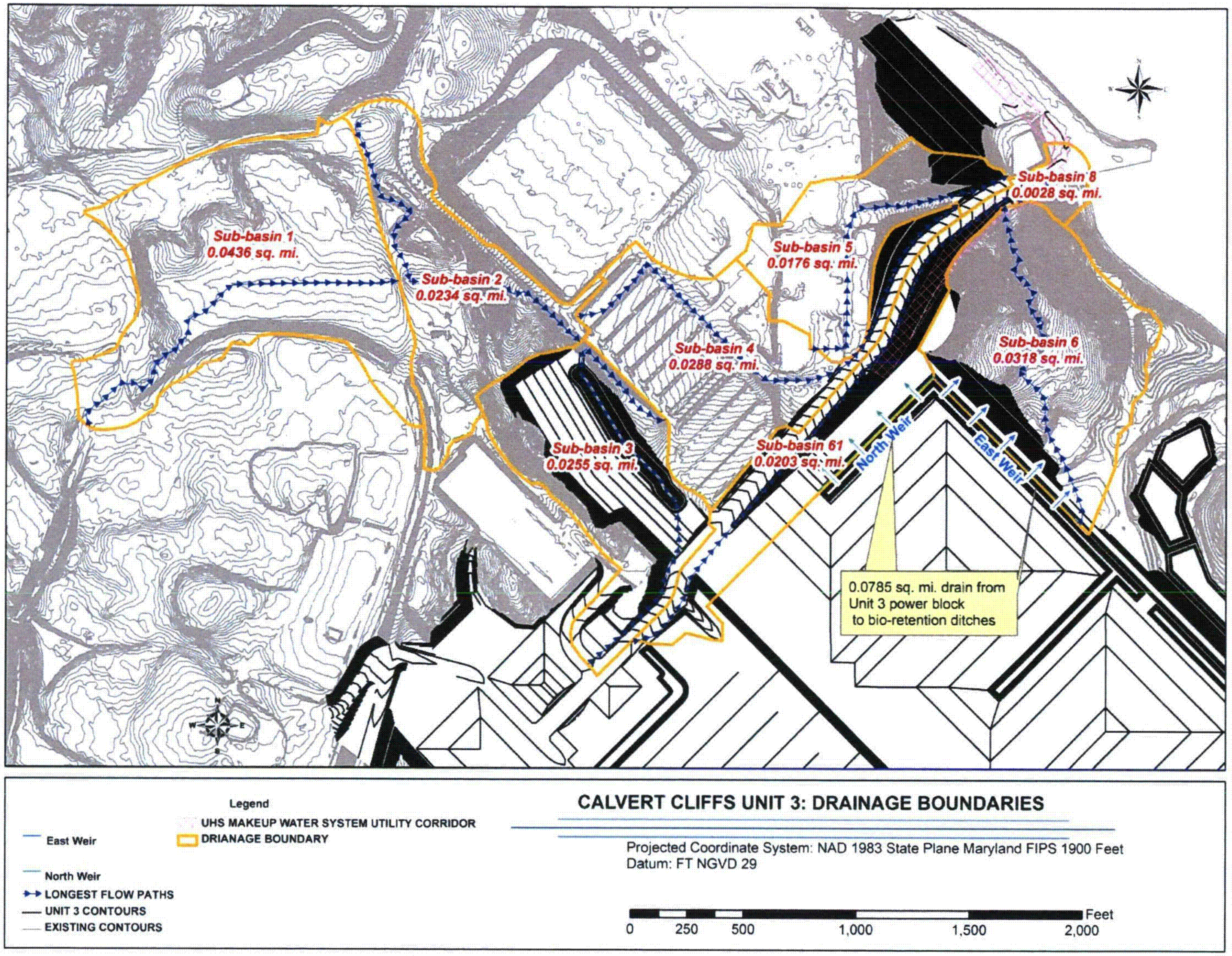


Figure 2.4-7D