Initial Inflow Design Flood Control System Plan

Brunner Island Ash Basin No. 6

Prepared for:
Brunner Island, LLC

October 11, 2016

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Contents

Appendices

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1.0 Executive Summary

This report presents the Initial Inflow Design Flood Control System Plan for the Brunner Island Ash Basin No. 6 facility. This plan was prepared by HDR Engineering, Inc. (HDR) in accordance with the requirements of the U.S. Environmental Protection Agency (USEPA) 40 CFR Parts 257 and 261 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities, April 17, 2015 (USEPA 2015) (CCR Final Rule). The CCR Final Rule establishes nationally applicable minimum criteria for the safe disposal of CCR in landfills and surface impoundments and requires that the owner or operator of each CCR unit demonstrate and document that the CCR unit complies with these criteria.

Brunner Island Ash Basin No. 6 is an operating Coal Combustion Residual (CCR) surface impoundment, referred to as an ash basin, which is owned and operated by Brunner Island, LLC, a division of Talen Energy (Talen). The ash basin, which has been partially filled with ash, is formed by an earth embankment perimeter dike with a maximum height of approximately 30 feet. The ash basin is, therefore, required to have an Inflow Design Flood Control System Plan certified by a qualified engineer in accordance with the CCR Final Rule §257.82(c)(5). This is the initial (first) Inflow Design Flood Control System Plan prepared in accordance with the CCR Final Rule. The ash basin is also subject to regulation by the Pennsylvania Department of Environmental Protection (PADEP) and has been previously found to satisfy the spillway capacity requirements of the PADEP Dam Safety Guidelines, though USEPA and PADEP have different spillway adequacy criteria.

The inflow design flood control system plan must document how the CCR meets the following requirements:

- The inflow design flood control system must adequately manage flow into the CCR during the peak discharge of the inflow design flood;
- The inflow design flood control system must adequately manage flow from the CCR to collect and control the peak discharge resulting from the inflow design flood; and
- Discharge from the CCR must be handled in accordance with the surface water requirements in accordance with USEPA National Pollutant Discharges Elimination System (NPDES) (NPDES, 40 CFR Section 257.3-3).

For USEPA, the inflow design flood (IDF) is the 1,000-year flood for a significant-hazard-potential surface impoundment, as discussed in the 2016 Initial Dam Failure Analysis and Hazard Potential Classification Report (HDR 2016).

The ash basin is somewhat unique from a hydrological perspective, in that the ash basin is elevated with respect to the surrounding ground and is totally self contained, with no tributary inflow from outside of the basin. Based on a review of existing and proposed surface contours, the analyses assumed that all rainfall falling within the basin drains to and is routed through the open part of the reservoir. Talen is currently performing ash removal activities within the impoundment which is actively improving areas where existing slopes and drainage provisions may not have been adequate and is currently constructing drainage improvements in these areas.

A rainfall/storage/discharge model has been created to model the hydrologic response of the ash basin to a flood corresponding to the 1,000-year precipitation from the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14, per USEPA regulations. The full 24-hour, 1,000-year storm, with a total precipitation of 12.4 inches, was utilized in the hydraulic model, resulting in a peak total inflow volume of 67 acre-feet to the main basin. The discharge characteristics of the filled part of the main basin were developed using 2015 topographic and bathymetric data provided by Talen.

The discharge from the polishing pond may be affected by backwater effects of the Susquehanna River during a major flood. Because the size and hydrologic timing of the drainage areas for the ash basin and the Susquehanna River differ greatly, a 100-year flood was assumed to be occurring concurrently on the Susquehanna River, which results in a peak stage of 278.2 feet adjacent to the ash basin. All elevations in this report are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29), which is also Plant Datum.

The peak stage within the main basin resulting from the 1,000-year flood was determined to be elevation 286.9 feet, occurring 12.8 hours into the storm. Wave run-up under flood conditions was estimated to be 1 foot, resulting in a net freeboard of 2.1 feet, which is considered acceptable. This analysis assumes that the ash basin was designed and constructed as shown on the drawings provided in Appendix A.

Talen has verified that Ash Basin No. 6 is operated in compliance with the USEPA NPDES Permit No. PA0008281 Discharge Monitoring Report.

2.0 Project Description and History

Ash Basin No. 6 is located between Black Gut Creek and the Susquehanna River at the southern end of Brunner Island in East Manchester Township, York County, Pennsylvania. The island is located along the western shore of the river and can be located on the York Haven USGS 7.5 Minute Quadrangle Map at 40°04′59″N, 76°40′58″W. An aerial view and drawings of Ash Basin No. 6 are provided in Appendix A.

The surface impoundment consists of a main basin with a polishing pond on the southern end. The ash basin has a total area of 76.4 acres and is surrounded by a perimeter dike with a nominal crest elevation of 290 feet and a length of about 8,400 feet. The northern end of the main basin has been filled with ash to near the crest of the dike and has a surface area of 64.3 acres. Bottom ash is currently removed prior to entering the surface impoundment; therefore, only the process water is currently sluiced into the basin. Low volume process waste water is also sluiced into the basin. The area of the open pool at the southern end of the main basin is 9.4 acres, which is controlled by a weir in the outlet structure. The last stoplog was removed during the summer of 2015, with the top of fixed weir elevation of 283.50 feet, providing a normal water surface elevation of approximately 284.2 feet and a normal freeboard of 5.8 feet. The main basin is separated from the polishing pond by an intermediate dike, with the main basin outlet structure connecting the two basins with a 48-inch-diameter buried pipe with a Komax static mixing chamber located in the outlet piping of the main basin that is used for environmental testing and control. The polishing pond is used for final treatment of the process water before it is discharged to the Susquehanna River. The polishing pond has an area of 2.7 acres and is controlled by twin baffled morning glory outlet structures, with top-of-weir elevations of 268.0 feet, which both discharge into a single 48-inch-diameter pipe to the river. The water elevation in the polishing pond is normally maintained slightly above elevation 268.0 feet. A flap gate is provided at the river end of the discharge pipe to prevent river water from entering the ash basin during high tailwater conditions.

The perimeter dike is constructed with random earth fill and includes a 10-foot-thick clay liner covering the upstream slope from bedrock to elevation 287.5 feet. The crest of the perimeter dike is nominally at elevation 290 feet, and the maximum height of the dike is about 30 feet. Overall, the perimeter dike is about 8,300 feet long.

The polishing pond outlet structure consists of two 60-inch-diameter, reinforced-concrete riser pipes with a top-of-weir elevation of 268.0 feet draining into a single, 48-inch-diameter, reinforced-concrete discharge pipe that discharges into the Susquehanna River.

3.0 Inflow Design Flood Control Plan

Documentation and assessment of the required elements of the Inflow Design Flood Control Plan are provided below.

3.1 Managing Flow Into CCR During IDF

As noted previously, the site is unusual from a hydrologic perspective in that the ash basin is constructed completely above ground and is higher than the surrounding area, so that no runoff enters the basin from adjacent areas. Site grading indicates that, in general, runoff will drain towards the open part of the basin, as required by the CCR Final Rule, though this was not analyzed specifically. Talen has identified areas where existing slopes and drainage provisions may not be adequate and is currently constructing drainage improvements in these areas. For the analysis of the outlet works, HDR conservatively assumed that all rainfall falling on the basin stays within the basin and drains to the open-water section of the main basin.

Schnabel Engineering conducted a structural stability analysis in 2015, which included documentation that the 1,000-year flood elevation for the Susquehanna River would reach a maximum water surface level of 289.5 feet, 0.5 feet below the crest of Ash Basin No. 6. Therefore, the ash basin will not be overtopped during the 1,000-year flood of the

Susquehanna River, verifying that there would be no inflow to the basin from the adjacent area for any flood events up to the IDF.

3.2 Managing Flow From the CCR During the IDF

A hydrologic and hydraulic assessment was conducted by HDR to assess if the inflow design flood control system can adequately manage flow from the CCR to collect and control the peak discharge resulting from the IDF. This analyses consisted of the following steps:

- Development of the 1,000-year flood, based on 1,000-year precipitation, and determination of the resulting inflow;
- Routing of the inflows through the filled part of the basin and into the open basin;
- Discharge of flow from the main basin to the polishing pond;
- Routing of the inflow to the polishing pond and the inflow from the main basin; and
- Discharge from the polishing pond into the Susquehanna River.

The hydrologic model, HydroCAD v9.0 (model), was selected for use due to the small size of the study basin and the program's ability to model complex outlet controls. HydroCAD combines portions of the Natural Resource Conservation Service (NRCS) computer programs TR-20 and TR-55, in addition to built-in hydraulics, graphics, database references, and on-screen routing diagrams. The program models the precipitation, runoff, and routing of flows through the drainage, as well as the outlet hydraulics of the structures.

<u>Development of the On-site 1,000-Year Precipitation</u>

The CCR Final Rule stipulates that the spillway system shall adequately manage flow into and from the surface impoundment during and following the peak discharge of the IDF. For dams with a significant-hazard-potential classification, the IDF is specified as the 1,000-year flood, which is also consistent with the Federal Emergency Management Agency's (FEMA) "Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams" guidance for selecting and accommodating IDFs for dam, which the USEPA referred to while evaluating the adequacy of the CCR surface impoundment's hydrologic and hydraulic capacity during its assessment effort. The 1,000-year flood was determined by routing the 1,000-year precipitation. FEMA guidance documents reference the use of NOAA's National Weather Service Atlas 14 Precipitation Frequency Atlas for the United States to determine the precipitation to be used in developing the IDF for dams. Using NOAA's Atlas 14, the 24-hour, 1,000-year precipitation was determined to be 12.4 inches for the project location.

<u>Routing of the On-site IDF</u>

HDR used HydroCAD to model the hydrologic response of the basin to the 1,000-year precipitation. The HydroCAD model is capable of simulating the rainfall, runoff, and routing and provides a detailed simulation of the outlet hydraulics for the complicated arrangement of stoplog weirs, vertical inlets, and piping. The HydroCAD model uses NRCS curve number and time-of-concentration techniques with reach routing to calculate discharge hydrographs. The model uses the dynamic Muskingum-Cunge routing for reach routing.

Infiltration was assumed in the above-water part of the basin, utilizing Curve Numbers of 80 and 88, corresponding to a moderately impermeable soil cover, per TR-55 methodology. Of the 76.4 acre-feet of precipitation that falls during the modeled storm, the total infiltration was 9.0 acre-feet, or an average of 1.7 inches of rainfall over the 64.9 acres of the upland areas of the basin, which excludes open water. Talen maintains several piezometers within the above-water part of the basin that indicate the depth to the groundwater table, which is used to estimate the anticipated void space and subsurface storage capacity. From this assessment, it was assumed that limited infiltration can be accommodated prior to saturation of the above-water part of the basin.

The model was developed assuming full hydraulic capacity of the discharge system, based on the following assumptions:

1. Vegetation is regularly maintained along the interior of the main basin and polishing pond to prevent debris build up and accumulation within the outlet works.
2. The site is staffed during extreme floods so that discharge structure performance can be monitored and appropriate actions can be taken. As stated in the Brunner Island Ash Basin Emergency Procedure EP No. 11, issued November 17, 2015, there is an Operations On-Duty Shift Supervisor designated as the Ash Basin's Incident Commander during an emergency event.
3. Field conditions are verified regularly to ensure conditions are consistent with the assumptions of well-maintained control structures and that debris accumulation or deterioration of the structures or other conditions that would increase headloss in the discharge pipelines, control structures, and regulating or control valves and gates is addressed.
4. Measures are taken to restore the reservoir to normal levels after floods to reduce the potential adverse effects of back-to-back storms.
5. Spillway discharge requirements are accounted for in long-term closure plans, including the need to prevent or safely pass trash and vegetation and assess long-term maintenance requirements.

On-site IDF Discharge from the CCR and Into the Susquehanna River

The discharge structure from the main basin consists of a stoplog-controlled concrete vault that discharges through a 48-inch-diameter, reinforced-concrete pipe (RCP) with an in-line Komax static mixing chamber and into the polishing pond. The primary hydraulic control during normal operating conditions is a weir, with the headpond overflowing the bulkhead (as stoplogs were removed in 2015) with a crest elevation of 283.50 feet. Secondary means of conduit closure are available, including a skimmer gate section which could form an emergency stoplog slot, as well as a gate located immediately upstream of the pipe inlet. These secondary means of closure were assumed to be fully open and were assumed to have negligible headloss. The structure geometry was taken from construction drawings for the outlet provided by Talen. A Manning's n value of 0.015 was assumed, corresponding to concrete pipe formed with rough forms. HydroCAD was used to estimate the discharge dynamically for the inflow and outflow hydrographs, accounting for the effects of varying water levels in the main basin, polishing pond, and the Susquehanna River. The anticipated starting reservoir elevation of 284.2 feet was provided by Talen. Discharge characteristics for the Komax mixing chamber were provided by the manufacturer in the form of pressure loss in pounds per square inch (psi) versus discharge in cubic feet per second (cfs). These values were converted to headloss in feet of head (ft) and applied as a user-defined head-discharge outlet structure in HydroCAD to account for headloss through the mixing chamber. Discharge was found to be controlled by the mixing chamber for the peak discharge from the main basin. The outlet structures and all piping were assumed to be free of debris.

The polishing pond outlet structure consists of two vertical, 60-inch-diameter risers that merge with one 48-inch-diameter discharge pipe that passes through the perimeter dike, enters and exits an emergency closure structure, and discharges to the river where a heavy flap valve serves as a back-flow preventer. The top-of-weir elevation is 268.0 feet, controlling the polishing pond elevations. A Manning's n value of 0.015 was assumed for the 48-inch-diameter outlet pipe, corresponding to concrete pipe formed with rough forms.

Because the size and hydrologic timing of flows from the drainage areas for the ash basin and the Susquehanna River basin differ greatly, a 100-year flood was assumed to be occurring concurrently on the Susquehanna River with the 1,000-year precipitation of the ash basin, resulting in a peak river stage of 278.2 feet at the outlet from the polishing pond. This elevation was taken from the Slope Stability Assessment Report by HDR, dated December 2009. The Susquehanna River flows react relatively slowly to basin precipitation compared to the ash basin, and the river flood level was assumed constant at the 100-year-flood level for the duration of the ash basin flood assessment.

IDF Discharge Analysis Results

Table 1 Spillway Design Flood Analysis Summary – Starting Elevation 284.20 Feet

Main Basin	
Peak Stage, feet	286.93
Peak Discharge, cfs	92.95
Time to Peak Stage, hours	12.77
Time to Peak Discharge, hours	12.38

Polishing Pond	
Peak Stage, feet	280.46
Peak Discharge, cfs	89.75
Time to Peak Stage, hours	13.84
Time to Peak Discharge, hours	13.84

The peak stage within the main basin resulting from the 1,000-year flood was determined to be elevation 286.9 feet, occurring 12.8 hours into the storm. A wave run-up estimate, included as Appendix C, resulted in a wave run-up height of 1 foot for flood conditions. Applying the wave run-up height to the 1,000-year precipitation event peak water surface elevation results in a net freeboard of 2.1 feet, which is considered acceptable. The HydroCAD analysis report is provided in Appendix B. The U.S. Bureau of Reclamation's *Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams* (1981) provides criteria of 1 foot minimum freeboard allowance, considered necessary to account for the potential malfunction of the gated spillway, though there are no gates that require operation at the ash basin.

3.3 Handling Discharge from the CCR

The Final Rule requires that the discharge from the ash basin be handled in accordance with USEPA National Pollutant Discharges Elimination System (NPDES) (NPDES, 40 CFR Section 257.3-3). The Ash Basin No. 6 NPDES sampling point is monitoring location No. 004. Talen verified that Ash Basin No. 6 is in compliance with Ash Basin No. 6 USEPA NPDES Permit No. PA0008281 Discharge Monitoring Report.

4.0 Conclusions and Certification

Ash Basin No. 6 can adequately manage inflow to the basin and flow from the basin during and following the 1,000-year flood with the current normal main basin water surface elevation of 284.2 feet and the control structures fully open, while providing adequate freeboard allowance.

Site grading documentation provided by Talen indicates that, in general, runoff will drain towards the open part of the basin, as required by the CCR Final Rule, though this was not analyzed specifically.

Talen has verified that Ash Basin No. 6 is in compliance with the USEPA NPDES Permit No. PA0008281 Discharge Monitoring Report.

Based on the information currently available and provided to HDR, I certify to the best of my knowledge, information, and belief that, the Inflow Design Flood Control System Plan meets the requirements of CCR Rule §257.82(c) Hydrologic and Hydraulic Capacity

Requirements for CCR Surface Impoundments, Inflow Design Flood Control System Plan, in accordance with professional standards of care for similar work. HDR appreciates the opportunity to assist Talen with this project. Please contact us if you have any questions or comments.

HDR ENGINEERING, INC.

10/11/2016

Adam N. Jones, P.E.
Senior Engineer

Christopher R. MacDonald, P.E.
Civil Engineer

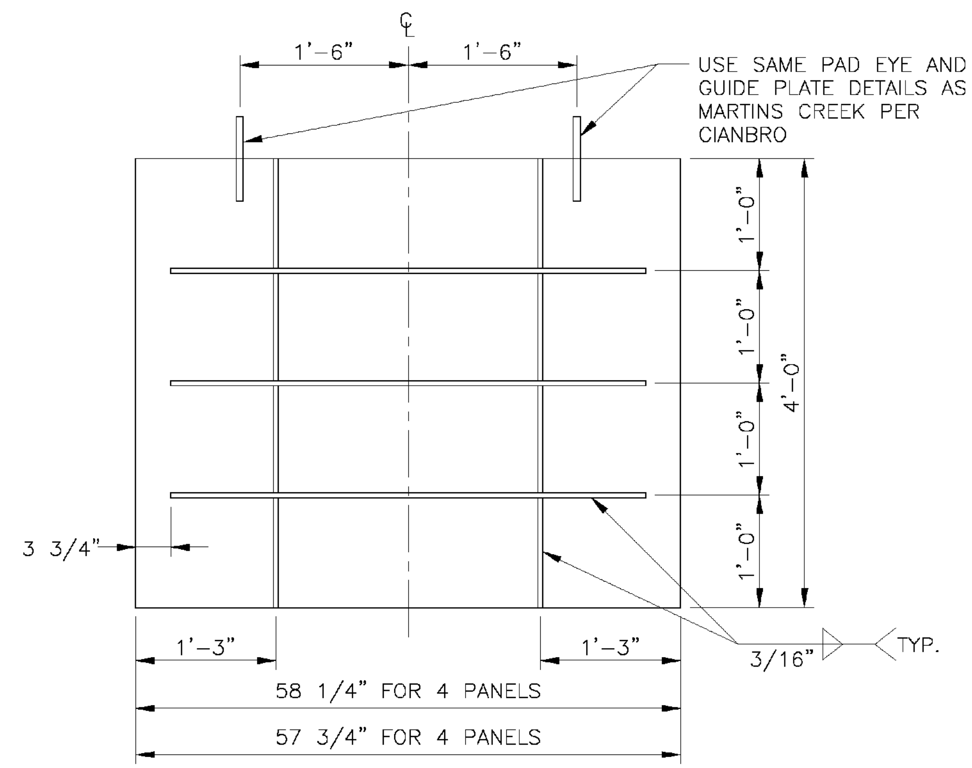
Jennifer N. Gagnon, P.E.
Associate Engineer

Appendix A. Reference Photos and Drawings

Kleinschmidt
Energy & Water Resource Consultants
75 Main St. P.O. Box 576
Pittsfield, Maine 04967
Telephone: (207) 487-3328
Fax: (207) 487-3124
www.KleinschmidtUSA.com

Page:	BI-SK-1
Project No:	112-054
Project:	BRUNNER ISLAND FOR CIANBRO BALTIMORE
Subject:	ASH BASIN OUTLET MODIFICATIONS
By: LLC	Date: 1/10/06
Checked: JML	Date: 1/13/06

SKIMMER GATE PANELS



PANEL ELEVATION
3/8"= 1'-0"

NOTES:

1. PLATE 1/2" THICK
2. STIFFENERS 1/2"x 4"
3. MATERIAL – STAINLESS STEEL WITH MIN. Fy=30 ksi
4. TOTAL 8 PANELS
5. DESIGN WATER ELEVATION EL. 290'
6. IN LIEU OF STAINLESS STEEL, GRADE 50 CARBON STEEL CAN BE USED WITH THE FOLLOWING TREATMENT:

   SHERWIN WILLIAMS TARGUARD COAL TAR EPOXY, 10 TO 16 MILS DFT, SURFACE PREP SSPC-SP6, OR APPROVED EQUAL

J:\112\054\Drawings\112-054 Brunner Revised 1-10-06.dwg

NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED

ACCT-
SCALE- NTS
BY- KLEINSCHMIDT
REVIEWED G.D.HOPFER

BRUNNER ISLAND S.E.S.
ASH BASIN OUTLET MODIFICATIONS
SKIMMER GATE PANEL
ELEVATION AND DETAILS

APPROVED KLEINSCHMIDT 1/13/06 DATE

PPL CORP.