Local Drainage Boundaries

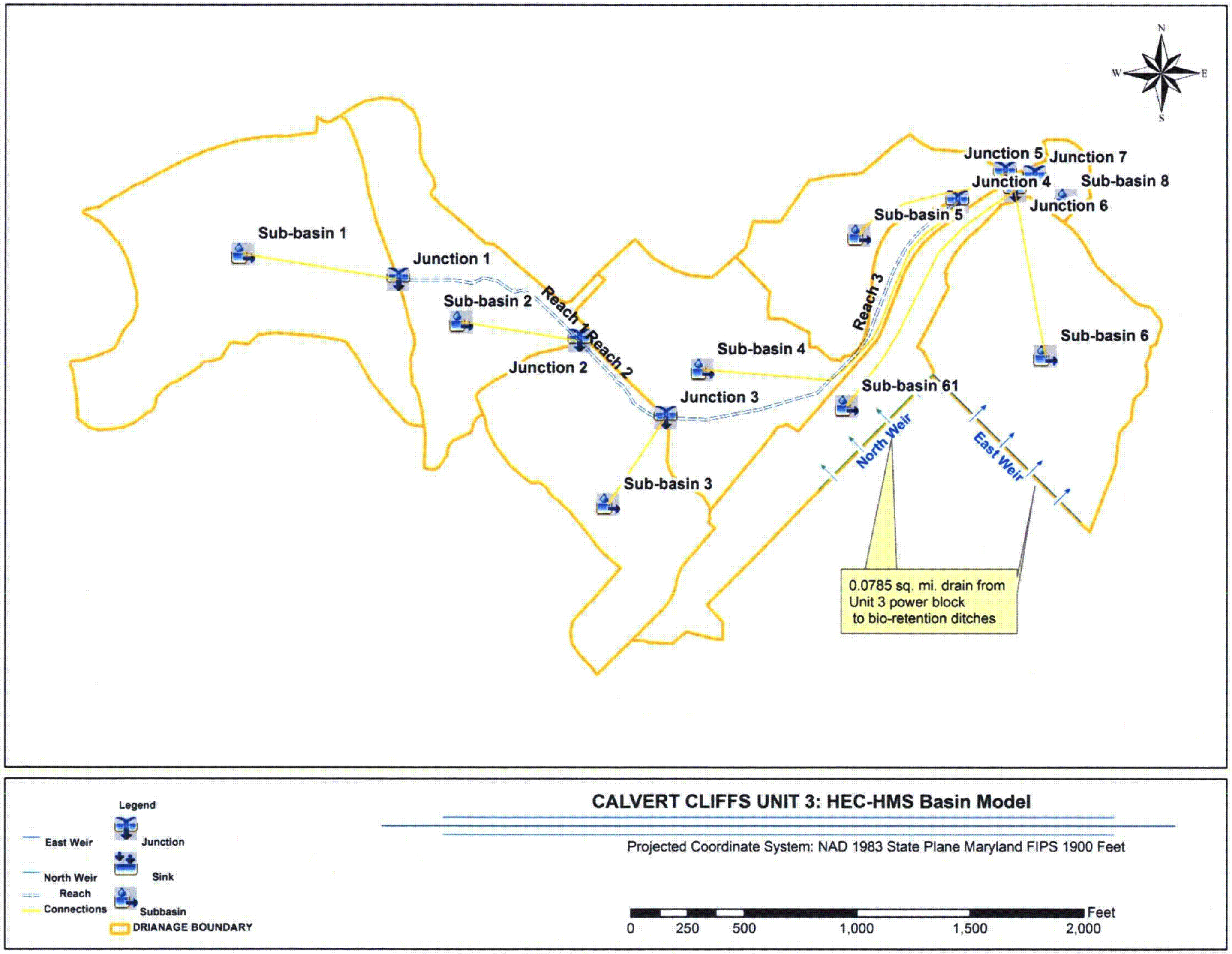
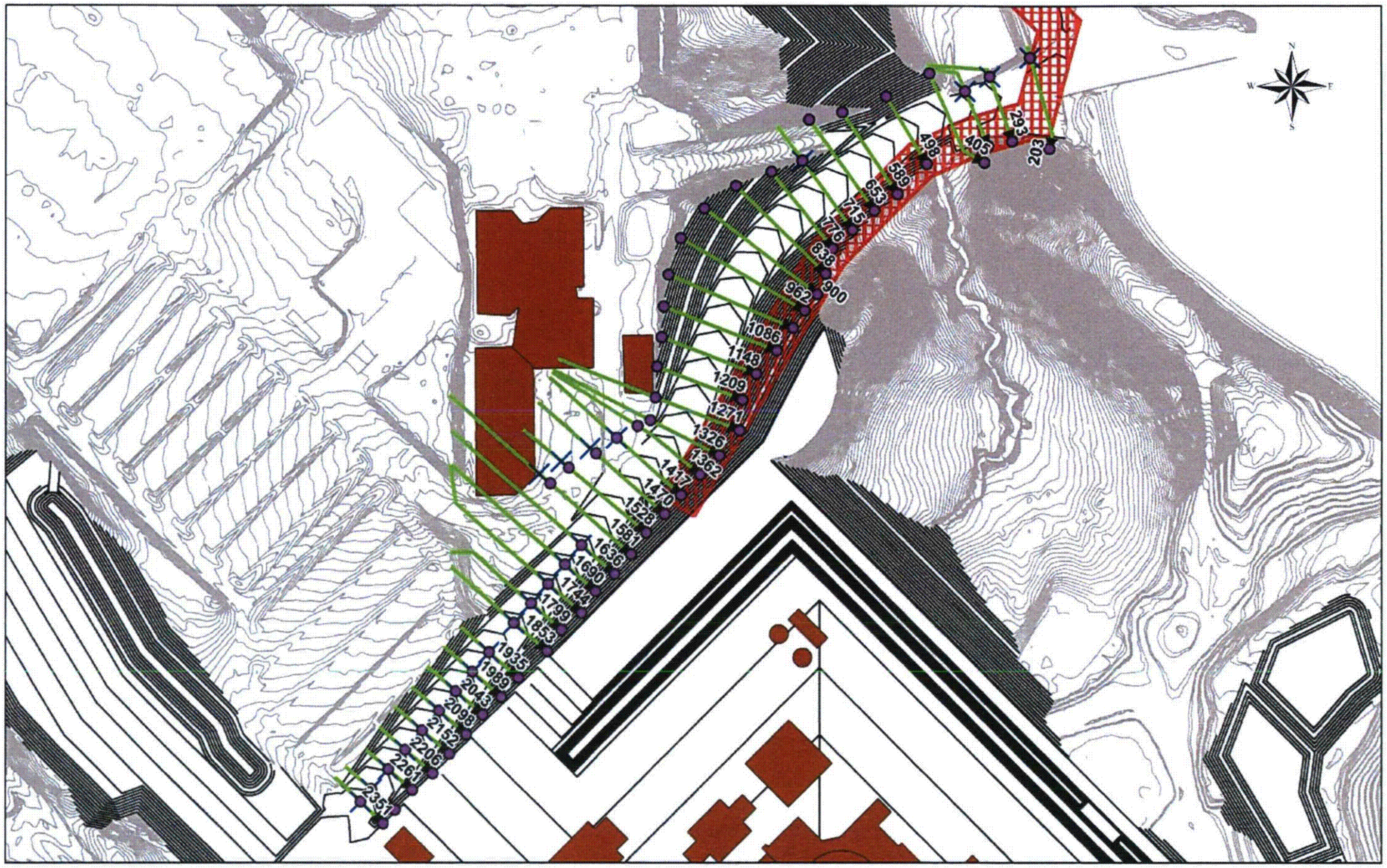