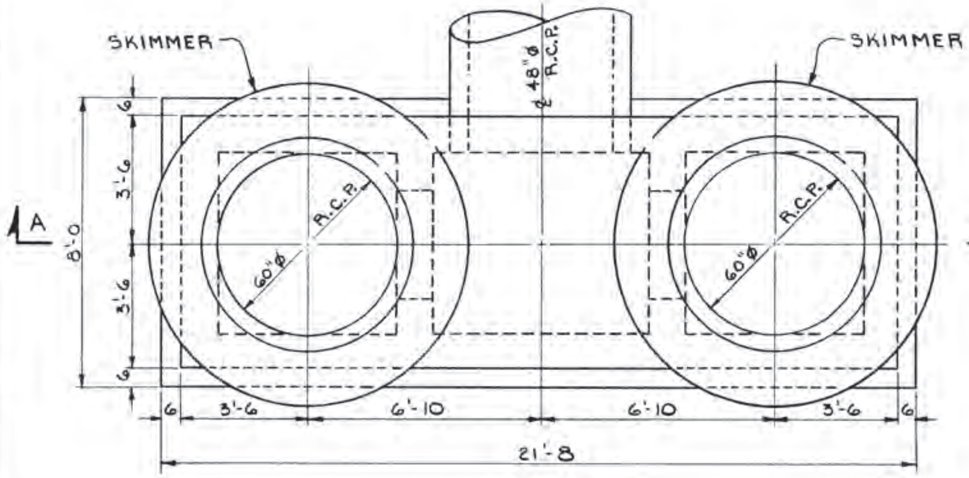
PPL DRAWING NO.	SHEET NO.	REV.
B324374	1	0

PC CAD

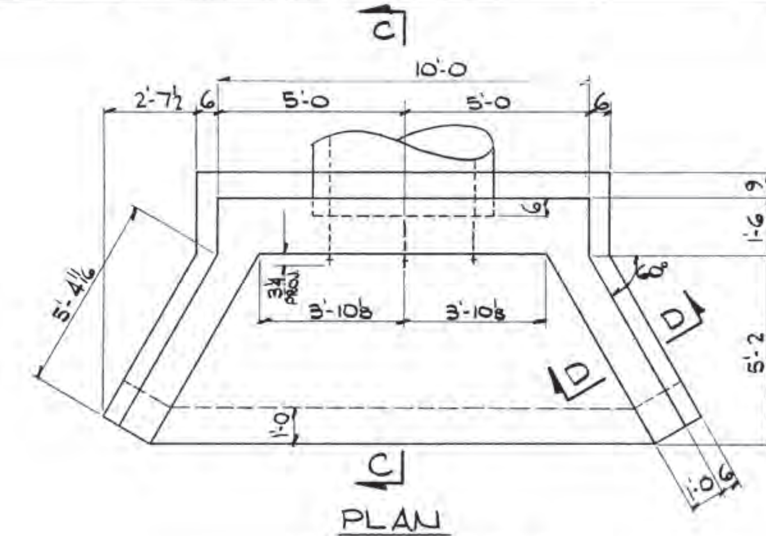
FRACTIONAL DECIMAL LOCATION CODES SORTS

B324374_S1.dwg

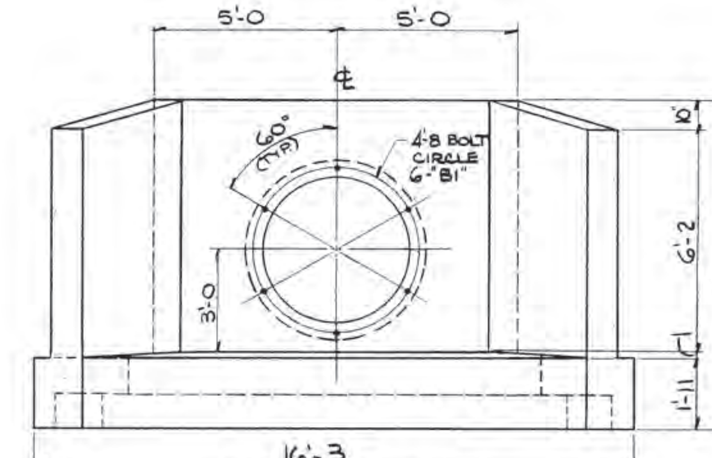
PPL CORP. FORM 4163B (4/00)
Nov. 6, 2006 - 8:19 AM



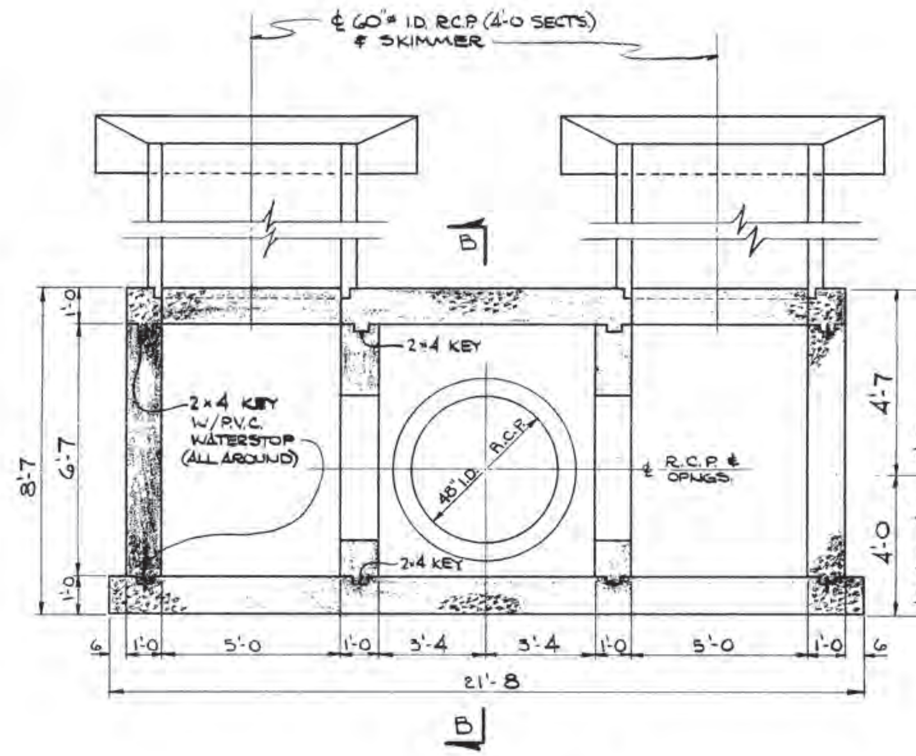
PLAN
(OUTLET WORKS)



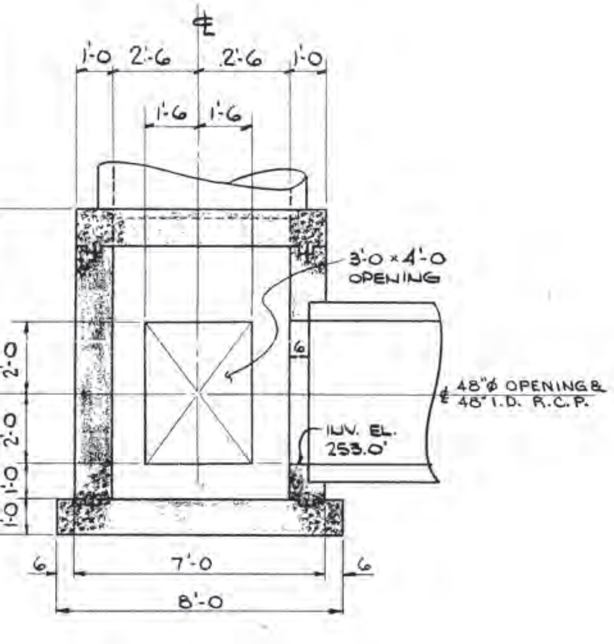
PLAN
WINGWALL
(FLAP VALVE NOT SHOWN)



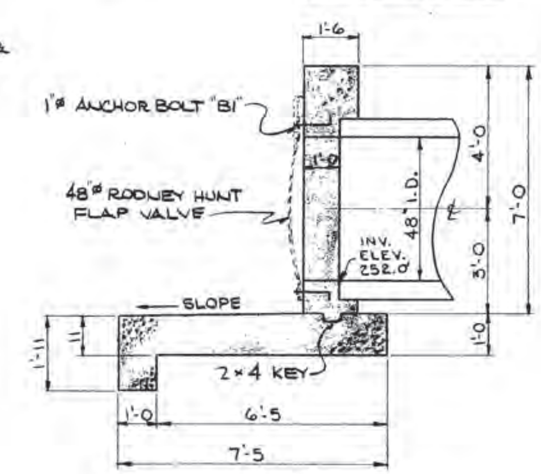
ELEVATION



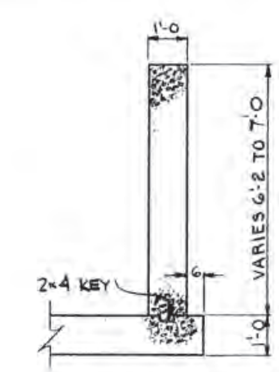
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

LIST OF MATERIAL

QUANT.	DESCRIPTION
AS REQ'D	CU. YDS. CONCRETE.
ONE	LOT OF REINF. FOR OUTLET WORKS & WINGWALL PER A-158186
2	SKIMMERS PER DETAILS ON DRAWING E-178080
ONE	48"ø RODNEY HUNT FLAP VALVE SERIES FV-AC TEMP NO. B-048042 W/BRONZE SEATS AS MFG. BY RODNEY HUNT CO. ORANGE, MASS.
6	ANCHOR BOLTS "B1" PER DETAIL THIS DRAWING, SH. 2.
4	PCS. 60"ø × 4'-0 LONG EXTRA STRENGTH R.C.P. - T & G.
110	LIN. FT. P.V.C. WATERSTOP #4316 AS MFG. BY W.R. MEADOWS OF PA., INC. YORK, PA. OR EQUAL.

NOTES

REINFORCING BARS TO BE INTERMEDIATE GRADE, DEFORMED STEEL BARS, CONFORMING TO ASTM A-615 - GRADE 60.

CONCRETE SHALL BE IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE'S LATEST REVISION, AND DEVELOP A 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI.

REFERENCE TITLE	NUMBER
NEW FLY ASH DISPOSAL BASIN #6	E-158595
LIST OF REINFORCING	A-158186
SKIMMER DETAILS	E-178080
POLISHING POND - PLAN & DETAILS	E-178085

ER- 102351
SCALE- AS SHOWN
DATE- 7-31-79
DRAWN- CDJ
CHECKED- GDC
LEADER-
APPR'D-
APPR'D-

BRUNNER ISLAND S.E.S.
ASH BASIN #6
OUTLET WORKS & WINGWALL
PLANS, ELEVATIONS & SECTIONS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA. Nº 1 OF 2

APPROVED John A. Stefanik 7/31/79 RESPONSIBLE ENGINEER

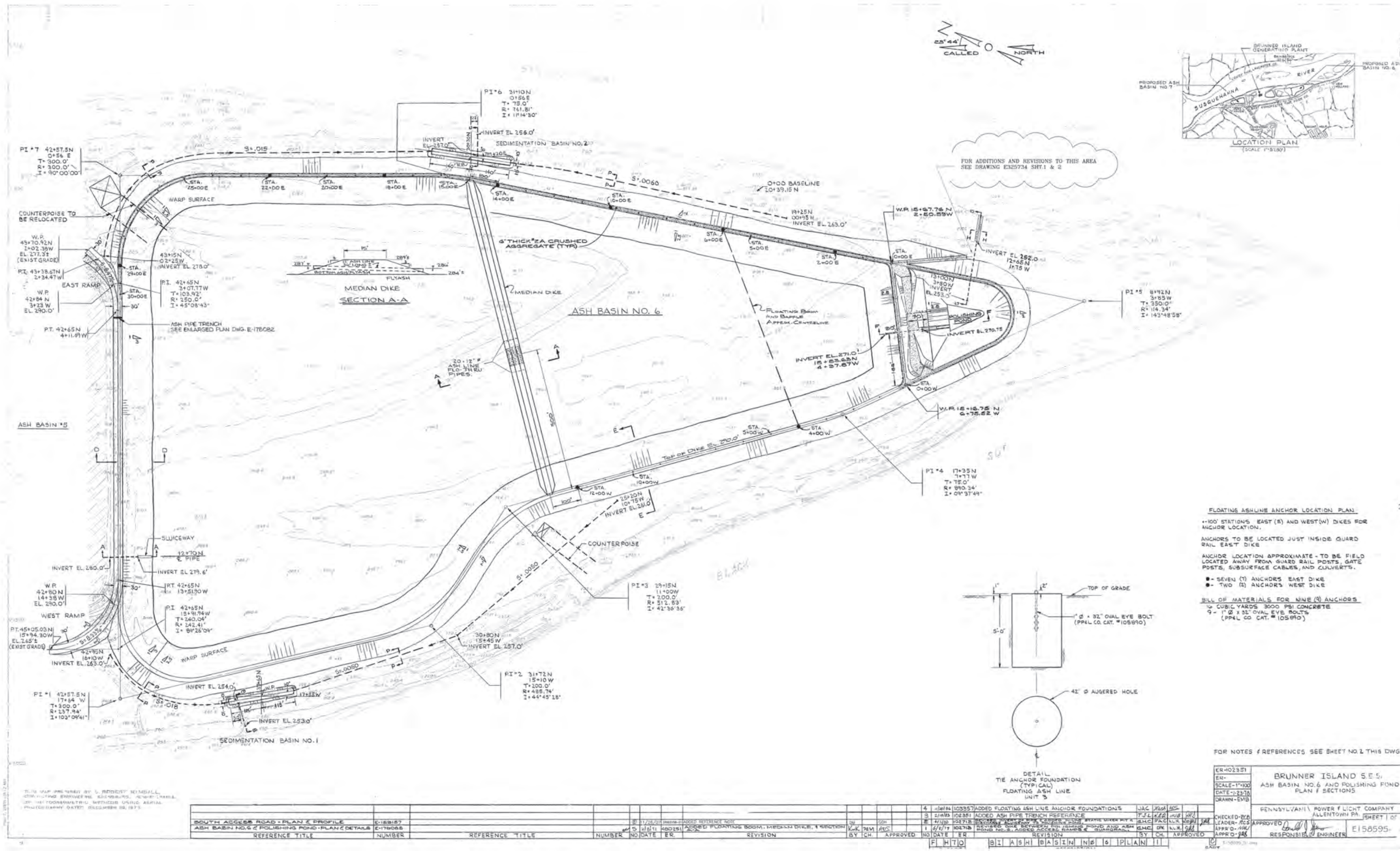
D-158185-0

NO. DATE ER. REVISION BY CH. APPROVED

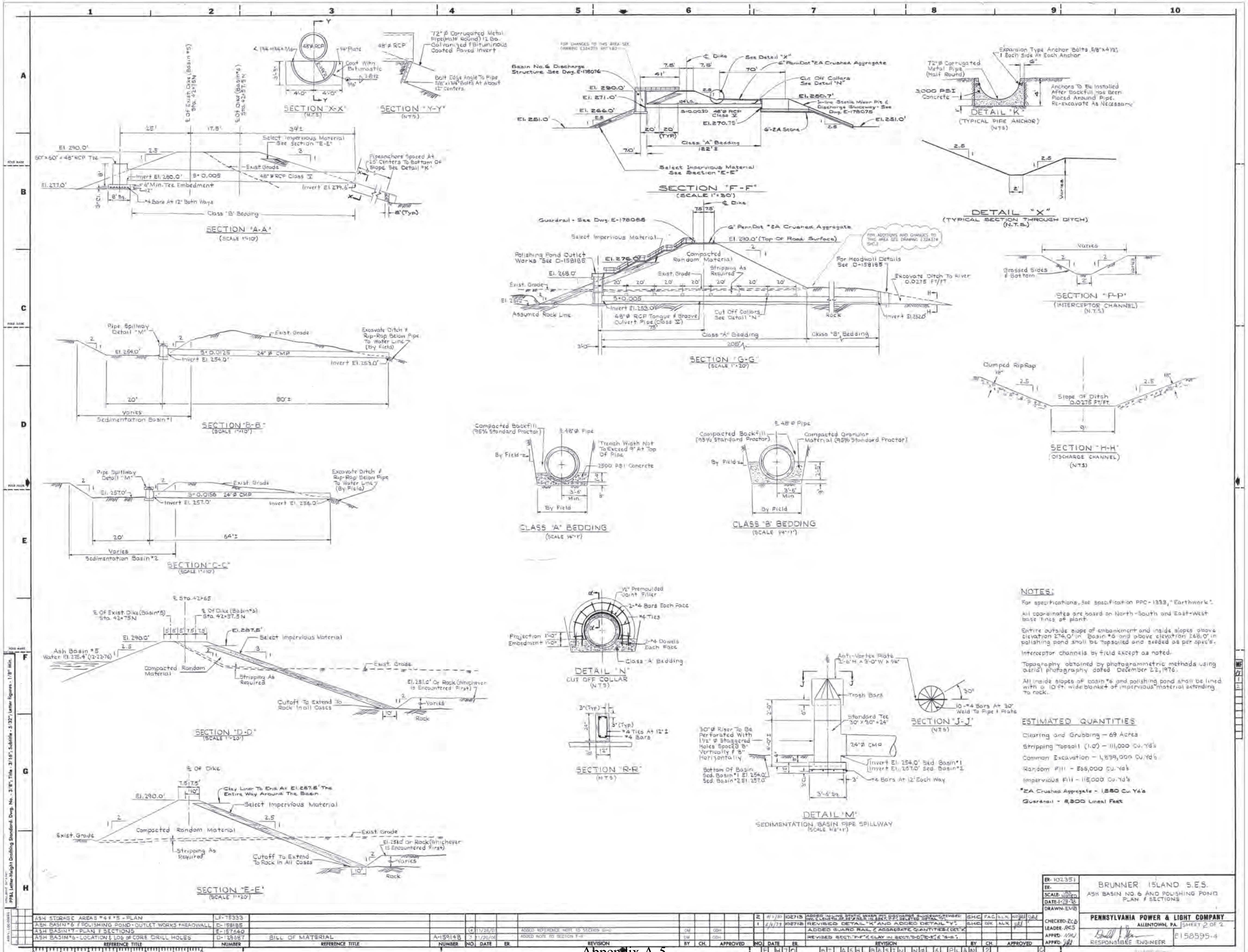
F H70 LOC CODE

BSN 6 OUT & WINGWL PLN & SECT DESCRIPTION

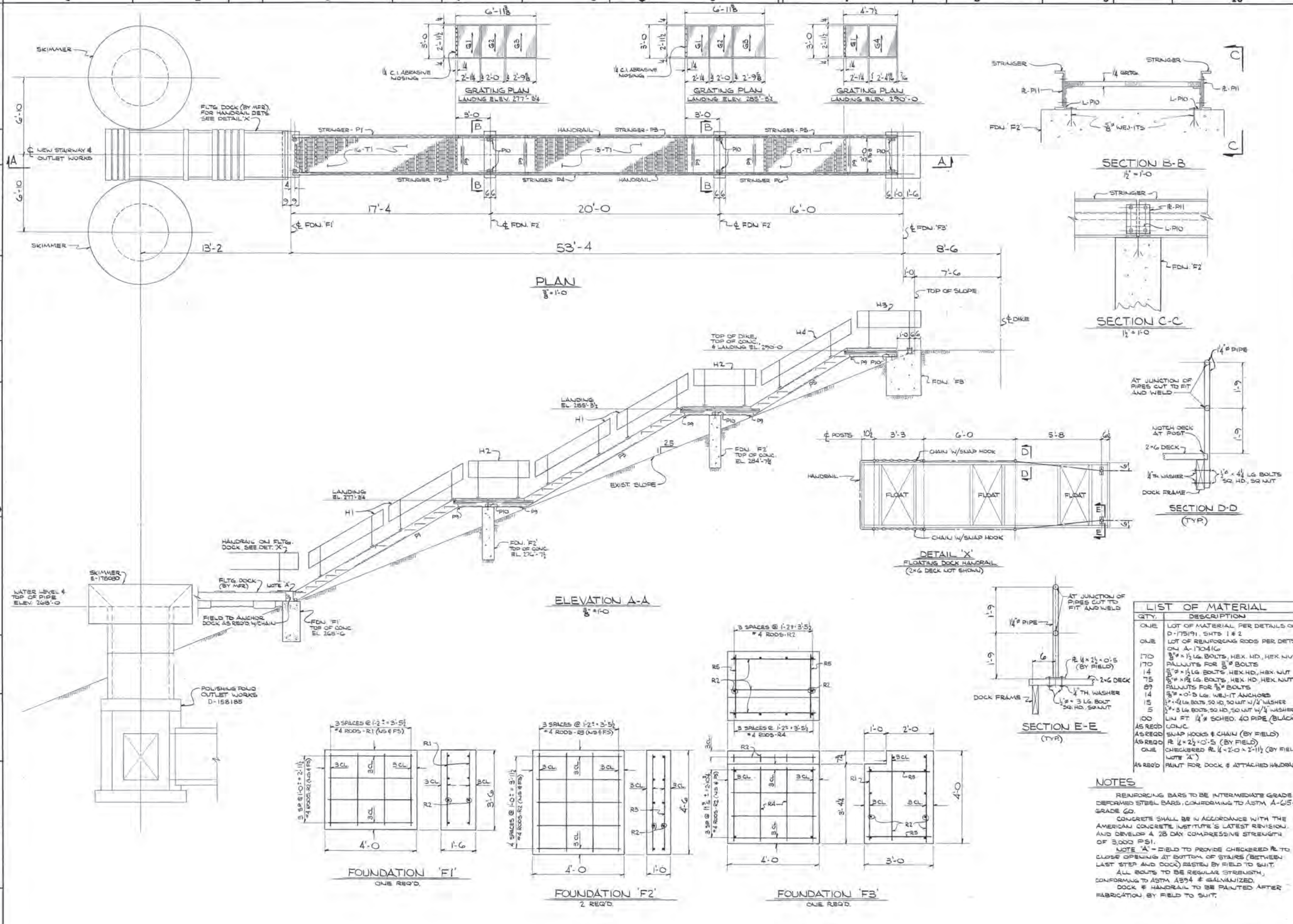
C SORT



ASH BASIN NO. 6
ASH BASIN #5
MEDIAN DIKE
SECTION A-A
SEDIMENTATION BASIN NO. 1
SEDIMENTATION BASIN NO. 2
EAST RAMP
WEST RAMP
WARP SURFACE
COUNTERPOISE TO BE RELOCATED
SLUICEWAY
COUNTERPOISE
6" THICK #2A CRUSHED AGGREGATE (TYP)
FLOATING BOOM AND BAFFLE APPROX. CENTERLINE
TOP OF DIKE EL. 290.0'
FOR ADDITIONS AND REVISIONS TO THIS AREA SEE DRAWING E325734 SHT.1 & 2
LOCATION PLAN
SUSQUEHANNA RIVER
FLOATING ASHLINE ANCHOR LOCATION PLAN
BILL OF MATERIALS FOR NINE (9) ANCHORS
DETAIL TIE ANCHOR FOUNDATION (TYPICAL) FLOATING ASH LINE UNIT 3
FOR NOTES & REFERENCES SEE SHEET NO. 2 THIS DWG.
BRUNNER ISLAND S.E.S.
ASH BASIN NO. 6 AND POLISHING POND PLAN & SECTIONS
PENNSYLVANIA POWER & LIGHT COMPANY ALLENTOWN PA.
E158595



SECTION "A-A"
(SCALE 1"=10')
SECTION "X-X"
SECTION "Y-Y"
SECTION "F-F"
(SCALE 1"=30')
DETAIL "K"
(TYPICAL PIPE ANCHOR)
DETAIL "X"
(TYPICAL SECTION THROUGH DITCH)
SECTION "G-G"
(SCALE 1"=20')
SECTION "P-P"
(INTERCEPTOR CHANNEL)
SECTION "B-B"
(SCALE 1"=10')
SECTION "H-H"
(DISCHARGE CHANNEL)
CLASS 'A' BEDDING
CLASS 'B' BEDDING
SECTION "C-C"
(SCALE 1"=10')
DETAIL "N"
CUT OFF COLLAR
SECTION "D-D"
(SCALE 1"=20')
SECTION "R-R"
SECTION "J-J"
DETAIL "M"
SEDIMENTATION BASIN PIPE SPILLWAY
SECTION "E-E"
(SCALE 1"=20')
NOTES:
For specifications, see specification PPC-1333, "Earthwork".
All coordinates are based on North-South and East-West base lines of plant.
Entire outside slope of embankment and inside slopes above elevation 274.0' in Basin #6 and above elevation 268.0' in polishing pond shall be topsoiled and seeded as per spec's.
Interceptor channels by field except as noted.
Topography obtained by photogrammetric methods using aerial photography dated December 22, 1976.
All inside slopes of basin #6 and polishing pond shall be lined with a 10 ft. wide blanket of impervious material extending to rock.
ESTIMATED QUANTITIES
Clearing and Grubbing – 69 Acres
Stripping Topsoil (1.0') – 111,000 Cu. Yd's
Common Excavation – 1,839,000 Cu. Yd's
Random Fill – 566,000 Cu. Yd's
Impervious Fill – 115,000 Cu. Yd's
#2A Crushed Aggregate – 1,550 Cu. Yd's
Guardrail – 8,300 Lineal Feet
BRUNNER ISLAND S.E.S.
ASH BASIN NO. 6 AND POLISHING POND
PLAN & SECTIONS
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.
SHEET 2 OF 2
E158595-4
RESPONSIBLE ENGINEER



LIST OF MATERIAL

QTY.	DESCRIPTION
ONE	LOT OF MATERIAL PER DETAILS ON D-175191, SHTS 1 & 2
ONE	LOT OF REINFORCING RODS PER DETS. ON A-170416
170	⅜"ø × 1½ LG. BOLTS, HEX. HD., HEX. NUT
170	PALNUTS FOR ⅜"ø BOLTS
14	⅝"ø × 1½ LG. BOLTS, HEX. HD., HEX. NUT
75	⅝"ø × 1¾ LG. BOLTS, HEX. HD., HEX. NUT
89	PALNUTS FOR ⅝"ø BOLTS
14	⅝"ø × 0'-5 LG. WEJ-IT ANCHORS
15	½"ø × 4¼ LG. BOLTS, SQ. HD., SQ. NUT W/ ¼" WASHER
5	½"ø × 3 LG. BOLTS, SQ. HD., SQ. NUT W/ ¼" WASHER
100	LIN. FT. 1¼"ø SCHED. 40 PIPE (BLACK)
AS REQD	CONC.
AS REQD	SNAP HOOKS & CHAIN (BY FIELD)
AS REQD	PL ¼ × 2½ × 0'-5 (BY FIELD)
ONE	CHECKERED PL ¼ × 2'-0 × 2'-11½ (BY FIELD - NOTE "A")
AS REQ'D	PAINT FOR DOCK & ATTACHED HANDRAIL

NOTES

REINFORCING BARS TO BE INTERMEDIATE GRADE, DEFORMED STEEL BARS, CONFORMING TO ASTM A-615-GRADE 60.

CONCRETE SHALL BE IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE'S LATEST REVISION, AND DEVELOP A 28 DAY COMPRESSIVE STRENGTH OF 3,000 PSI.

NOTE "A" - FIELD TO PROVIDE CHECKERED PL TO CLOSE OPENING AT BOTTOM OF STAIRS (BETWEEN LAST STEP AND DOCK) FASTEN BY FIELD TO SUIT.

ALL BOLTS TO BE REGULAR STRENGTH, CONFORMING TO ASTM A394 & GALVANIZED.

DOCK & HANDRAIL TO BE PAINTED AFTER FABRICATION, BY FIELD TO SUIT.

REFERENCE TITLE	NUMBER
SHOP DETAILS	D-175191
OUTLET WORKS & WINGWALL	D-158185
PLAN & SECTIONS	E-158595
POLISHING POND - PLAN & DETAILS	E-178085

ER-102351
ER-
SCALE-AS NOTED
DATE-7-31-79
DRAWN-WBM
CHECKED-
LEADER-
APPR'D-
APPR'D-

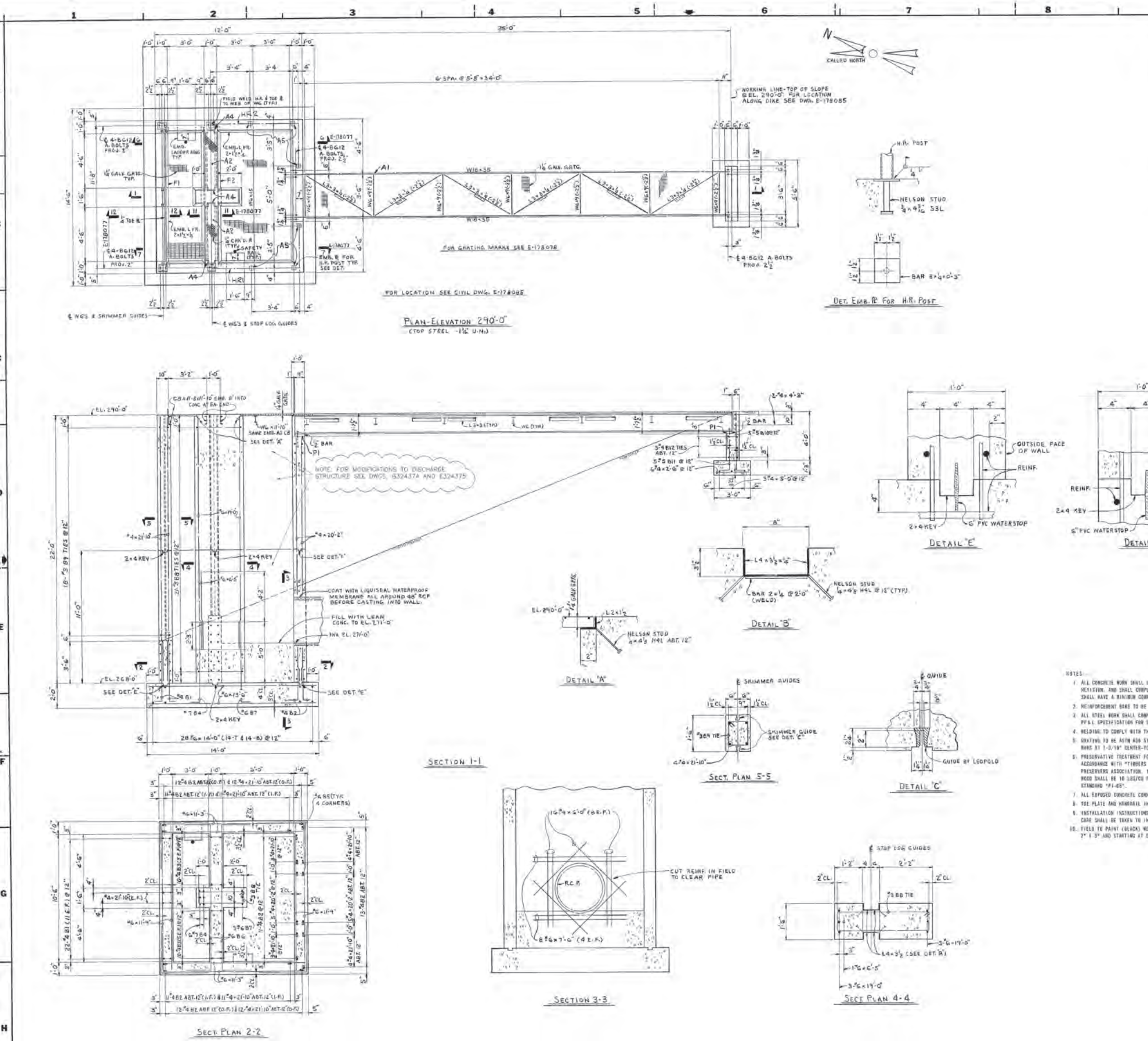
BRUNNER ISLAND S.E.S.
ASH BASIN #6
ACCESS TO POLISHING POND OUTLET WORKS
ASSEMBLY & DETAILS

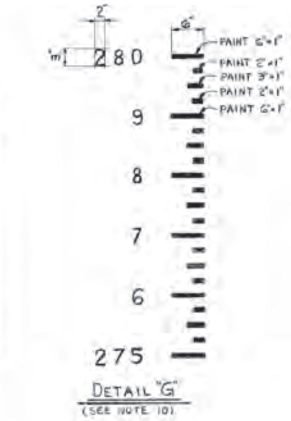
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

APPROVED [signature] 7/31/79
RESPONSIBLE ENGINEER

E-175190-0

Appendix A-6





BILL OF MATERIALS

QUANTITY	DESCRIPTION
54 CU. YDS.	3,000 P.S.I. CONCRETE
86 LIN. FT.	6" PVC WATERSTOP TYPE NO. 6380 W.R. MEADOWS OR EQUAL
1 GAL.	LIQUISEAL WATERPROOF MEMBRANE BY SURE SEAL
16	3/4"ϕ A. BOLTS BG12 AS PER SHEET NO. 9 OF LA-50165
18	LOGS LONGLEAF YELLOW PINE SELECT STRUCT. GRADE SEE STOP LOG DET. (E-178077) & NOTE 6
2	SKIMMER GATE, FIBERGLASS REINFORCED POLYESTER RESIN, 4'-0" H. x 4'-6" W. COMPLETE WITH 18'-6" H. TYPE EP-103 FRAME, LIFT BOLTS, AND 25 L.F. 5/8" STAINLESS STEEL CABLE. GATE TO HAVE NEOPRENE SEAL STRIPS AS MANUFACTURED BY F.B. LEOPOLD CO., ZELIENOPLE, PA.
1	FOUR WHEEL I BEAM TROLLEY FOR 8" I BEAM, 4,000 LBS. CAPACITY. McMASTER-CARR CO. NO. 3267T4 OR EQUAL.
2	WORM GEAR WINCH 2000 LBS. CAPACITY, McMASTERS-CARR NO. 3210T14 OR EQUAL
1	CABLE RATCHET WINCH HOIST, 4,000 LBS. CAPACITY. 25' LIFT WITH SAFETY HOOKS AND STAINLESS STEEL CABLE DETACHABLE HANDLE MARINE SERVICE, LUG ALL MODEL 450-R-M OR EQUAL
7 CU. YDS.	LEAN CONC.
1	LOT OF STEEL & GRTG. AS PER E-178078 & E-178079
1	LOT OF REINF. STEEL AS PER A-178084 SHTS 3 & 4
2	LADDER FALL PREVENTION DEVICE COMPLETE WITH CARRIER RAIL, LADDER RUNG CLAMPS, SLEEVE, AND 4'-6" REMOVABLE TOP EXTENSION, ALL GALVANIZED. ONE ASSEMBLY 26' LONG ONE ASSEMBLY 23' LONG. NORTON COMPANY "SAF-T-CLIMB" OR EQUAL.

NOTES:-

1. ALL CONCRETE WORK SHALL BE IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE CODE LATEST REVISION, AND SHALL COMPLY WITH PP&L SPECIFICATION FOR CONCRETE LA-50166, EXCEPT CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT THE END OF 28 DAYS.
2. REINFORCEMENT BARS TO BE DEFORMED STEEL BARS CONFORMING TO ASTM A615, GRADE 60.
3. ALL STEEL WORK SHALL COMPLY WITH AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE AND PP&L SPECIFICATION FOR STRUCTURAL STEEL LA-50165 AND SHALL CONFORM TO ASTM A36.
4. WELDING TO COMPLY WITH THE SPECIFICATIONS OF THE AMERICAN WELDING SOCIETY.
5. GRATING TO BE ASTM A36 STEEL, GALVANIZED AS PER ASTM A123-73, WITH 1-1/4" X 1/4" BEARING BARS AT 1-3/16" CENTER-TO-CENTER AND 9/32" CROSS BARS AT 4" CENTER-TO-CENTER.
6. PRESERVATIVE TREATMENT FOR STOP LOGS SHALL BE PRESSURE CREOSOTING AND SHALL BE DONE IN ACCORDANCE WITH "TIMBERS IN MARINE CONSTRUCTION SPECIFICATION C-18" OF THE AMERICAN WOOD PRESERVERS ASSOCIATION, 1958. FINAL RETENTION OF GRADE NO. 1 CREOSOTE PER CUBIC FOOT OF WOOD SHALL BE 16 LBS/CU FT CREOSOTE SHALL CONFORM TO AMERICAN WOOD PRESERVERS ASSOCIATION STANDARD "P1-65".
7. ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 3/4" CHAMFER.
8. TOE PLATE AND HANDRAIL INDICATED THUS——— - ——— - ———
9. INSTALLATION INSTRUCTIONS FOR THE SKIMMER GATE AND GUIDE SHALL BE SUPPLIED BY F.B. LEOPOLD COMPANY CARE SHALL BE TAKEN TO INSURE THE TIGHTEST SEAL POSSIBLE WITH THE MATERIAL PROVIDED.
10. FIELD TO PAINT (BLACK) WEST FACE OF WALL (NORTHWEST CORNER) WITH A GRADUATED SCALE WITH FIGURES 2" X 3" AND STARTING AT EL. 273'-6" TO EL. 280'-0" AS SHOWN IN DETAIL "G".