Figure2.4-7E HEC-HMS Basin Model



CALVERT CLIFFS UNIT 3: CROSS SECTION LOCATION PLAN

Legend

- BANKS
- INEFFECTIVE AREA
- CROSS SECTIONS
- UNIT 3 CONTOURS
- EXISTING CONTOURS
- BUILDINGS
- UTILITY CORRIDOR (WITH UHS MAKEUP WATER BURIED PIPING)

Projected Coordinate System: NAD 1983 StatePlane Maryland FIPS 1900 Feet
Datum: FT NGVD 29

0 125 250 500 750 1,000 Feet

Figure 2.4-7F HEC-RAS Cross Section Location Plan

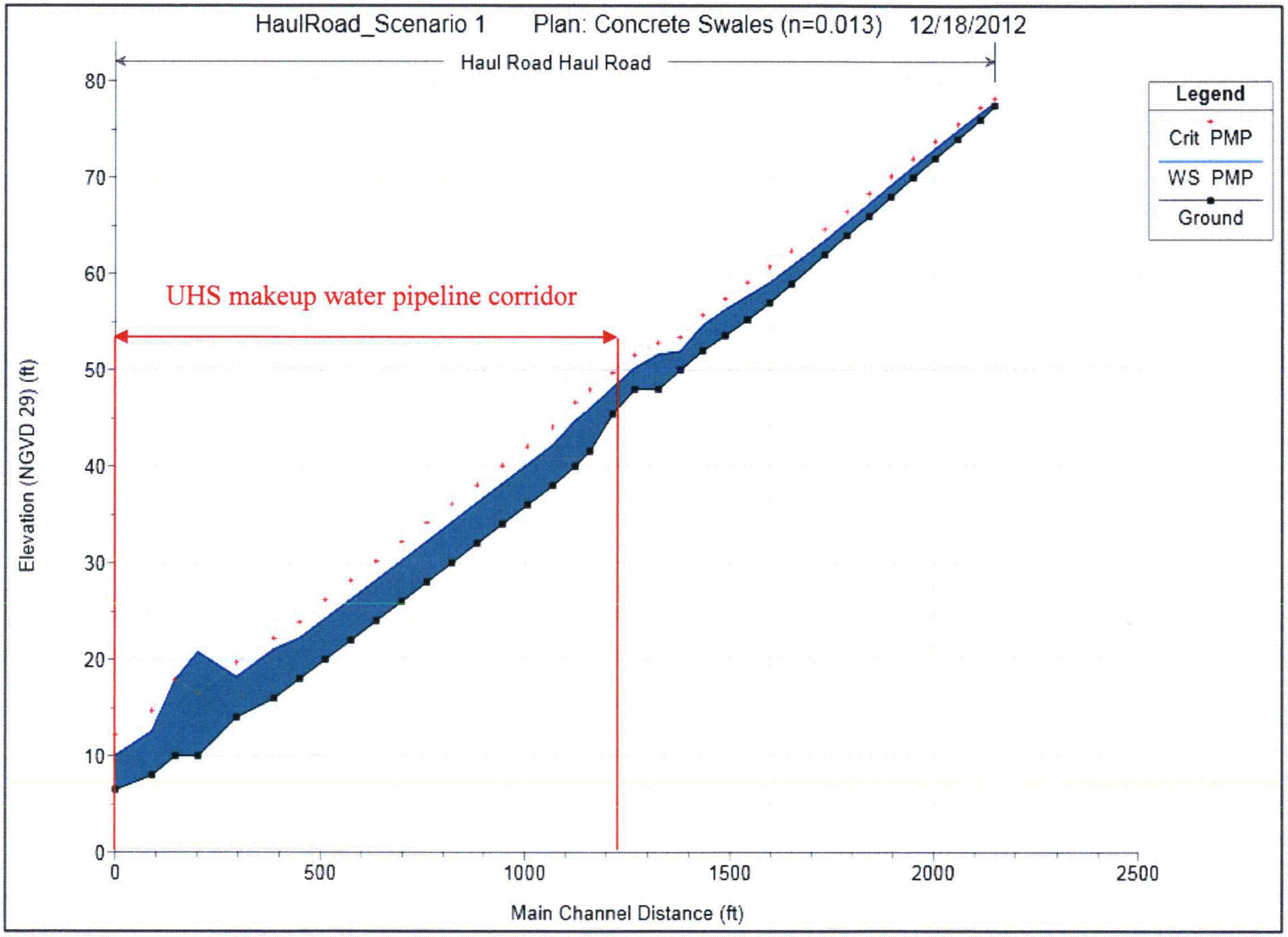


Figure 2.4-7G Water Surface Profile Plot for Concrete Lined Swales

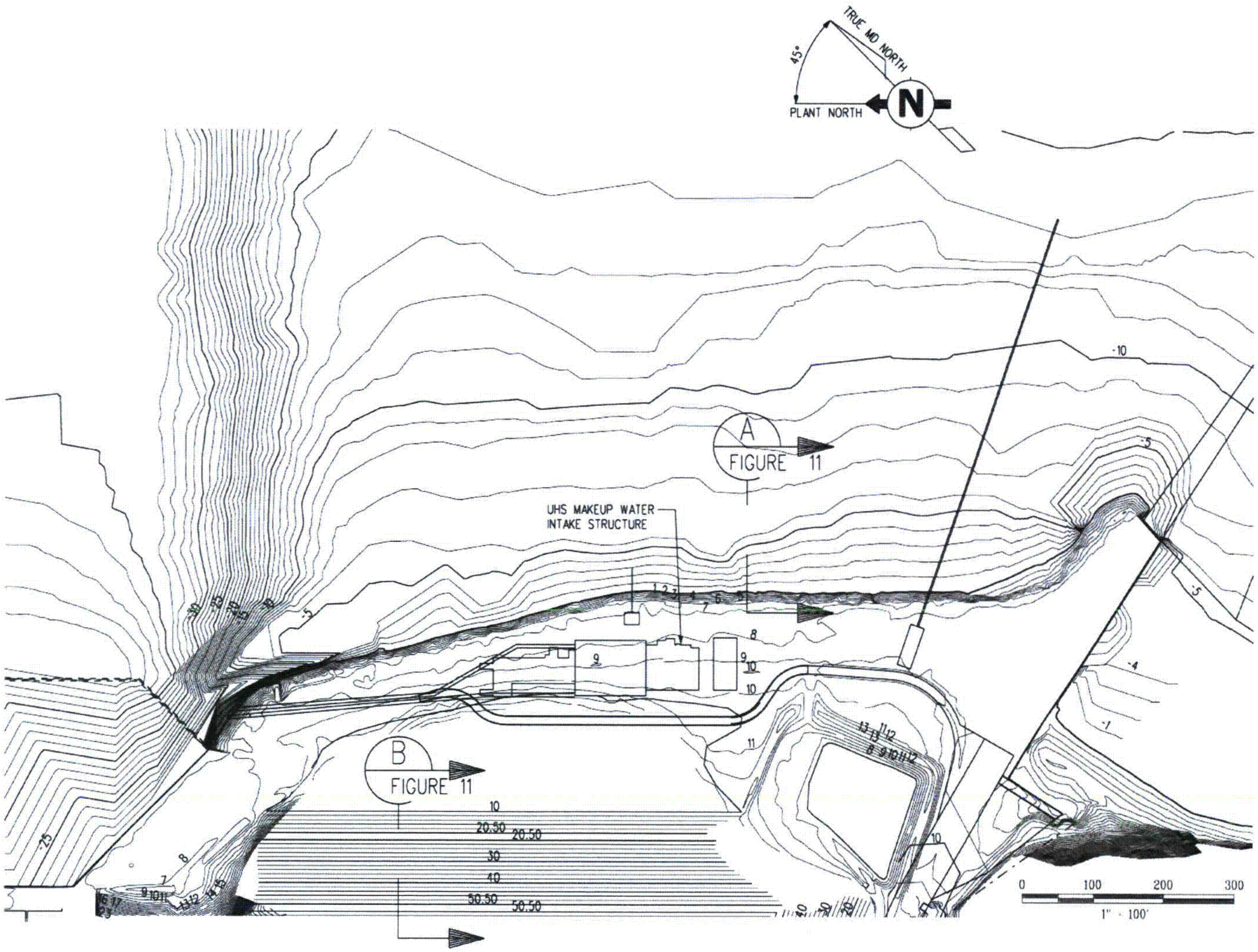