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER
ASH BASIN #6 DISCH. STRUCTURE STRL. CONC. & STL. SECT. & DET.	E-178077	LIST OF REINFORCING SHEETS 3 & 4	A-178084
LAYOUT OF DIKE BETWEEN ASH POND #6 & POLISHING POND CIVIL	E-158595		
STEEL DETAILS	E-178078		
STEEL DETAILS	E-178079		

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
2	10/23/09		REVISED REFERENCE NUMBER (D3)	DM		GDH
1	11/06		ADDED NOTE FOR DISCHARGE STRUCTURE (D3)	DM		GDH

W.O. 844712-841

ER- 137351
ER-
SCALE- 3/8"=1'-0"
DATE- 6/8/79
DRAWN- N.K.
CHECKED- LPH 5.16.79
LEADER- J.J.F.
APPR'D-
APPR'D-

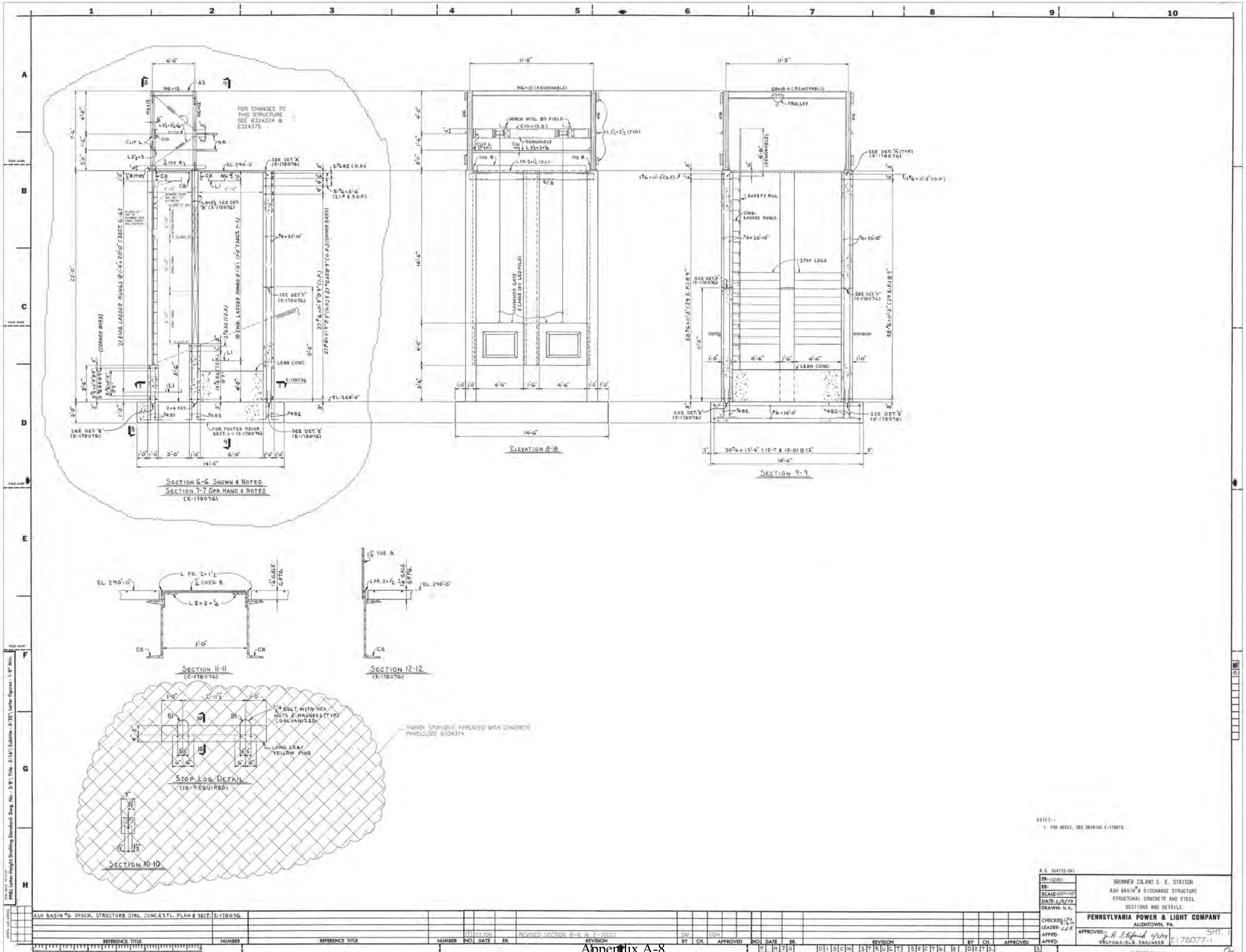
BRUNNER ISLAND S. E. STATION
ASH BASIN 6 DISCHARGE STRUCTURE
STRUCTURAL CONCRETE AND STEEL
PLAN AND SECTIONS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

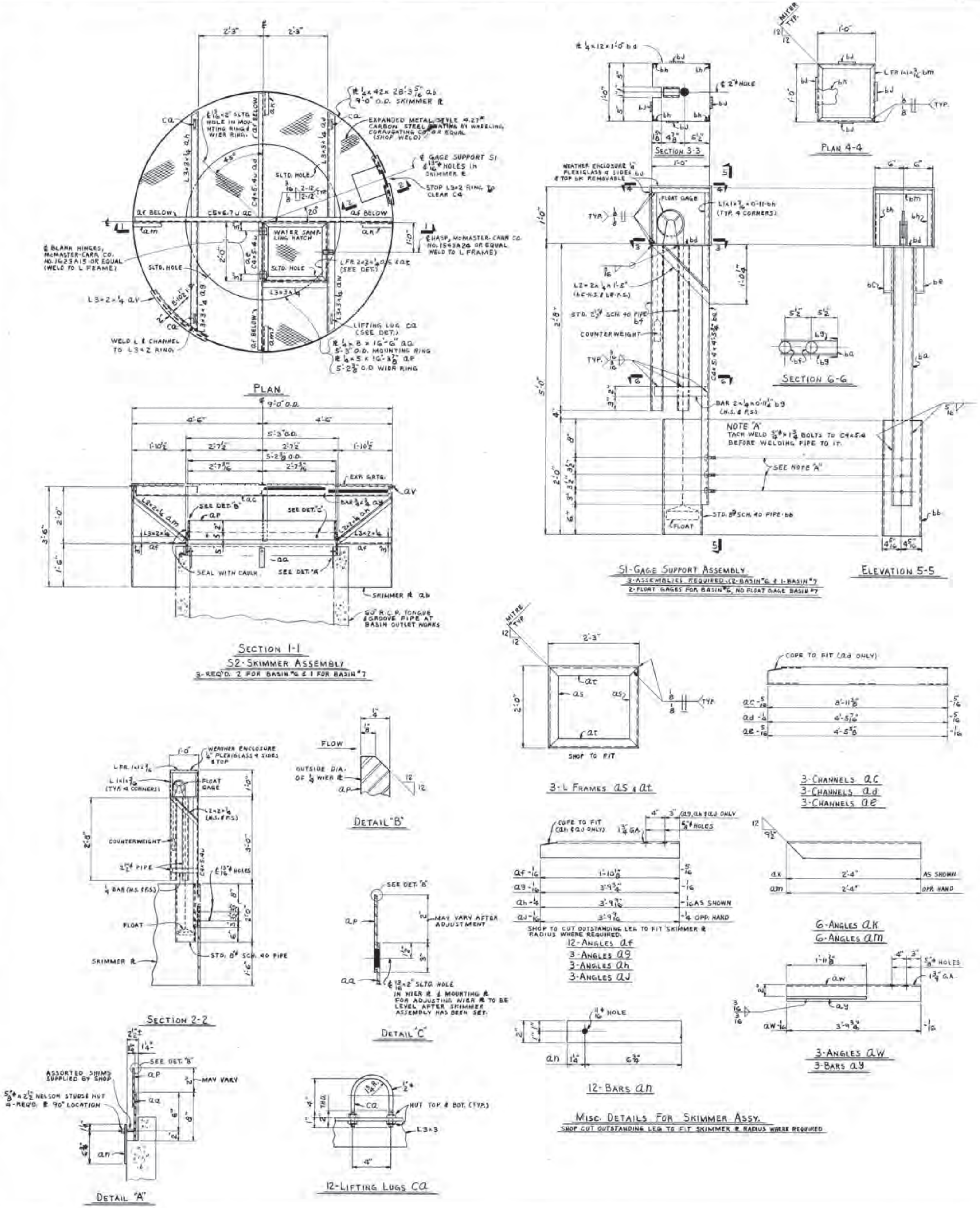
APPROVED J.A. Stefanik 6/8/79
RESPONSIBLE ENGINEER

SHT. 1
E178076-2

E H70 LOC. CODE — DISCH. STRUCT. PLAN & SECTS. — 5 SORT



FOR CHANGES TO THIS STRUCTURE SEE B324374 & E324375
SECTION 6-6 SHOWN & NOTED
SECTION 7-7 OPP. HAND & NOTED
(E-178076)
ELEVATION 8-8
SECTION 9-9
SECTION 11-11
(E-178076)
SECTION 12-12
(E-178076)
STOP LOG DETAIL
(18 REQUIRED)
TIMBER STOPLOGS REPLACED WITH CONCRETE PANELS,SEE B324374
SECTION 10-10
NOTES:-
1. FOR NOTES, SEE DRAWING E-178075.
W.O. 044712-041
ER-102351
SCALE-3/8"=1'-0"
DATE-6/9/77
DRAWN- N.K.
CHECKED-LFH
LEADER-J.J.F.
BRUNNER ISLAND S. E. STATION
ASH BASIN #8 DISCHARGE STRUCTURE
STRUCTURAL CONCRETE AND STEEL
SECTIONS AND DETAILS
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.
APPROVED J. A. Stefanik 6/8/79
RESPONSIBLE ENGINEER
SHT. 1
E178077-1
ASH BASIN #8 DISCH. STRUCTURE STRL. CONC. & STL. PLAN & SECT. E-178076
REFERENCE TITLE
NUMBER
REVISED SECTION 6-6 & 7-7(CD)
REVISION



SHOP BILL

LINE	ASSY. MARK	NO	SHAPE	SECTION SIZE	SECTION SIZE OR POUNDS	SECTION THICK	LENGTH FT.	LENGTH IN.	REMARKS
	3-ASSEMBLIES S1, (2-BASIN #6 & 1-BASIN #7)								
1	ba	3	C	4	5.4		4	5 3/8	
2	bb	3	STD.	8"φ	PIPE		2	0	SCH. 40
3	bc	3	L	2	2	1/4	1	5	
4	bd	3	PL	12		1/4	1	0	
5	be	3	L	2	2	1/4	1	5	
6	bf	6	STD.	2 1/2"φ	PIPE		2	8	SCH. 40
7	bg	6	BAR	2		1/4	0	11 1/4	
8	bh	12	L	1	1	3/16	0	11	
9	bj	12	SHT	12		1/4	1	0 1/4	PLEXIGLASS
10	bk	3	SHT	12 1/2		1/4	1	0 1/2	PLEXIGLASS
11	bm	12	L	1	1	3/16	1	0	L FRAME
12		2	STEVENS FLOAT GAGES PART						BASIN #6
13			NO. 15112 BY LEUPOLD & STEVENS						
14			INC., BEAVERTON, OREGON						
15		2	6" FLOATS W/8 OZ. COUNTERWEIGHT						BASIN #6
16			BY LEUPOLD & STEVENS INC. PART						
17			NO. 20447-22673						
18		2	FLOAT TAPES BY LEUPOLD &						BASIN #6
19			STEVENS INC. PART NO.						
20			20838-15147						
21		9	307	3/4			0	1 3/4	GALV. BOLTS
22									
23									
24									
25									
26	3-SKIMMER ASSY. S2 (2-BASIN #6 & 1-BASIN #7)								
27									
28	aa	3	PL	8		1/4	16	6	RING 5'-3" O.D.
29	ab	3	PL	42		1/4	28	3 5/16	RING 9'-0" O.D.
30	ac	3	C	5	6.7		8	11 3/8	
31	ad	3	C	4	5.4		4	5 7/16	
32	ae	3	C	4	5.4		4	5 5/8	
33	af	12	L	3	2	1/4	1	10 1/8	
34	ag	3	L	3	3	1/4	3	9 3/4	
35	ah	3	L	3	3	1/4	3	9 9/16	
36	aj	3	L	3	3	1/4	3	9 9/16	
37	ak	6	L	2	2	1/4	2	4	
38	am	6	L	2	2	1/4	2	4	
39	an	12	BAR	2		1/4	0	8	
40	ap	3	PL	5		1/4	16	3 3/8	RING 5'-2 3/8" O.D.
41	as	6	L	2	2	1/4	2	0	L FRAME
42	at	6	L	2	2	1/4	2	3	L FRAME
43		6	BLANK HINGES, McMASTER-CARR						
44			CO. NO. 1623A15 OR EQUAL						
45		3	HASPS, McMASTER-CARR CO.						
46			NO. 1543A24 OR EQUAL						
47		12	NELSON STUDS & NUTS 5/8"φ x 2 1/2"						PART NO. 101-017-379
48		81	SQ. FT. EXPANDED METAL STYLE						
49			4.27# CARBON STEEL GRATING BY						
50			WHEELING CORRUGATING Co. OR EQUAL						
51	av	3	L	3	2	1/4	27	10 9/16	RING 8'-10 1/2" I.D.
52	aw	3	L	3	3	1/4	3	9 3/4	
53	ay	3	BAR	3/4		3/4	1	11 7/8	
54	ca	12	BAR	1/2"φ			1	2	48-HEX NUTS
55									
56									
57									
58									

NOTES:-

1. ALL STEEL WORK SHALL COMPLY WITH AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE AND PP&L SPECIFICATION FOR STRUCTURAL STEEL LA-50165 AND SHALL CONFORM TO ASTM A36.
2. WELDING TO COMPLY WITH THE SPECIFICATIONS OF THE AMERICAN WELDING SOCIETY.
3. GRATING TO BE GALVANIZED AS PER ASTM A123-73.
4. ALL MATERIAL TO BE FURNISHED ASSEMBLED.
5. ALL MATERIAL TO BE GALVANIZED AFTER WELDING.
6. ALL WELDS 1/4" FILLET WELD ALL AROUND, UNLESS NOTED.
7. DAMAGED SURFACES OF GALVANIZED STEEL DUE TO FIELD WELDING OR CUTTING SHALL BE CLEANED AND PAINTED WITH "GALVANOX" TYPE I AS MANUFACTURED BY SUBOX, INC. OR EQUAL.

REFERENCE TITLE	NUMBER
ASH BASIN #6 PLAN & SECTIONS	E-158595
ASH BASIN #6 OUTLET WORKS	D-158185
ASH BASIN #7 PLAN & SECTIONS	E-167640

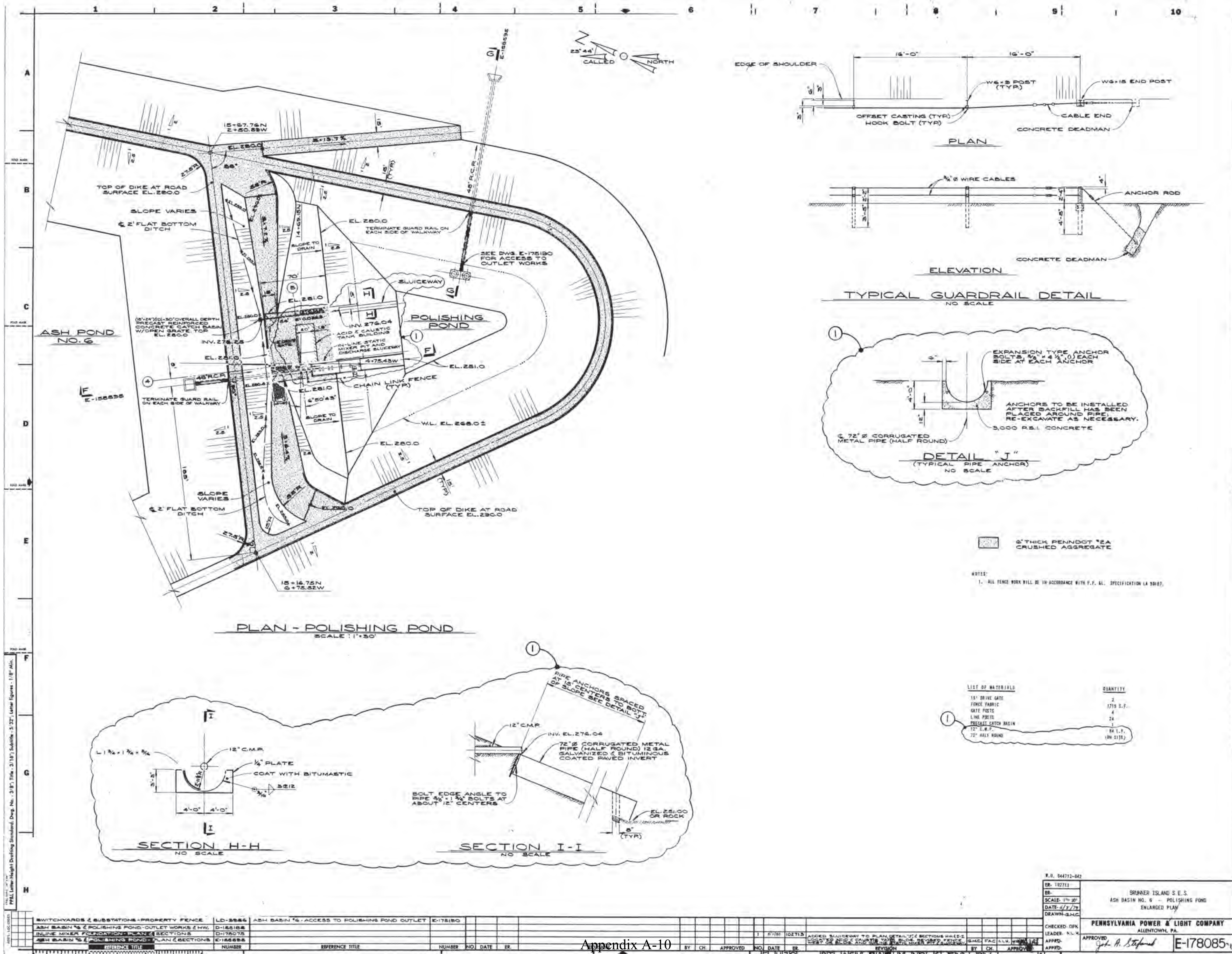
W.O. 044712-041
ER-183351
ER-
SCALE- VARIES
DATE- 8-3-77
DRAWN- N. K.
CHECKED- [illegible]
LEADER- J.J.F.
APPR'D-
APPR'D-

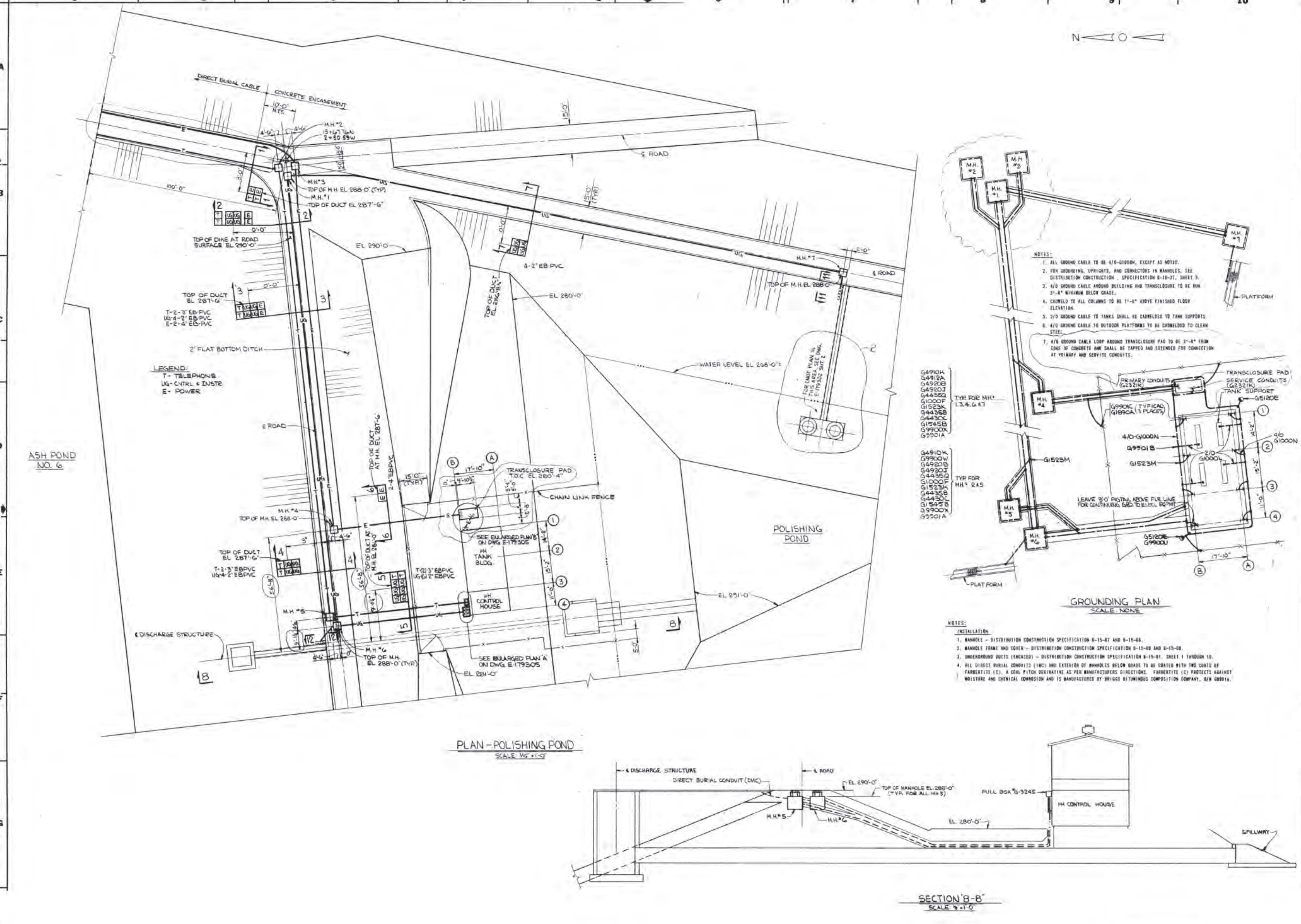
BRUNNER ISLAND S. E. STATION
ASH BASINS 6 AND 7
SKIMMER AND FLOAT GAGE
SHOP DETAILS AND LIST OF MATERIALS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

APPROVED John A. [illegible] 8/4/77
RESPONSIBLE ENGINEER

E-178080-0


PLAN - POLISHING POND
SCALE: 1"=30'
ASH POND NO. 6
POLISHING POND
TOP OF DIKE AT ROAD SURFACE EL. 280.0
SLOPE VARIES
℄ 2' FLAT BOTTOM DITCH
SLUICEWAY
ACID & CAUSTIC TANK BUILDING
IN-LINE STATIC MIXER PIT AND DISCHARGE SLUICEWAY
CHAIN LINK FENCE (TYP)
W.L. EL. 268.0±
SEE DWG. E-175190 FOR ACCESS TO OUTLET WORKS
TERMINATE GUARD RAIL ON EACH SIDE OF WALKWAY
SLOPE TO DRAIN
NORTH
PLAN
ELEVATION
TYPICAL GUARDRAIL DETAIL
NO SCALE
EDGE OF SHOULDER
W6×9 POST (TYP.)
W6×15 END POST
OFFSET CASTING (TYP)
HOOK BOLT (TYP)
CABLE END
CONCRETE DEADMAN
3/4"Ø WIRE CABLES
ANCHOR ROD
DETAIL "J"
(TYPICAL PIPE ANCHOR)
NO SCALE
EXPANSION TYPE ANCHOR BOLTS, 5/8"×4 1/2", (1) EACH SIDE AT EACH ANCHOR
ANCHORS TO BE INSTALLED AFTER BACKFILL HAS BEEN PLACED AROUND PIPE; RE-EXCAVATE AS NECESSARY.
℄ 72"Ø CORRUGATED METAL PIPE (HALF ROUND)
3,000 P.S.I. CONCRETE
6" THICK PENNDOT #2A CRUSHED AGGREGATE
NOTES:
1. ALL FENCE WORK WILL BE IN ACCORDANCE WITH P.P. &L. SPECIFICATION LA 50167.
LIST OF MATERIALS
SECTION H-H
NO SCALE
SECTION I-I
NO SCALE
12" C.M.P.
1/4" PLATE
COAT WITH BITUMASTIC
INV. EL. 276.04
72"Ø CORRUGATED METAL PIPE (HALF ROUND) 12 GA. GALVANIZED & BITUMINOUS COATED PAVED INVERT
PIPE ANCHORS SPACED AT 15' CENTERS TO BOTT. OF SLOPE SEE DETAIL "J"
BOLT EDGE ANGLE TO PIPE 5/8"×1 3/4" BOLTS AT ABOUT 12" CENTERS
EL. 251.00 OR ROCK
BRUNNER ISLAND S.E.S.
ASH BASIN NO. 6 - POLISHING POND
ENLARGED PLAN
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.
E-178085
SWITCHYARDS & SUBSTATIONS - PROPERTY FENCE
ASH BASIN #6 & POLISHING POND - OUTLET WORKS & MW.
INLINE MIXER FOUNDATION - PLAN & SECTIONS
ASH BASIN #6 & POLISHING POND - PLAN & SECTIONS
ASH BASIN #6 - ACCESS TO POLISHING POND OUTLET
REFERENCE TITLE
NUMBER
REVISION
APPROVED



Reference Title	Number	Reference Title	Number
BILL OF MATERIAL SH 1752 TO 1765	LA-50942		
ASH BASIN 6-PH CONT. FACILITY CONDUIT LAYOUT & CAUSTIC TANK BLDG	E-179302		
[redacted]	[redacted]		
ASH BASIN 6-POLISHING POND-ENLARGED PLAN	E-178085	ASH BASIN 6 DISCH STRUCTURE - PLAN STEEL	E-178076

No.	Date	ER.	Revision	By	Ch.	Approved	
2		102713	ADDED REFERENCE AS IND.	JPS	JMJ	WIP	
1	9-24-80	102713	REV. T-PAD & RELOCATED MH #4 & #6, REV. GRDNG @ T-PAD & ADDED NOTE 7	EEE	RAV	WIP	

W.O. 044712-042
ER-102713
SCALE-AS NOTED
DATE-8-8-80
DRAWN-TJW
CHECKED-EEK
LEADER-RAV

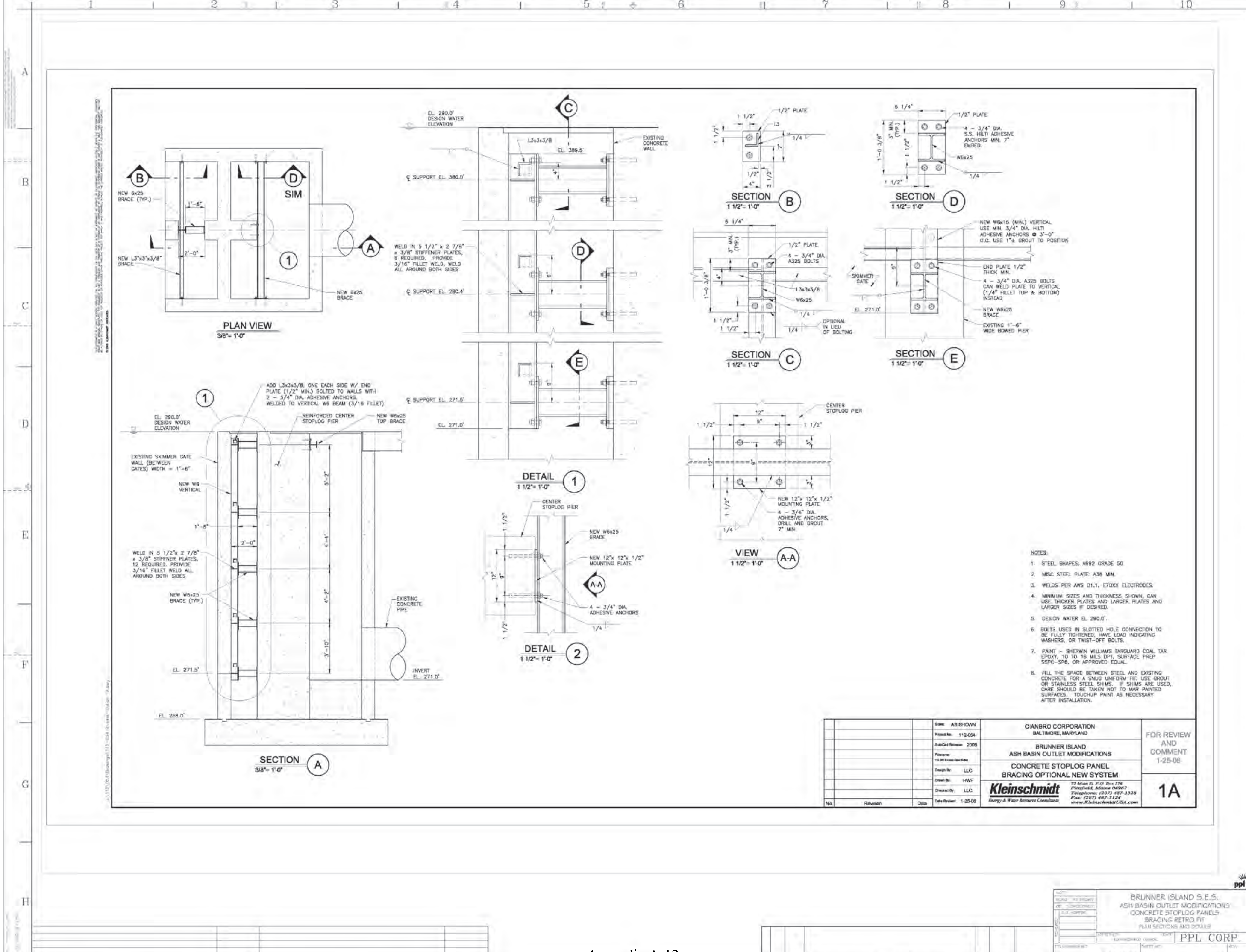
BRUNNER ISLAND S. E. STATION
ELECTRICAL
ASH BASIN 6, pH CONTROL FACILITY
PLAN
MANHOLES - UNDERGROUND DUCTS - GROUNDING

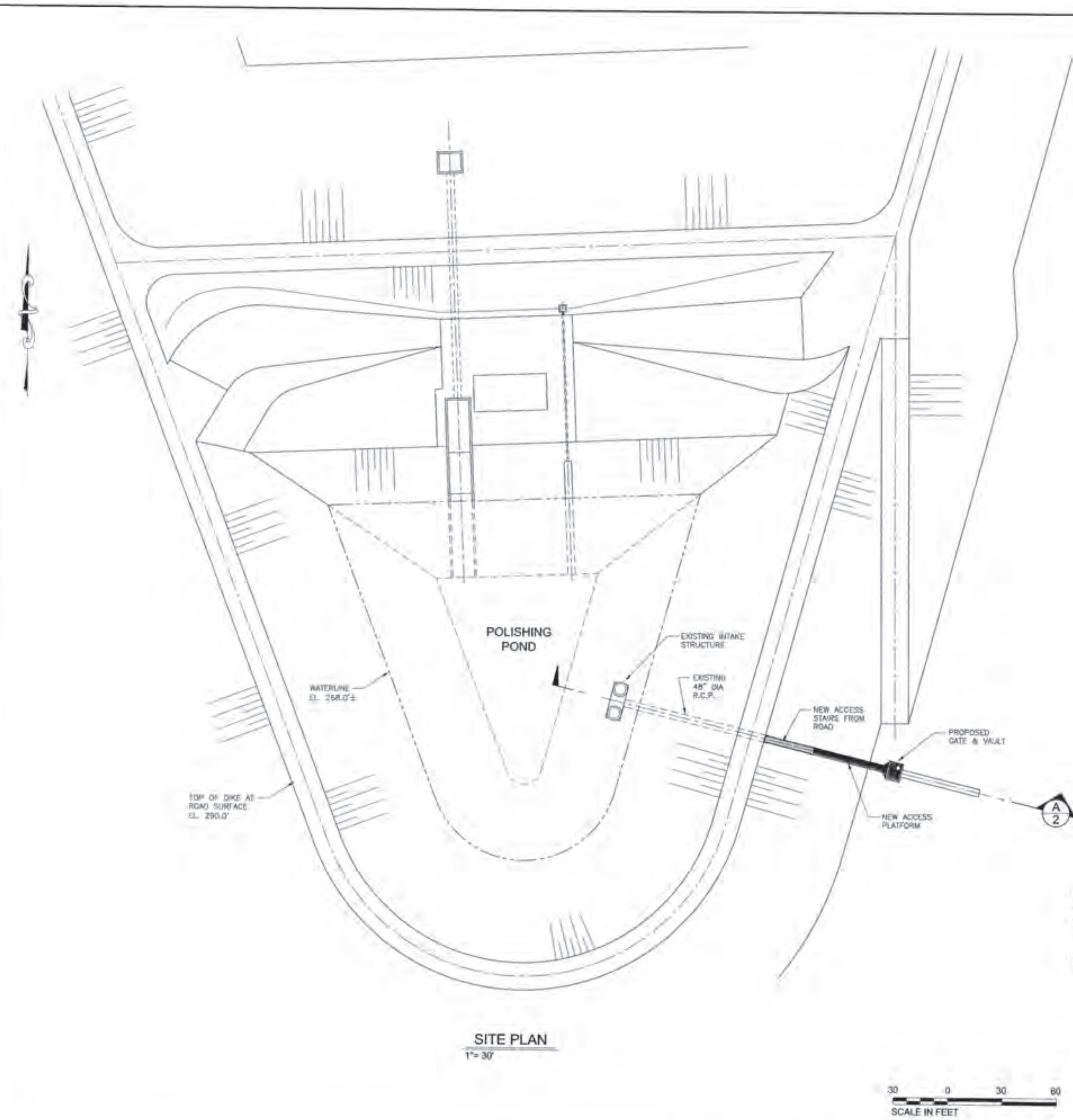
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

APPROVED — SENIOR PROJECT ENGINEER

E-179301-2

F3D70 — CNTRL FAC MH UG GRDNG PLN — E


PLAN VIEW
3/8"= 1'-0"
NEW 6x25 BRACE (TYP.)
NEW L3"x3"x3/8" BRACE
NEW 6x25 BRACE
SIM
SECTION A
3/8"= 1'-0"
EL. 290.0' DESIGN WATER ELEVATION
EXISTING SKIMMER GATE WALL (BETWEEN GATES) WIDTH = 1'-6"
NEW W6 VERTICAL
WELD IN 5 1/2"x 2 7/8" x 3/8" STIFFENER PLATES, 12 REQUIRED. PROVIDE 3/16" FILLET WELD ALL AROUND BOTH SIDES
NEW W6x25 BRACE (TYP.)
EXISTING CONCRETE PIPE
INVERT EL. 271.0'
EL. 271.5'
EL. 268.0'
ADD L3x3x3/8, ONE EACH SIDE W/ END PLATE (1/2" MIN.) BOLTED TO WALLS WITH 2 - 3/4" DIA. ADHESIVE ANCHORS. WELDED TO VERTICAL W6 BEAM (3/16 FILLET)
REINFORCED CENTER STOPLOG PIER
NEW W6x25 TOP BRACE
DETAIL 1
1 1/2"= 1'-0"
EXISTING CONCRETE WALL
L3x3x3/8
EL. 289.5'
℄ SUPPORT EL. 280.0'
℄ SUPPORT EL. 280.4'
℄ SUPPORT EL. 271.5'
EL. 271.0'
WELD IN 5 1/2" x 2 7/8" x 3/8" STIFFENER PLATES, 8 REQUIRED. PROVIDE 3/16" FILLET WELD, WELD ALL AROUND BOTH SIDES
DETAIL 2
1 1/2"= 1'-0"
CENTER STOPLOG PIER
NEW W6x25 BRACE
NEW 12"x 12"x 1/2" MOUNTING PLATE
4 - 3/4" DIA. ADHESIVE ANCHORS
SECTION B
1 1/2"= 1'-0"
1/2" PLATE
SECTION D
1 1/2"= 1'-0"
4 - 3/4" DIA. S.S. HILTI ADHESIVE ANCHORS MIN. 7" EMBED.
W6x25
SECTION C
1 1/2"= 1'-0"
1/2" PLATE
4 - 3/4" DIA. A325 BOLTS
L3x3x3/8
W6x25
OPTIONAL IN LIEU OF BOLTING
SECTION E
1 1/2"= 1'-0"
NEW W6x15 (MIN.) VERTICAL USE MIN. 3/4" DIA. HILTI ADHESIVE ANCHORS @ 3'-0" O.C. USE 1"± GROUT TO POSITION
SKIMMER GATE
END PLATE 1/2" THICK MIN.
4 - 3/4" DIA. A325 BOLTS CAN WELD PLATE TO VERTICAL (1/4" FILLET TOP & BOTTOM) INSTEAD
NEW W6x25 BRACE
EXISTING 1'-6" WIDE BOWED PIER
EL. 271.0'
VIEW A-A
1 1/2"= 1'-0"
CENTER STOPLOG PIER
NEW 12"x 12"x 1/2" MOUNTING PLATE
4 - 3/4" DIA. ADHESIVE ANCHORS, DRILL AND GROUT 7" MIN
NOTES:
1. STEEL SHAPES: A992 GRADE 50
2. MISC STEEL PLATE: A36 MIN.
3. WELDS PER AWS D1.1, E70XX ELECTRODES.
4. MINIMUM SIZES AND THICKNESS SHOWN, CAN USE THICKER PLATES AND LARGER PLATES AND LARGER SIZES IF DESIRED.
5. DESIGN WATER EL 290.0'.
6. BOLTS USED IN SLOTTED HOLE CONNECTION TO BE FULLY TIGHTENED, HAVE LOAD INDICATING WASHERS, OR TWIST-OFF BOLTS.
7. PAINT - SHERWIN WILLIAMS TARGUARD COAL TAR EPOXY, 10 TO 16 MILS DFT, SURFACE PREP SSPC-SP6, OR APPROVED EQUAL.
8. FILL THE SPACE BETWEEN STEEL AND EXISTING CONCRETE FOR A SNUG UNIFORM FIT. USE GROUT OR STAINLESS STEEL SHIMS. IF SHIMS ARE USED, CARE SHOULD BE TAKEN NOT TO MAR PAINTED SURFACES. TOUCHUP PAINT AS NECESSARY AFTER INSTALLATION.
Scale: AS SHOWN
Project No.: 112-054
AutoCad Release: 2005
Design By: LLC
Drawn By: HWF
Checked By: LLC
Date Revised: 1-25-06
No. Revision Date
CIANBRO CORPORATION
BALTIMORE, MARYLAND
BRUNNER ISLAND
ASH BASIN OUTLET MODIFICATIONS
CONCRETE STOPLOG PANEL
BRACING OPTIONAL NEW SYSTEM
Kleinschmidt
Energy & Water Resource Consultants
FOR REVIEW AND COMMENT 1-25-06
1A
BRUNNER ISLAND S.E.S.
ASH BASIN OUTLET MODIFICATIONS
CONCRETE STOPLOG PANELS
BRACING RETRO FIT
PLAN SECTIONS AND DETAILS
PPL CORP.
E324375



SITE PLAN
1"= 30'

GENERAL CONCRETE NOTES

1.) NEW CONCRETE VAULT CAN EITHER BE CAST-IN-PLACE OR PRE-CAST. PRE-CAST DESIGN SHALL BE SUBMITTED FOR APPROVAL.

2.) ALL LOOSE ROCK AND MUCK SHALL BE REMOVED PRIOR TO CONSTRUCTION. WHEN CONCRETE IS PLACED DIRECTLY AGAINST ROCK SURFACES, THE SURFACE SHALL BE CLEANED WITH HIGH PRESSURE WATER TO REMOVE ALL DIRT OR LOOSE MATERIAL. HIGH PRESSURE WATER IS DEFINED FOR THIS PURPOSE AS 1,500 PSI MINIMUM. IF GREASE, OIL OR OTHER COATINGS ARE ON THE ROCK SURFACE, OTHER METHODS MAY BE REQUIRED FOR REMOVAL.

3.) SURFACE PREPARATION OF EXISTING CONCRETE AND MASONRY SURFACES SHALL REMOVE LOOSE DETERIORATED MATERIAL AND VEGETATION. ACCEPTABLE METHODS INCLUDE: SANDBLASTING, MECHANICAL CHIPPING OR HIGH PRESSURE WATER BLAST (6,000 psi MIN.).

4.) EXCEPT AS OTHERWISE NOTED:

- A. CONCRETE: 4000 PSI @ 28 DAYS, AIR ENTRAINED 5% TO 7%
- B. REINFORCEMENT: 60,000 PSI, ASTM A615
- C. REBAR COVER: 2" UNLESS NOTED OTHERWISE
  - HOOKS – ACI STANDARD
  - SPLICES – #7 BAR = 54"
  - – #5 BAR = 31"
  - – #4 BAR = 25"
- D. CONCRETE ANCHORS: 3/4" MIN. DIA. S.S. SIMPSON EPOXY-TIE FOR DAMP OR SUBMERGED APPLICATIONS OR APPROVED EQUAL.
- E. GROUT: 5000psi NON-SHRINK GROUT @ 28 DAYS CRD-C621

5.) PROVIDE ADHESIVE WATERSTOPS OF WATER SWELLING ELASTIC SEALING MATERIAL WHERE INDICATED. END ALL WATERSTOP 3"± FROM EXPOSED FINISHED CONCRETE SURFACE. ACCEPTABLE SUPPLIERS: WATERSTOP RX. INSTALL PER MANUFACTURERS INSTRUCTIONS.

6.) UNLESS NOTED OTHERWISE PROVIDE 3/4" CHAMFER ON ALL UNARMORED CORNERS.

7.) FIELD BEND REINFORCING BARS TO CLEAR INCIDENTAL BOXOUTS WHERE REQUIRED. EXCEPT AS NOTED, NO CUTTING OF REINFORCING BARS WITHOUT PRIOR REVIEW BY OWNER.

8.) VERTICAL CONCRETE SURFACES SHALL HAVE A SMOOTH FORMED FINISH. HORIZONTAL CONCRETE SURFACES SHALL HAVE A SMOOTH RUBBED FINISH (U.N.O.), EXCEPT WALKING SURFACE SHALL HAVE BROOM FINISH.

9.) CONCRETE SHALL BE CURED FOR A MINIMUM OF 7 DAYS IN ACCORDANCE WITH ACI 301.

10.) REPAIR ALL SURFACE VOIDS GREATER THAN 1/4" WITH METHOD APPROVAL BY ENGINEER

SEE SPECIFICATIONS SECTION 03310 FOR ADDITIONAL NOTES.

STEEL NOTES

1.) STEEL – ASTM A-36 U.N.O.
PIPE – A53 GRADE B
BOLTS – ASTM A-325 GALVANIZED

2.) ALL WELDING PER AWS D1-1.