Figure 2.4-49A - Shoreline Area and Bathymetry

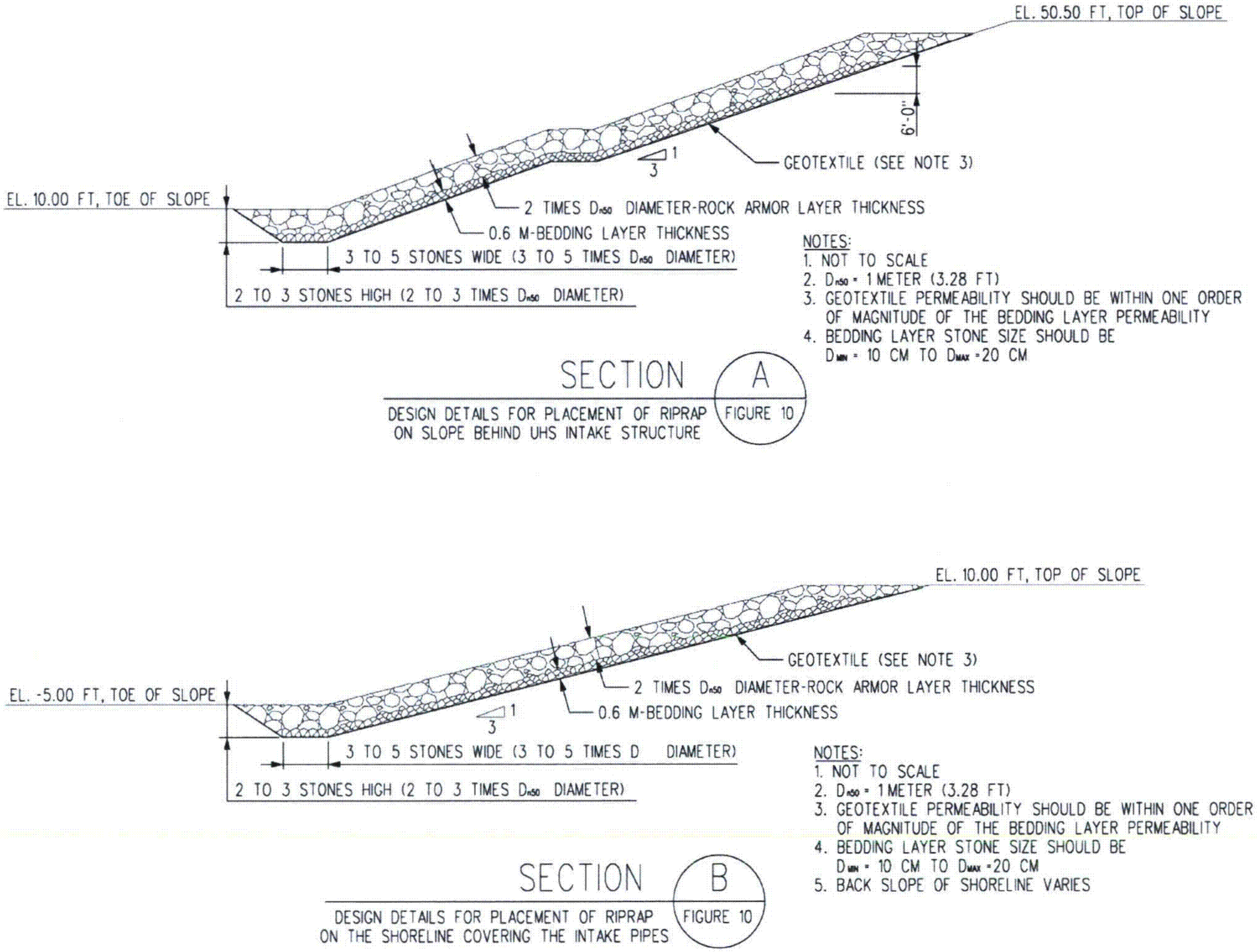


Figure 2.4-49B - Riprap Protection

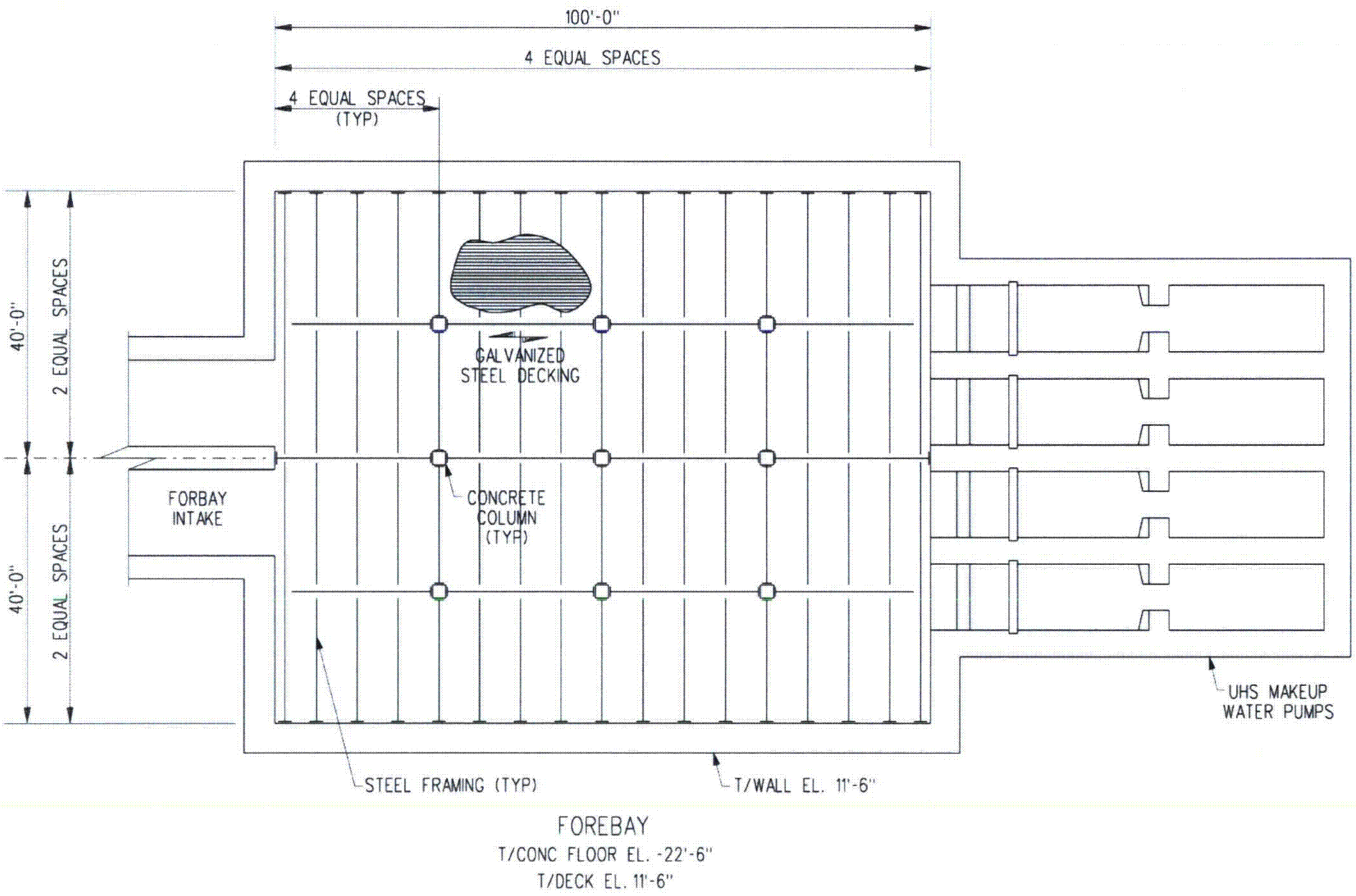


Figure 2.4-49C - - Unit 3 Forebay Cover

Table 2.4-17A - PMP Peak Discharges

Hydrologic Element	Drainage Area	Time of Concentration	Peak Discharge	Time of Peak*	Volume
	(mi^2)	(min)	(cfs)	ddmmmyyyy, hh:mm	(in)
Subbasin-1	0.0436	14.4	1068.9	15Aug2012, 00:40	18.24
Junction-1	0.0436	-	1068.9	15Aug2012, 00:40	18.24
Reach-1	0.0436	-	1068.9	15Aug2012, 00:40	18.24
Subbasin-2	0.0234	8.1	641.2	15Aug2012, 00:35	18.24