3.) ALL STEEL HOT DIPPED GALVANIZED PER ASTM A-123, HARDWARE PER A-153 U.N.O.

4.) ALL STEEL SHALL BE FABRICATED AND ERECTED PER AISC STEEL CONSTRUCTION MANUAL 13th EDITION.

GENERAL GATE NOTES

SEE SPECIFICATIONS FOR SECTION 11281

KLEINSCHMIDT DRAWING LIST

DRAWING NO.	DRAWING DESCRIPTION
1	PLAN VIEW - POLISHING POND AND PROPOSED ACCESS TO GATE AND VAULT
2	LONGITUDINAL SECTION THRU POND AND ACCESS DETAILS
3	CONCRETE REINFORCEMENT SECTIONS AND DETAILS
4	STEEL FRAMING SECTIONS AND DETAILS

RECORD DRAWING
THIS DRAWING REPRESENTS THE BEST INFORMATION AVAILABLE TO THE ENGINEER UPON COMPLETION OF THE WORK.
KLEINSCHMIDT ASSOCIATES
CONSULTING ENGINEERS
DATE: [signature] BY: [signature]

SUBMIT SHOP DRAWINGS TO E.O.R FOR APPROVAL

No.	Revision	Date
	RECORD DRAWING	1-18-08
1	UPDATED VAULT AND GATE	10-22-07
	RELEASED FOR CONSTRUCTION	9-17-07

Scale: AS SHOWN
Project No: 112-059
AutoCad Release: 2007
Filename: 112-059 RD Sheet 1.dwg
Design By: KMG
Drawn By: HWF
Checked By: TLK
Date Revised: 1-18-08

CIANBRO CORPORATION
BALTIMORE, MARYLAND

BRUNNER ISLAND
POLISHING POND OUTLET MODIFICATIONS

PLAN VIEW - POLISHING POND AND PROPOSED ACCESS TO GATE AND VAULT

Kleinschmidt
Energy & Water Resource Consultants
P.O. Box 650 141 Main Street
Pittsfield, Maine 04967
Telephone: (207) 487-3328
Fax: (207) 487-3124
www.KleinschmidtUSA.com

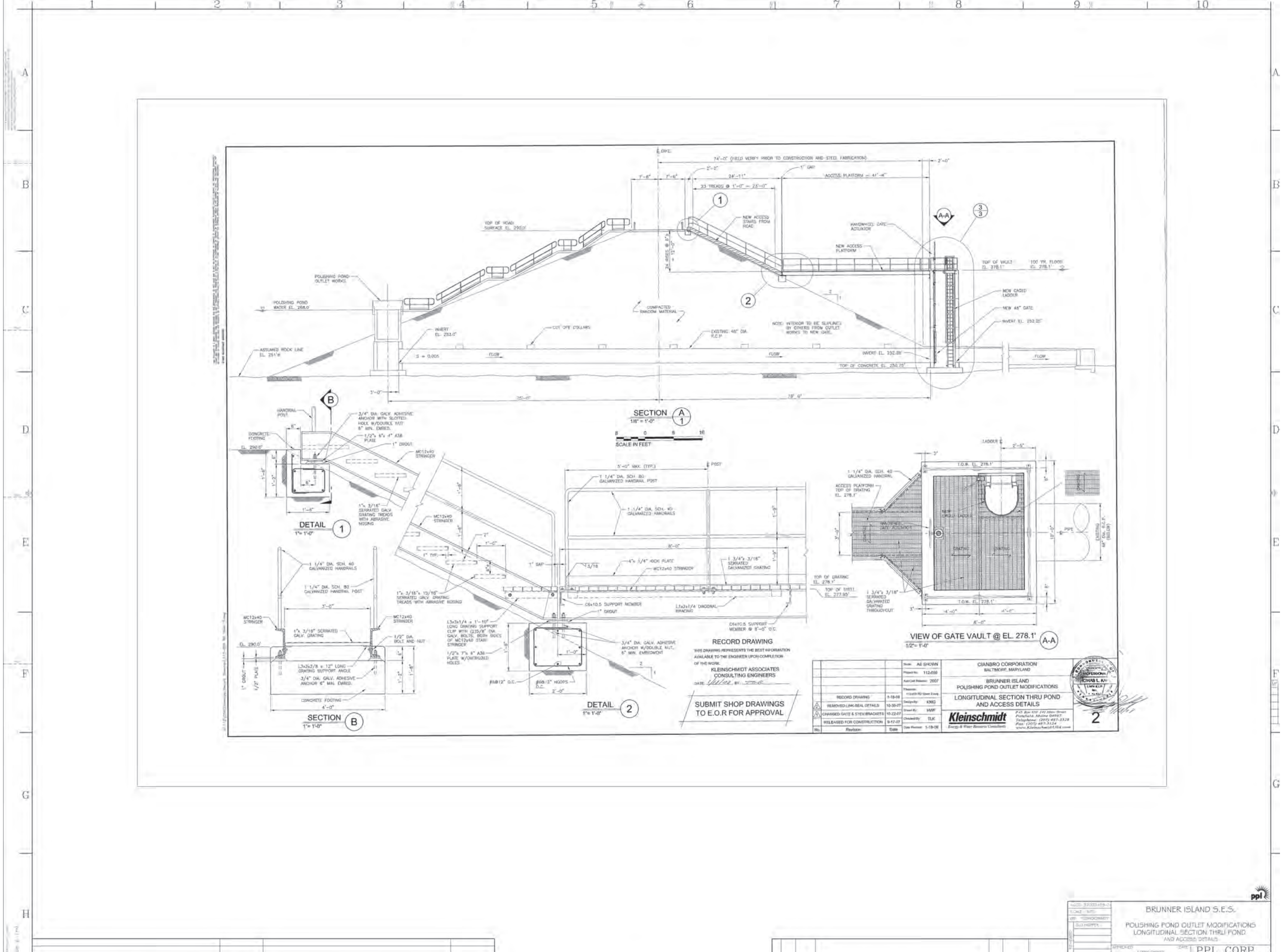
THOMAS L. KAHL
PROFESSIONAL ENGINEER

1

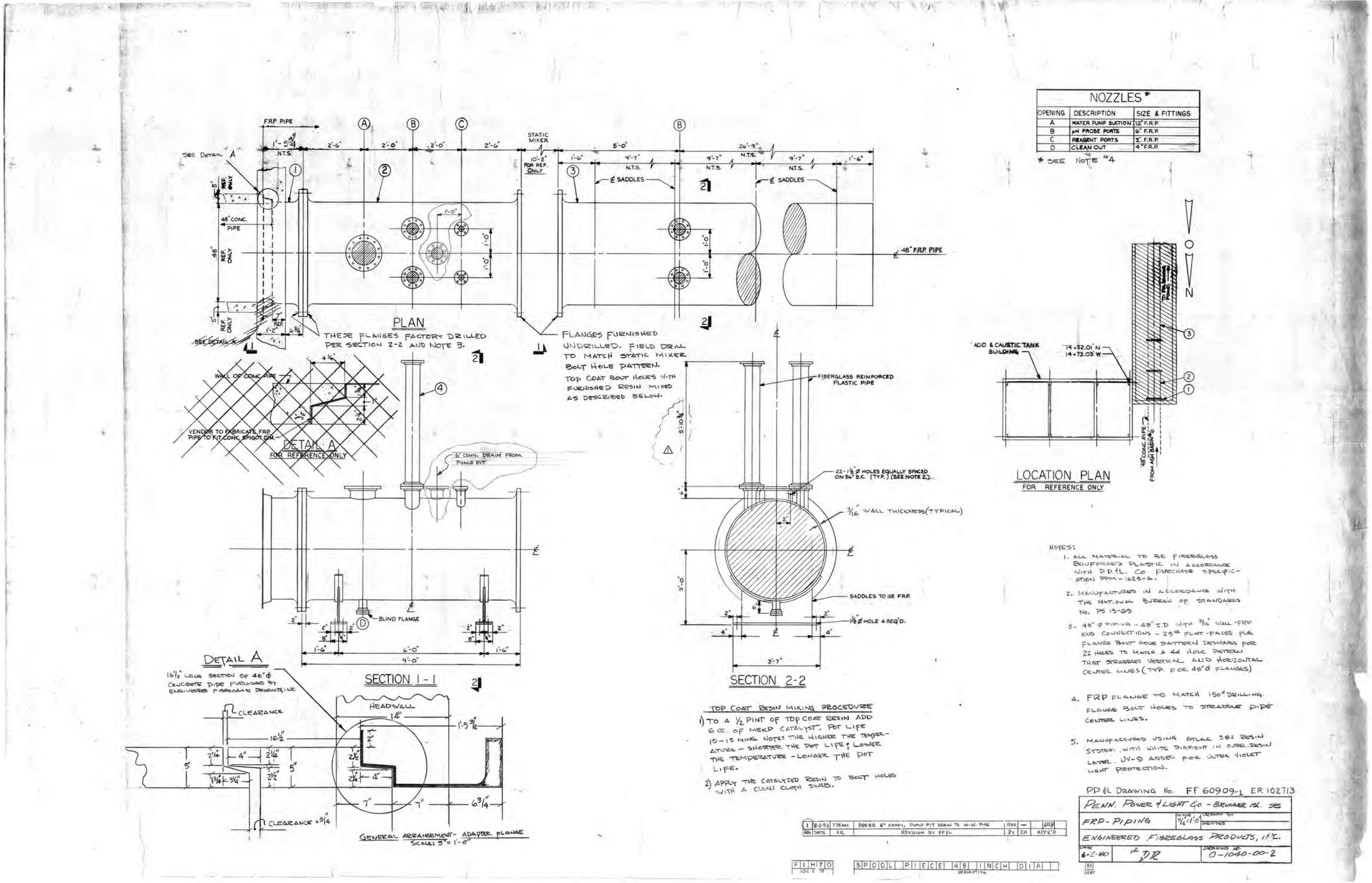
BRUNNER ISLAND S.E.S.
POLISHING POND OUTLET MODIFICATIONS
PLAN VIEW - POLISHING POND AND PROPOSED ACCESS TO GATE AND VAULT

APPROVED: KLEINSCHMIDT
PPL CORP.
PPL DRAWING NO. E325734
SHEET NO. 1
REV. 0

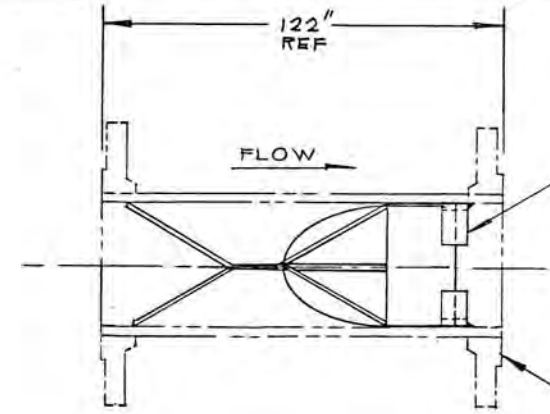
WALKWAY AND STAIR ASSEMBLY AND DETAILS	E325756
SITE PLAN	E158565



SECTION A 1
1/8" = 1'-0"
SCALE IN FEET
DETAIL 1
1" = 1'-0"
SECTION B
1" = 1'-0"
DETAIL 2
1" = 1'-0"
VIEW OF GATE VAULT @ EL. 278.1' A-A
1/2" = 1'-0"
RECORD DRAWING
KLEINSCHMIDT ASSOCIATES
CONSULTING ENGINEERS
SUBMIT SHOP DRAWINGS
TO E.O.R FOR APPROVAL
CIANBRO CORPORATION
BALTIMORE, MARYLAND
BRUNNER ISLAND
POLISHING POND OUTLET MODIFICATIONS
LONGITUDINAL SECTION THRU POND
AND ACCESS DETAILS
Kleinschmidt
2
BRUNNER ISLAND S.E.S.
POLISHING POND OUTLET MODIFICATIONS
LONGITUDINAL SECTION THRU POND
AND ACCESS DETAILS
PPL CORP.
E325734



NOZZLES *
OPENING | DESCRIPTION | SIZE & FITTINGS
A | WATER PUMP SUCTION | 12" F.R.P.
B | pH PROBE PORTS | 6" F.R.P.
C | REAGENT PORTS | 3" F.R.P.
D | CLEAN OUT | 4" F.R.P.
* SEE NOTE #4
PLAN
THESE FLANGES FACTORY DRILLED PER SECTION 2-2 AND NOTE 3.
FLANGES FURNISHED UNDRILLED. FIELD DRILL TO MATCH STATIC MIXER BOLT HOLE PATTERN.
TOP COAT BOLT HOLES WITH FURNISHED RESIN MIXED AS DESCRIBED BELOW.
FRP PIPE
STATIC MIXER
48" FRP PIPE
48" CONC. PIPE
SEE DETAIL "A"
DETAIL A
FOR REFERENCE ONLY
VENDOR TO FABRICATE FRP PIPE TO FIT CONC. SPIGOT DIM.
WALL OF CONC. PIPE
6" CONN. DRAIN FROM PUMP PIT
FIBERGLASS REINFORCED PLASTIC PIPE
22-1⅛"Ø HOLES EQUALLY SPACED ON 56" B.C. (TYP.) (SEE NOTE 2)
3/16" WALL THICKNESS (TYPICAL)
SADDLES TO BE FRP.
1⅛"Ø HOLE 4 REQ'D.
BLIND FLANGE
SECTION 1-1
SECTION 2-2
ACID & CAUSTIC TANK BUILDING
14+52.01' N
14+73.03' W
48" CONC. PIPE FROM ASH BASIN
LOCATION PLAN
FOR REFERENCE ONLY
DETAIL A
16½" LONG SECTION OF 48"Ø CONCRETE PIPE FURNISHED BY ENGINEERED FIBREGLASS PRODUCTS, INC.
HEADWALL
CLEARANCE
CLEARANCE +3/4
GENERAL ARRANGEMENT - ADAPTER FLANGE
SCALE: 3" = 1'-0"
TOP COAT RESIN MIXING PROCEDURE
1) TO A ½ PINT OF TOP COAT RESIN ADD 6 CC. OF MEKP CATALYST. POT LIFE 10-15 MINS. NOTE: THE HIGHER THE TEMPERATURE - SHORTER THE POT LIFE; LOWER THE TEMPERATURE - LONGER THE POT LIFE.
2) APPLY THE CATALYZED RESIN TO BOLT HOLES WITH A CLEAN CLOTH SWAB.
NOTES:
1. ALL MATERIAL TO BE FIBERGLASS REINFORCED PLASTIC IN ACCORDANCE WITH P.P.&L. CO PURCHASE SPECIFICATION PPM-1629-A.
2. MANUFACTURED IN ACCORDANCE WITH THE NATIONAL BUREAU OF STANDARDS No. PS 15-69
3. 48"Ø PIPING - 48" I.D WITH 3/16" WALL - FRP END CONNECTIONS - 25# FLAT-FACED FLG. FLANGE BOLT HOLE PATTERN DESIGNED FOR 22 HOLES TO MATCH A 44 HOLE PATTERN THAT STRADDLES VERTICAL AND HORIZONTAL CENTER LINES (TYP. FOR 48"Ø FLANGES)
4. FRP FLANGE TO MATCH 150# DRILLING. FLANGE BOLT HOLES TO STRADDLE PIPE CENTER LINES.
5. MANUFACTURED USING ATLAC 382 RESIN SYSTEM, WITH WHITE PIGMENT IN OUTER RESIN LAYER. UV-9 ADDED FOR ULTRA VIOLET LIGHT PROTECTION.
PP&L DRAWING No. FF 60909-1 ER 102713
PENN. POWER & LIGHT CO - BRUNNER ISL. SES
FRP-PIPING
SCALE 3/4"=1'-0"
ENGINEERED FIBREGLASS PRODUCTS, INC.
DATE 6-2-80
DRAWING NO. 0-1040-00-2
1 | 8-3-93 | 775001 | ADDED 6" CONN., PUMP PIT DRAIN TO W.W. PIPE | RHK | — | DSB
No | DATE | ER | REVISION BY PP&L | BY | CH | APPR'D
FIH70
SPOOL PIECE 48 INCH DIA



REMOVABLE ELEMENT ASSEMBLY HAVING 2 KOMAX MIXING ELEMENTS IN TYPE 316 STAINLESS STEEL

UNIT IS ADAPTED TO FIT THRU A 48" I.D PIPE.

NOTES:
1. ACID OR CAUSTIC INJECTED 2'-6" UPSTREAM FROM MIXER
2. pH MEASURED 5'-0" DOWNSTREAM FROM MIXER.

REV. NO.	DATE	REMARKS	BY	APP
1	7-12-83	NOTES ADDED PER CUSTOMER REQUEST	L.N.N.	

REVISION BLOCK

OUTLINE & MOUNTING CONFIGURATION

SCALE: NONE | APPROVED BY: | DRAWN BY L. N. N.
DATE: 02-17-83 | REVISED 6-20-83

KOMAX MODEL NO. 16863

KOMAX SYSTEMS, INC. Long Beach, Ca. 90810-1689 | REF Q 8549-83 J 5006-83 | DRAWING NUMBER 7242A

REFERENCE TITLE	NUMBER	NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
		2	4/2/84	102713	REFURBISHED DWG ON PP&L FORMAT	RHK	JP	

ER- 102713
SCALE-
DATE-
DRAWN-
CHECKED-
LEADER-
APP'D.
APP'D.

BRUNNER ISLAND S.E.S.
ASH BASIN #6 pH CONTROL
OUTLINE & MOUNTING CONFIGURATION

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA. SHEET 2 OF 2

APPROVED KOMAX SYSTEMS INC. ENGINEER FF-60569-2

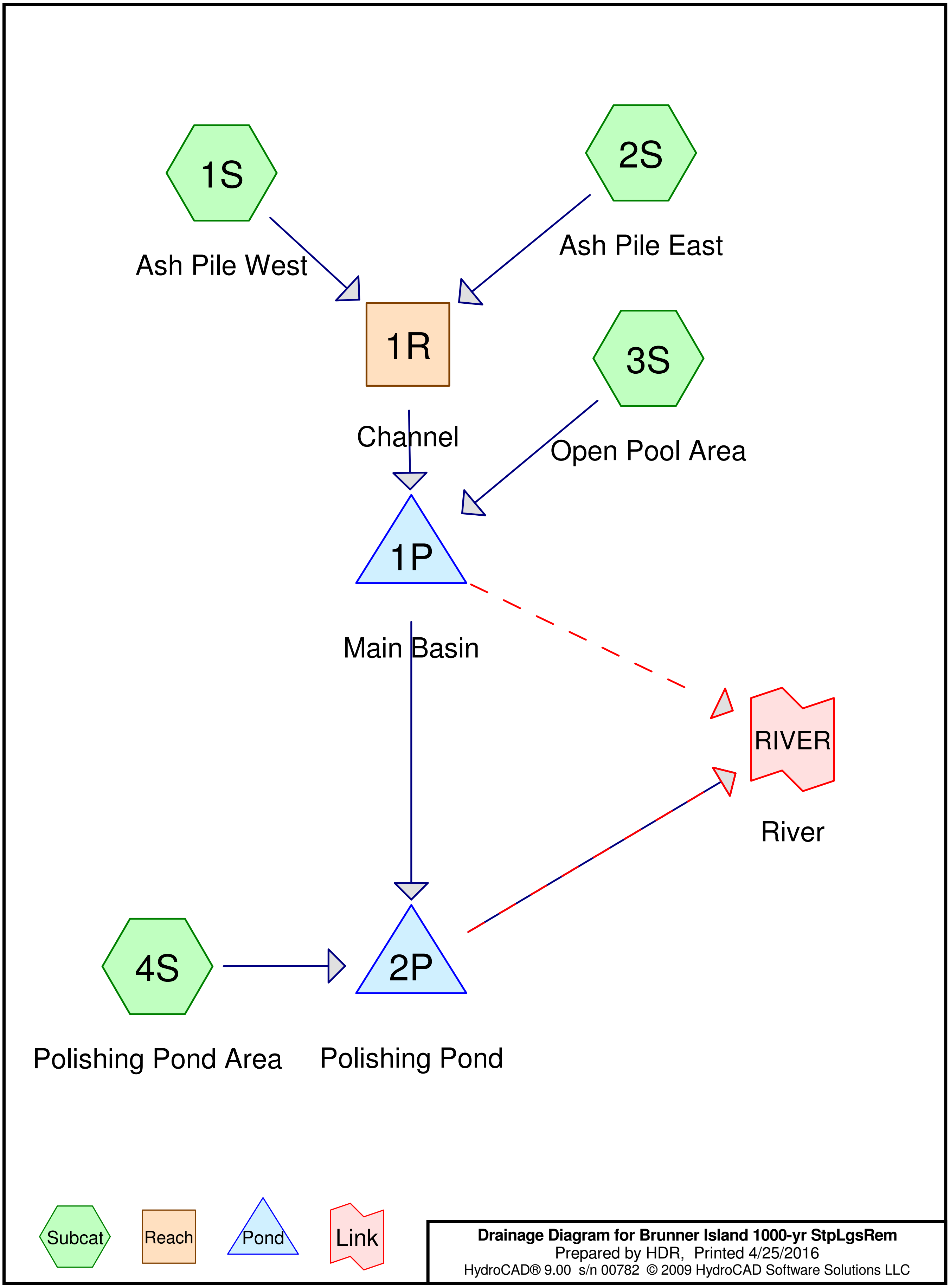
LOCATION CODE F I H 8 0

PP&L 895-C 17"X22" PP&L Letter - Height Drafting Standard: Dwg. No. - 3/8", Title - 3/16", Subtitle - 5/32", Letter Figures - 1/8" Min.