Junction-2	0.067	-	1695.2	15Aug2012, 00:40	18.24
Reach-2	0.067	-	1695.2	15Aug2012, 00:40	18.24
Subbasin-3	0.0255	6.3	831.2	15Aug2012, 00:35	18.24
Junction-3	0.0925	-	2306.3	15Aug2012, 00:40	18.24
Reach-3	0.0925	-	2306.3	15Aug2012, 00:40	18.24
Subbasin-4	0.0288	10.8	783.2	15Aug2012, 00:40	18.24
Junction-4	0.1213	-	3089.5	15Aug2012, 00:40	18.24
Subbasin-5	0.0176	6.3	573.7	15Aug2012, 00:35	18.24
Junction-5	0.1389	-	3511.2	15Aug2012, 00:40	18.24
Subbasin-6	0.0318	11.7	847.6	15Aug2012, 00:40	18.24
Subbasin-61	0.0203	5.4	727.1	15Aug2012, 00:35	18.24
Junction-6	0.0521	-	1376.7	15Aug2012, 00:35	18.24
Subbasin-8	0.0028	5.0	103.2	15Aug2012, 00:35	18.24
Junction-7	0.1938	-	4900.4	15Aug2012, 00:35	18.24

* The PMP storm control specifications are arbitrarily set to start on 15 August 2012, 00:00 and end on 15 August 2012, 06:00.

Table 2.4-17B - Manning's n values

Surface Cover	Selected Manning's n-values
Asphalt	0.016
Channel Lining (grass with soil stabilization)	0.04
Grass with Soil Stabilization	0.04
Short Grass	0.03
Trees	0.1

Table 2.4-17C - HEC-RAS Model Boundary Conditions

Boundary	Model Boundary Condition
Upstream	Normal Depth (0.057 ft/ft)
Downstream	Critical Depth