Data Table for 48" Mixer with 2 Elements		
Flow Rate (gpm)	**Pressure Drop (psi)**	**Velocity (ft/sec.)**
0 CFS	0.00 psi	0.00 ft/sec.
20 CFS	0.14 psi	1.59 ft/sec.
40 CFS	0.55 psi	3.18 ft/sec.
60 CFS	1.23 psi	4.77 ft/sec.
80 CFS	2.19 psi	6.36 ft/sec.
100 CFS	3.42 psi	7.95 ft/sec.
120 CFS	4.92 psi	9.54 ft/sec.
140 CFS	6.69 psi	11.13 ft/sec.
160 CFS	8.74 psi	12.72 ft/sec.
180 CFS	11.07 psi	14.31 ft/sec.
200 CFS	13.66 psi	15.90 ft/sec.
220 CFS	16.53 psi	17.49 ft/sec.
240 CFS	19.67 psi	19.08 ft/sec.
260 CFS	23.09 psi	20.66 ft/sec.
280 CFS	26.56 psi	22.17 ft/sec.
300 CFS	30.74 psi	23.84 ft/sec.

Provided by Komax Systems Inc, November 2015.

Appendix B. On-site IDF HydroCad Model Report


1S
Ash Pile West
2S
Ash Pile East
1R
Channel
3S
Open Pool Area
1P
Main Basin
RIVER
River
4S
Polishing Pond Area
2P
Polishing Pond
Subcat
Reach
Pond
Link
Drainage Diagram for Brunner Island 1000-yr StpLgsRem
Prepared by HDR, Printed 4/25/2016
HydroCAD® 9.00 s/n 00782 © 2009 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
12.560	80	Active Area (1S)
52.330	88	Non Active Area (1S, 2S, 3S, 4S)
11.550	100	Open Water (3S, 4S)
76.440		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.10 hrs, 361 points x 2
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Muskingum-Cunge method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Ash Pile West Runoff Area=40.610 ac 0.00% Impervious Runoff Depth=10.64"
Flow Length=2,631' Tc=16.0 min CN=86 Runoff=486.53 cfs 36.007 af

Subcatchment 2S: Ash Pile East Runoff Area=15.110 ac 0.00% Impervious Runoff Depth=10.90"
Flow Length=2,209' Tc=22.4 min CN=88 Runoff=156.17 cfs 13.727 af

Subcatchment 3S: Open Pool Area Runoff Area=18.010 ac 52.30% Impervious Runoff Depth=11.67"
Flow Length=515' Tc=9.3 min CN=94 Runoff=273.14 cfs 17.508 af

Subcatchment 4S: Polishing Pond Area Runoff Area=2.710 ac 78.60% Impervious Runoff Depth=12.04"
Flow Length=401' Tc=2.8 min CN=97 Runoff=46.85 cfs 2.718 af

Reach 1R: Channel Avg. Depth=2.31' Max Vel=9.97 fps Inflow=634.51 cfs 49.734 af
n=0.025 L=624.1' S=0.0024 '/' Capacity=1,070.42 cfs Outflow=627.83 cfs 49.734 af

Pond 1P: Main Basin Peak Elev=286.93' Storage=157.475 af Inflow=811.93 cfs 67.242 af
Primary=92.95 cfs 74.847 af Secondary=0.00 cfs 0.000 af Outflow=92.95 cfs 74.847 af

Pond 2P: Polishing Pond Peak Elev=280.46' Storage=706,833 cf Inflow=97.67 cfs 77.565 af
Primary=89.75 cfs 69.154 af Secondary=0.00 cfs 0.000 af Outflow=89.75 cfs 69.154 af

Link RIVER: River Inflow=89.75 cfs 69.154 af
Primary=89.75 cfs 69.154 af

Total Runoff Area = 76.440 ac Runoff Volume = 69.960 af Average Runoff Depth = 10.98"
84.89% Pervious = 64.890 ac 15.11% Impervious = 11.550 ac

Summary for Subcatchment 1S: Ash Pile West

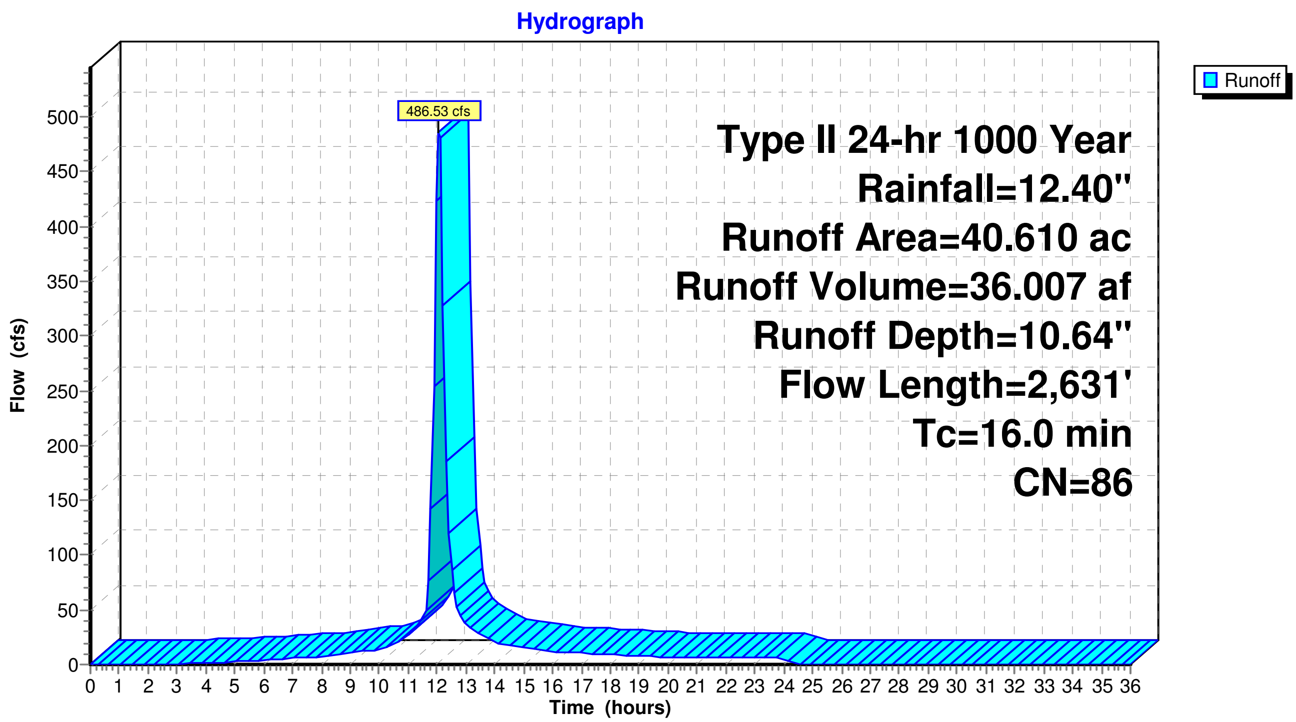
Runoff = 486.53 cfs @ 12.08 hrs, Volume= 36.007 af, Depth=10.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs
Type II 24-hr 1000 Year Rainfall=12.40"

	Area (ac)	CN	Description
*	28.050	88	Non Active Area
*	12.560	80	Active Area
	40.610	86	Weighted Average
	40.610		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	31	0.0540	0.46		**Sheet Flow, Sheet Flow** Fallow n= 0.050 P2= 2.90"
0.2	51	0.2360	4.86		**Shallow Concentrated Flow, Overland Flow** Nearly Bare & Untilled Kv= 10.0 fps
0.9	118	0.0510	2.26		**Shallow Concentrated Flow, Overland Flow** Nearly Bare & Untilled Kv= 10.0 fps
13.8	2,431	0.0008	2.93	158.15	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=15.00' D=3.00' Z= 1.0 '/' Top.W=21.00' n= 0.025
16.0	2,631	Total			

Subcatchment 1S: Ash Pile West



Summary for Subcatchment 2S: Ash Pile East

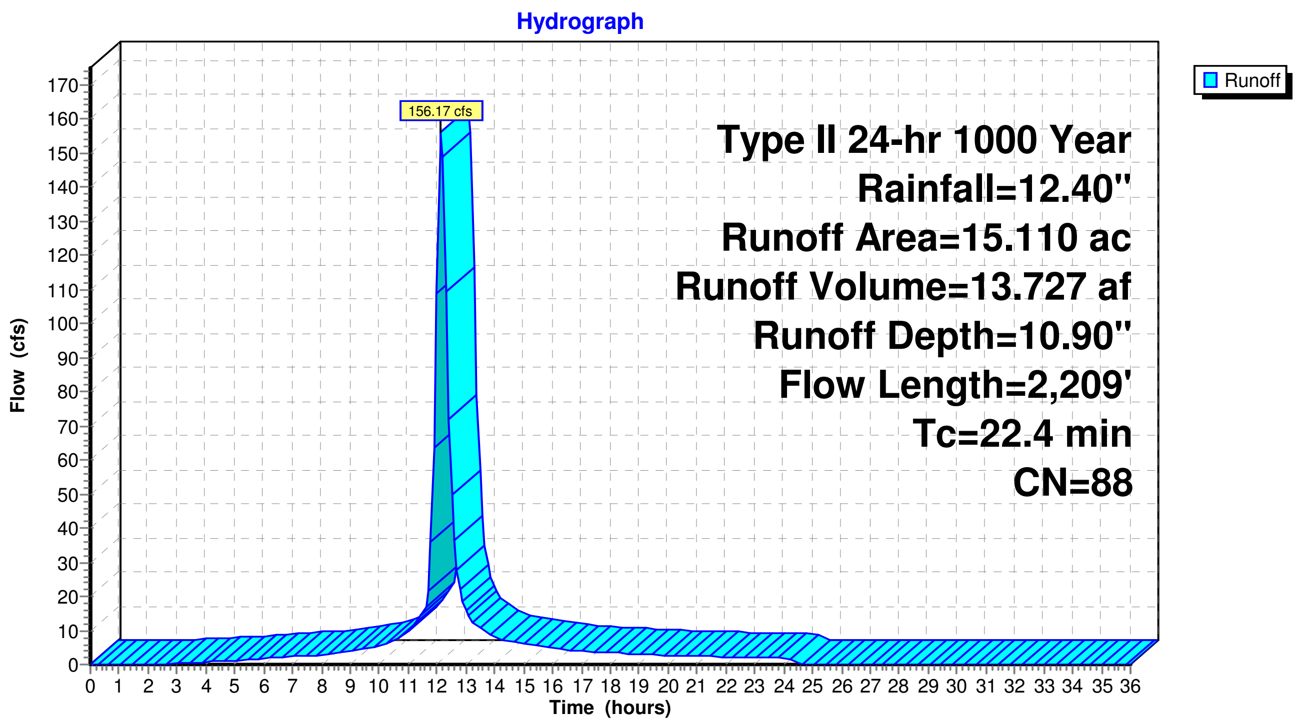
Runoff = 156.17 cfs @ 12.14 hrs, Volume= 13.727 af, Depth=10.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs
Type II 24-hr 1000 Year Rainfall=12.40"

	Area (ac)	CN	Description
*	15.110	88	Non Active Area
	15.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	50	0.0340	0.42		**Sheet Flow, Sheet Flow** Fallow n= 0.050 P2= 2.90"
0.1	39	0.2590	5.09		**Shallow Concentrated Flow, Overland Flow** Nearly Bare & Untilled Kv= 10.0 fps
0.9	135	0.0592	2.43		**Shallow Concentrated Flow, Overland Flow** Nearly Bare & Untilled Kv= 10.0 fps
8.6	366	0.0050	0.71		**Shallow Concentrated Flow, Overland Flow** Nearly Bare & Untilled Kv= 10.0 fps
10.8	1,619	0.0010	2.50	59.97	**Trap/Vee/Rect Channel Flow, Channel Flow** Bot.W=10.00' D=2.00' Z= 1.0 '/' Top.W=14.00' n= 0.025
22.4	2,209	Total			

Subcatchment 2S: Ash Pile East



Summary for Subcatchment 3S: Open Pool Area

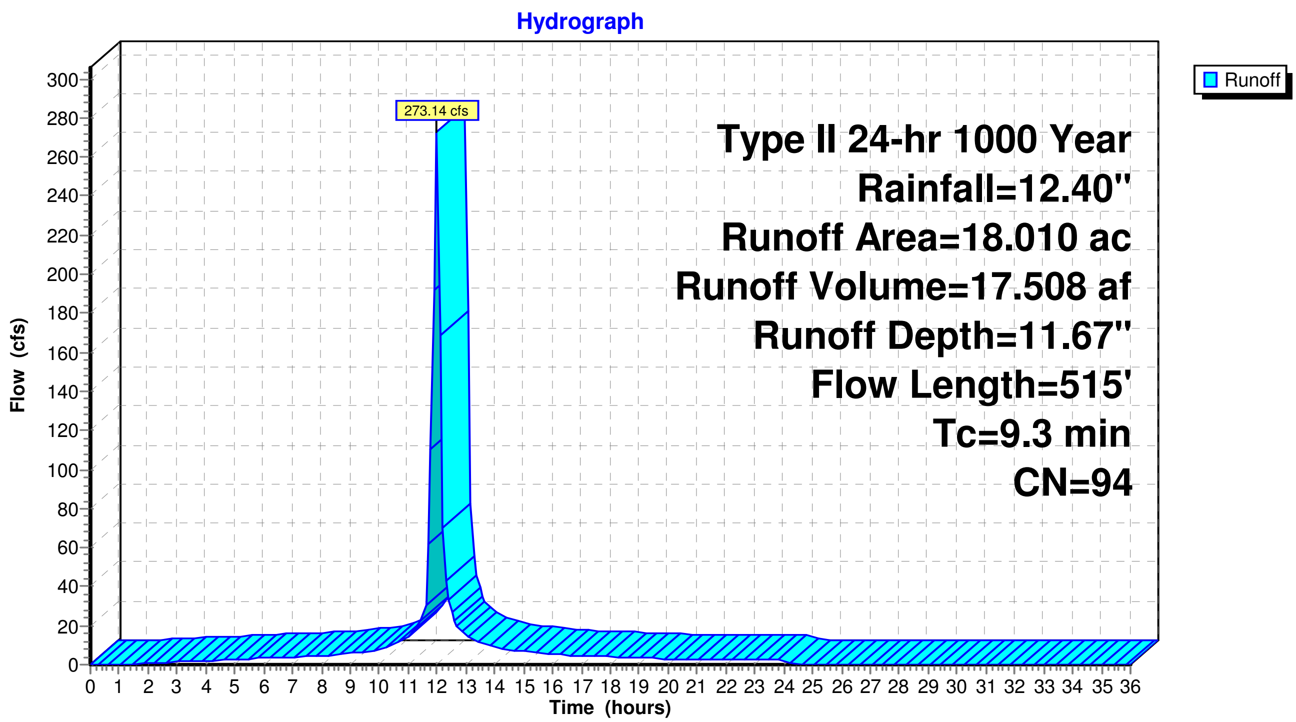
Runoff = 273.14 cfs @ 11.99 hrs, Volume= 17.508 af, Depth=11.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs
Type II 24-hr 1000 Year Rainfall=12.40"

	Area (ac)	CN	Description
*	9.420	100	Open Water
*	8.590	88	Non Active Area
	18.010	94	Weighted Average
	8.590		47.70% Pervious Area
	9.420		52.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0100	0.26		**Sheet Flow, Sheet Flow** Fallow n= 0.050 P2= 2.90"
6.1	465	0.0160	1.26		**Shallow Concentrated Flow, Shallow Flow** Nearly Bare & Untilled Kv= 10.0 fps
9.3	515	Total			

Subcatchment 3S: Open Pool Area



Summary for Subcatchment 4S: Polishing Pond Area

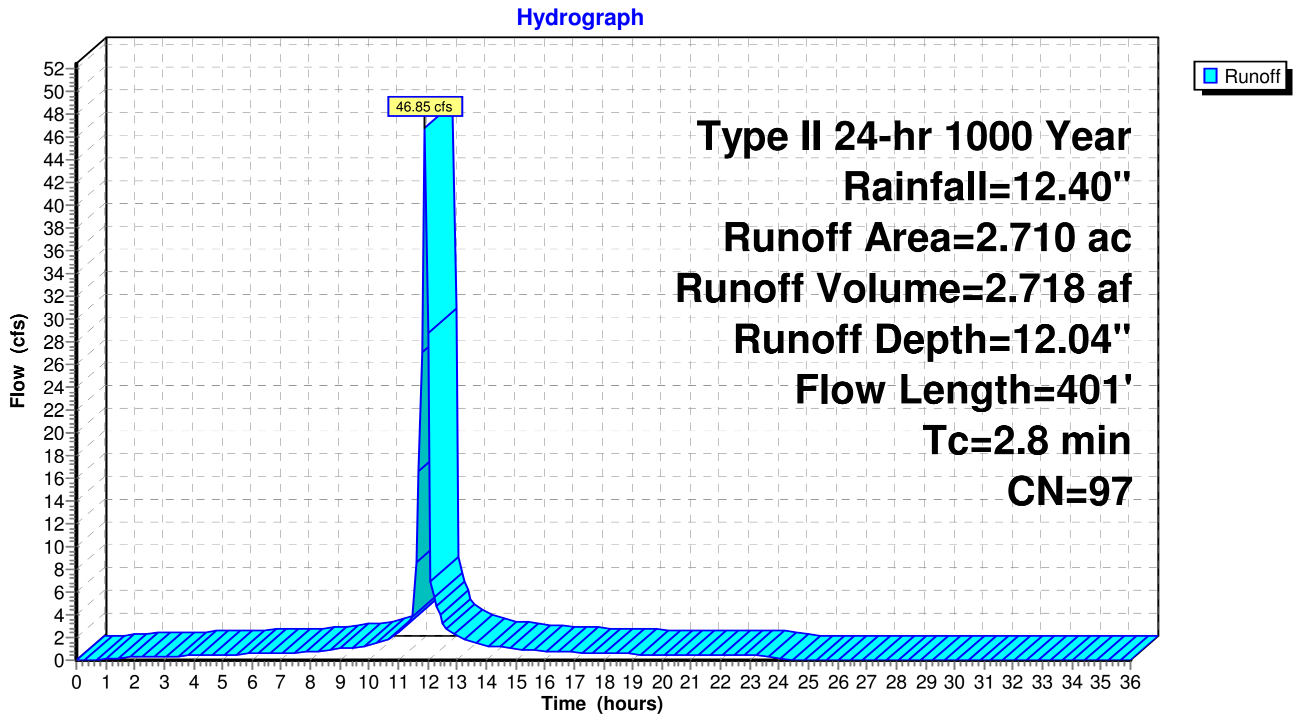
Runoff = 46.85 cfs @ 11.90 hrs, Volume= 2.718 af, Depth=12.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs
Type II 24-hr 1000 Year Rainfall=12.40"

	Area (ac)	CN	Description
*	2.130	100	Open Water
*	0.580	88	Non Active Area
	2.710	97	Weighted Average
	0.580		21.40% Pervious Area
	2.130		78.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	50	0.0200	0.34		**Sheet Flow, Shallow Flow** Fallow n= 0.050 P2= 2.90"
0.2	129	0.0620	11.75	46.99	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=0.00' D=2.00' Z= 1.0 '/' Top.W=4.00' n= 0.025
0.1	222		28.93		**Lake or Reservoir, Flow through pond** Mean Depth= 26.00'
2.8	401	Total			