Table 2.4-17D - Maximum water surface elevations and channel velocities

Cross Section	Profile	Cumulative Q	Channel Invert Elevation (NGVD 29)	Water Surface Elevation (NGVD 29)	Critical Water Surface Elevation (NGVD 29)	Channel Velocity	Channel Froude Number
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	
2351	PMP	21.4	77.5	77.8	78.2	11.4	3.8
2316	PMP	42.8	76.0	76.7	77.3	11.3	2.8
2261	PMP	64.2	74.0	74.9	75.5	12.5	2.8
2206	PMP	85.6	72.0	73.0	73.8	13.7	2.9
2152	PMP	107	70.0	71.1	72.0	14.7	3.0
2098	PMP	128.4	68.0	69.2	70.1	15.6	3.1
2043	PMP	149.8	66.0	67.3	68.3	16.4	3.2
1989	PMP	171.2	64.0	65.4	66.4	17.1	3.2
1935	PMP	192.6	62.0	63.5	64.6	17.8	3.3
1853	PMP	300.7	59.0	60.8	62.4	18.7	3.1
1799	PMP	408.8	57.0	59.1	60.8	19.5	3.0
1744	PMP	516.9	55.2	57.8	59.1	19.9	2.9
1690	PMP	625	53.6	56.3	57.4	20.0	3.6
1636	PMP	733.1	52.0	54.7	55.7	18.9	3.7
1581	PMP	3930.7	50.0	52.0	53.4	21.0	2.9
1528	PMP	4038.8	48.0	51.7	52.9	18.2	3.0

Table 2.4-17D - Maximum water surface elevations and channel velocities

Cross Section	Profile	Cumulative Q	Channel Invert Elevation (NGVD 29)	Water Surface Elevation (NGVD 29)	Critical Water Surface Elevation (NGVD 29)	Channel Velocity	Channel Froude Number
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	
1470	PMP	4146.9	48.0	50.3	51.6	18.1	2.5
1417*	PMP	4255	45.5	48.2	49.7	19.6	2.8
1362*	PMP	4363.1	41.6	46.0	48.0	21.1	2.8
1326*	PMP	4471.2	40.0	44.8	46.7	21.8	2.8
1271*	PMP	4492.6	38.0	42.2	44.1	23.4	3.4
1209*	PMP	4514	36.0	40.2	42.1	23.6	3.4
1148*	PMP	4535.4	34.0	38.2	40.1	23.7	3.4
1086*	PMP	4556.8	32.0	36.2	38.1	23.8	3.4
1024*	PMP	4578.2	30.0	34.2	36.1	23.9	3.5
962*	PMP	4599.6	28.0	32.2	34.1	24.0	3.5
900*	PMP	4621	26.0	30.2	32.2	24.0	3.5
838*	PMP	4642.4	24.0	28.2	30.2	24.1	3.5
776*	PMP	4663.8	22.0	26.2	28.2	24.1	3.5
715*	PMP	4685.2	20.0	24.2	26.2	24.2	3.5
653*	PMP	5280.3	18.0	22.2	23.9	21.0	3.1
589*	PMP	5301.7	16.0	21.1	22.2	15.5	1.8
498*	PMP	5323.1	14.0	18.2	19.7	17.9	2.1
405*	PMP	8061.5	10.0	20.8	16.6	5.5	0.4
350*	PMP	8095.9	10.0	17.9	17.9	13.8	1.0
293*	PMP	8130.3	8.0	12.6	14.7	21.8	2.2
203*	PMP	8164.7	6.5	10.1	12.2	22.8	2.7

*Cross sections where UHS makeup water pipes will be buried underneath.

Enclosure 3

Table of Changes to CCNPP Unit 3 COLA Associated with the Response to RAI No. 328, Question 02.04.10-1 Calvert Cliffs Nuclear Power Plant, Unit 3

Table of Changes to CCNPP Unit 3 COLA

Associated with the Response to RAI No. 328

Change ID #	Subsection	Type of Change	Description of Change
Part 2 – FSAR			
09-0121	2.4.10	Incorporate CCNPP Unit 3 COLA Revision 5 changes[2].	The CCNPP Unit 3 COLA Revision 5 modified FSAR 2.4.10 as part of changes associated with the Ultimate Heat Sink (UHS).
12-0228	2.4.2, 2.4.2.3.1, 2.4.2.3.2, 2.4.2.4, 2.4.10, Figure 2.4-7 (multiple), Figure 2.4-49 (multiple), Table 2.4-17 (multiple).	Incorporate COLA markups associated with the response to RAI 328 Question 02.04.10-1.	The response to RAI 328 Question 02.04.10-1 modifies FSAR paragraphs in Sections 2.4.2.2 and 2.4.10, adds paragraphs to Sections 2.4.2.2 and 2.4.10, divides Section 2.4.2.3 into two sections and adds material, adds references to Section 2.4.2.4, and adds figures and tables to Section 2.4.

[2] UniStar Nuclear Energy Letter UN#09-308, from Greg Gibson to Document Control Desk, U.S. NRC, Submittal of Revision 5 to the Combined License Application for the Calvert Cliffs Nuclear Power Plant, Unit 3, and Application for Withholding of Documents, dated June 30, 2009