Subcatchment 4S: Polishing Pond Area



Summary for Reach 1R: Channel

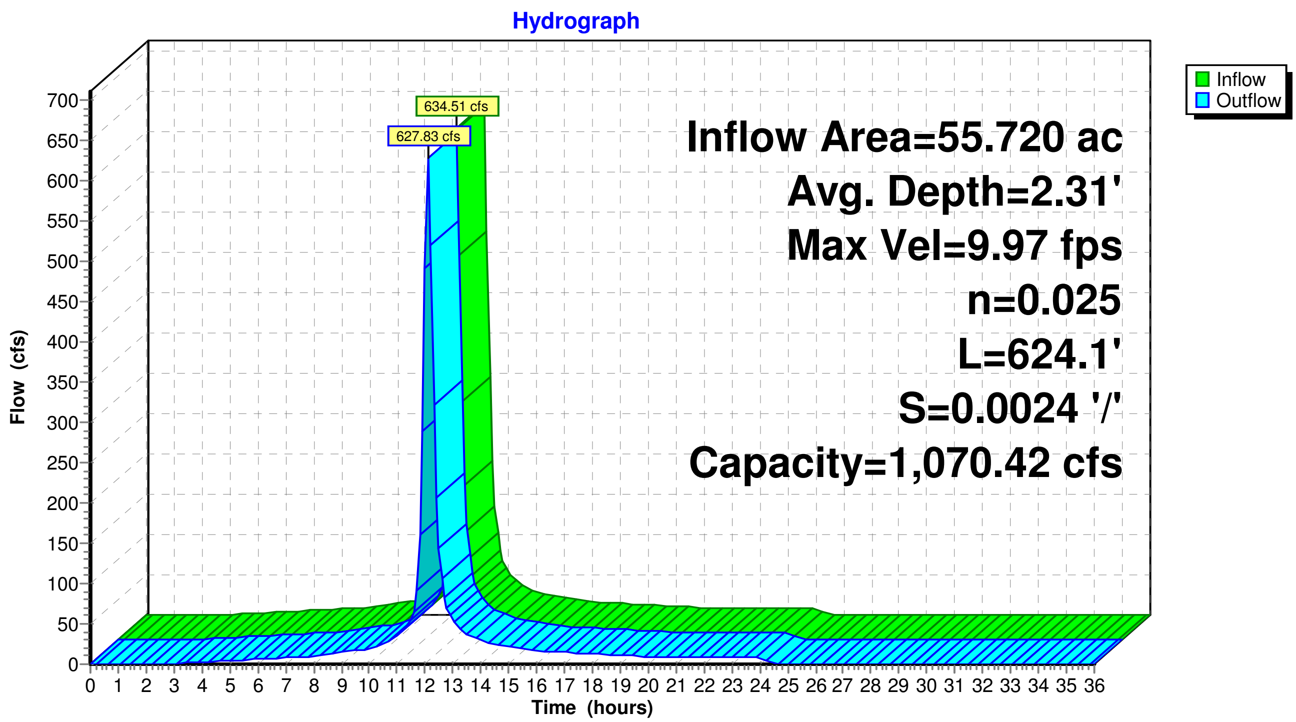
Inflow Area = 55.720 ac, 0.00% Impervious, Inflow Depth = 10.71" for 1000 Year event
Inflow = 634.51 cfs @ 12.09 hrs, Volume= 49.734 af
Outflow = 627.83 cfs @ 12.11 hrs, Volume= 49.734 af, Atten= 1%, Lag= 1.0 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs / 2
Reference Flow= 802.81 cfs Estimated Depth= 4.22' Velocity= 6.51 fps
m= 1.532, c= 9.97 fps, dt= 6.0 min, dx= 624.1' / 1 = 624.1', K= 1.0 min, X= 0.000
Max. Velocity= 9.97 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 9.97 fps, Avg. Travel Time= 1.0 min

Peak Storage= 39,289 cf @ 12.11 hrs, Average Depth at Peak Storage= 2.31'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 1,070.42 cfs

25.00' x 5.00' deep channel, n= 0.025
Side Slope Z-value= 1.0 '/' Top Width= 35.00'
Length= 624.1' Slope= 0.0024 '/'
Inlet Invert= 286.00', Outlet Invert= 284.50'

Reach 1R: Channel



Summary for Pond 1P: Main Basin

Inflow Area = 73.730 ac, 12.78% Impervious, Inflow Depth = 10.94" for 1000 Year event
Inflow = 811.93 cfs @ 12.06 hrs, Volume= 67.242 af
Outflow = 92.95 cfs @ 12.38 hrs, Volume= 74.847 af, Atten= 89%, Lag= 19.0 min
Primary = 92.95 cfs @ 12.38 hrs, Volume= 74.847 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs / 2
Starting Elev= 284.20' Surf.Area= 8.603 ac Storage= 128.140 af
Peak Elev= 286.93' @ 12.77 hrs Surf.Area= 11.845 ac Storage= 157.475 af (29.335 af above start)
Flood Elev= 290.00' Surf.Area= 15.499 ac Storage= 182.785 af (54.644 af above start)

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= 188.1 min (961.6 - 773.5)

Volume	Invert	Avail.Storage	Storage Description
#1	282.80'	63.938 af	**Custom Stage Data (Irregular)** Listed below
#2	260.55'	118.846 af	**Custom Stage Data** Listed below
		182.785 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
282.80	6.304	2,980.4	0.000	0.000	6.304
284.80	9.588	3,383.9	15.777	15.777	10.997
286.80	11.600	5,963.1	21.156	36.933	55.039
288.80	15.499	11,766.4	27.005	63.938	243.003

Elevation (feet)	Cum.Store (acre-feet)
260.55	0.000
262.00	0.118
264.00	2.461
266.00	7.710
268.00	14.514
270.00	22.556
272.00	31.808
274.00	42.297
276.00	54.081
278.00	67.274
280.00	81.900
282.00	97.845
284.40	118.846

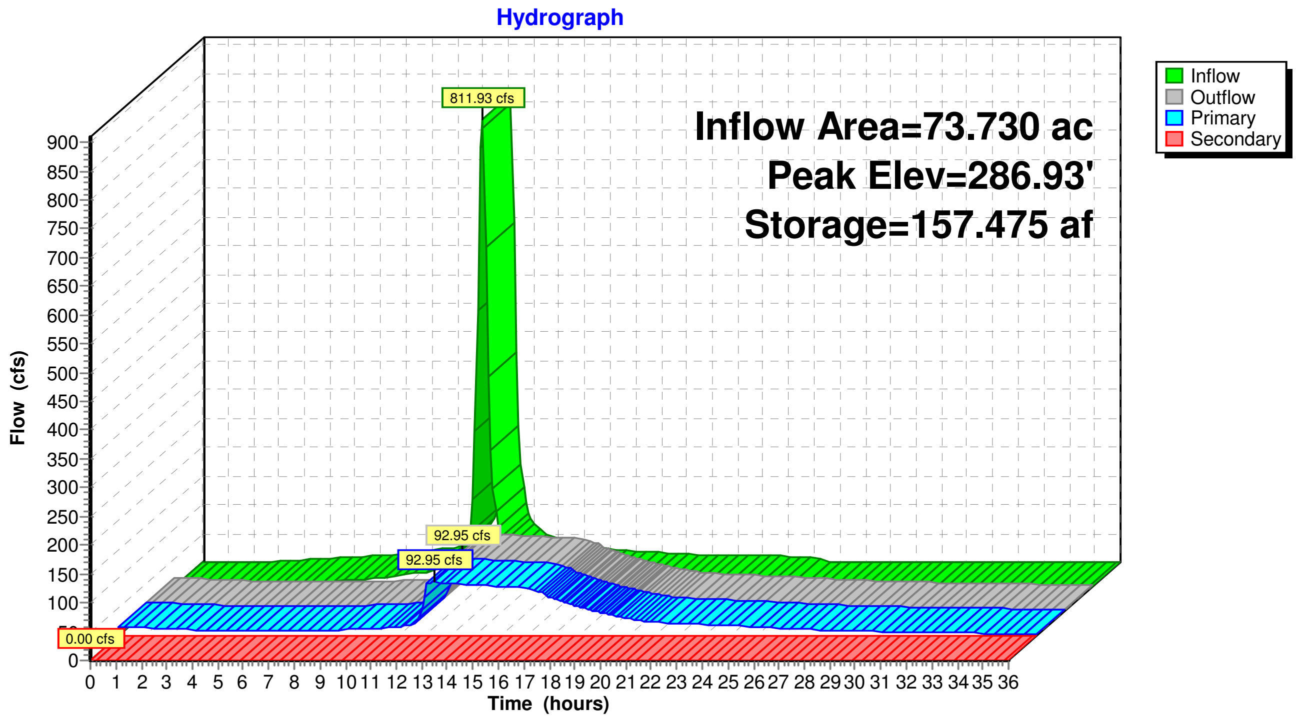
Device	Routing	Invert	Outlet Devices
#1	Primary	270.75'	**Special & User-Defined** Loss (feet) 0.00 0.32 1.27 2.84 5.05 7.89 11.35 15.43 20.16 25.54 31.51 38.14 45.38 53.27 61.28 70.92 Disch. (cfs) 0.000 20.000 40.000 60.000 80.000 100.000 120.000 140.000 160.000 180.000 200.000 220.000 240.000 260.000 280.000 300.000

#2	Device 1	271.00'	**48.0" Round Culvert** L= 122.0' Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 270.75' S= 0.0020 '/' Cc= 0.900 n= 0.015
#3	Secondary	289.90'	**850.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#4	Device 2	283.50'	**4.5' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s)

Primary OutFlow Max=92.94 cfs @ 12.38 hrs HW=286.77' TW=279.89' (Dynamic Tailwater)
└─**1=Special & User-Defined** (Custom Controls 92.94 cfs)
  └─**2=Culvert** (Passes 92.94 cfs of 158.80 cfs potential flow)
    └─**4=Sharp-Crested Rectangular Weir** (Passes 92.94 cfs of 148.95 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=284.20' TW=278.20' (Dynamic Tailwater)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Main Basin



Summary for Pond 2P: Polishing Pond

Inflow Area = 76.440 ac, 15.11% Impervious, Inflow Depth > 12.18" for 1000 Year event
Inflow = 97.67 cfs @ 12.27 hrs, Volume= 77.565 af
Outflow = 89.75 cfs @ 13.84 hrs, Volume= 69.154 af, Atten= 8%, Lag= 94.6 min
Primary = 89.75 cfs @ 13.84 hrs, Volume= 69.154 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs / 2
Starting Elev= 268.00' Surf.Area= 27,156 sf Storage= 228,055 cf
Peak Elev= 280.46' @ 13.84 hrs Surf.Area= 56,523 sf Storage= 706,833 cf (478,777 cf above start)
Flood Elev= 290.00' Surf.Area= 101,962 sf Storage= 1,352,744 cf (1,124,689 cf above start)

Plug-Flow detention time= 261.7 min calculated for 63.672 af (82% of inflow)
Center-of-Mass det. time= 98.9 min (1,052.5 - 953.6)

Volume	Invert	Avail.Storage	Storage Description
#1	266.80'	1,156,243 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)
#2	252.58'	196,501 cf	**Custom Stage Data** Listed below
		1,352,744 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
266.80	25,444	614.4	0	0	25,444
268.80	28,328	637.6	53,746	53,746	28,073
270.80	32,030	731.2	60,320	114,066	38,360
272.80	35,349	787.4	67,352	181,418	45,319
274.80	38,704	810.1	74,028	255,446	48,617
276.80	42,410	830.8	81,086	336,531	51,779
278.80	46,317	854.8	88,698	425,230	55,413
280.80	58,757	938.1	104,828	530,057	67,433
282.80	68,268	1,019.0	126,906	656,964	80,183
284.80	77,642	1,100.1	145,810	802,773	94,022
286.80	87,076	1,160.5	164,628	967,401	105,121
288.80	101,962	1,268.3	188,842	1,156,243	126,097

Elevation (feet)	Cum.Store (cubic-feet)
252.58	0
254.00	641
256.00	8,160
258.00	29,470
260.00	58,643
262.00	94,060
264.00	135,336
266.60	196,501

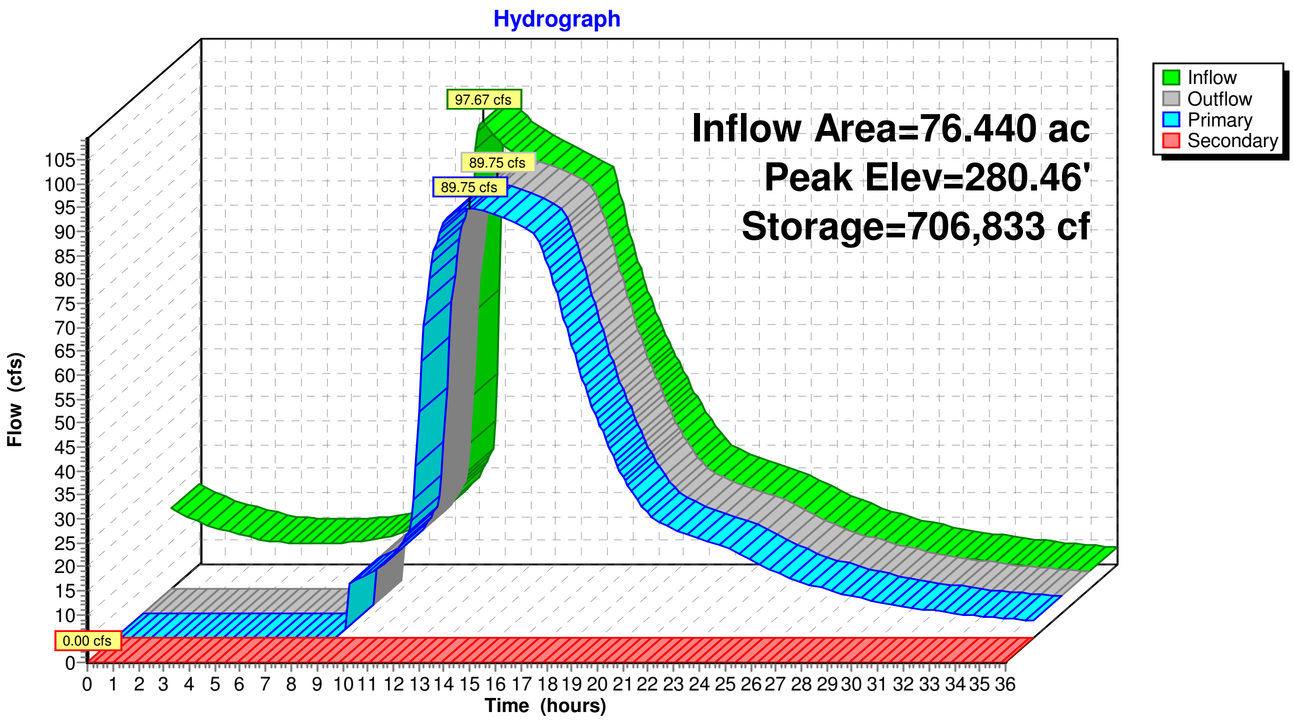
Device	Routing	Invert	Outlet Devices
#1	Primary	253.00'	**48.0" Round Culvert** L= 205.0' Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 252.00' S= 0.0049 '/' Cc= 0.900 n= 0.015

#2	Secondary	289.90'	**650.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Device 1	268.00'	**60.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=89.75 cfs @ 13.84 hrs HW=280.46' TW=278.20' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 89.75 cfs @ 7.14 fps)
  └─**3=Orifice/Grate** (Passes 89.75 cfs of 284.10 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=268.11' TW=278.20' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Polishing Pond



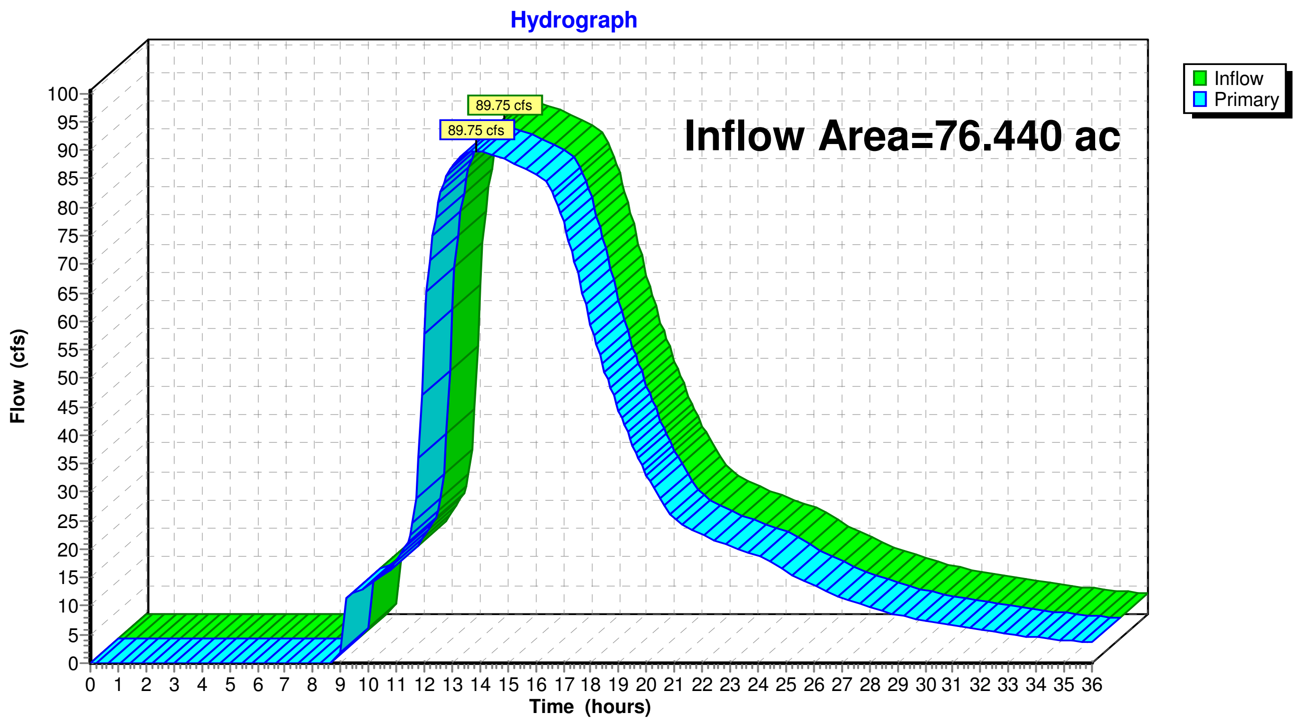
Summary for Link RIVER: River

Inflow Area = 76.440 ac, 15.11% Impervious, Inflow Depth > 10.86" for 1000 Year event
Inflow = 89.75 cfs @ 13.84 hrs, Volume= 69.154 af
Primary = 89.75 cfs @ 13.84 hrs, Volume= 69.154 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.10 hrs

Fixed water surface Elevation= 278.20'

Link RIVER: River



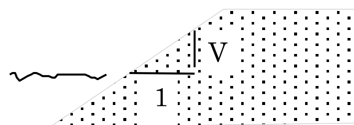
Appendix C. On-site IDF Wave Run-up Calculation

Analysis Procedure for determining the wind induced significant wave H_s and wave run-up using "Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams", USBR, 1981.

This procedure assumes that site specific wind data are not available, therefore, use the generalized fastest mile and 1-hour maximum winds from Figures 1 to 8 in above Reference. Use 80% of maximum winds for moderate wind condition during Maximum Flood condition.

Project Structures		**NA**	**NA**
Top Elevation w/o camber	290	NA	NA
Slope of u/s face (V >0.2 or 11.3°)	0.4	Vertical	Vertical
U/s Type of Surface	Soil Cement	Concrete	Concrete
General Direction Orientation			

Effective Fetch	***Normal***	***Flood***
F_e from Trial and Error (miles)	0.13	0.13
Wind correction Water/Land based on Table 2 & F_e	1.043	1.043



Where: Wind velocity Ratio Land/Water = $1.0301 + 0.098184F_e + 0.0079048F_e^2 - 0.0076136F_e^3 + 0.00085282F_e^4$ with a maximum of 1.30

Meteorological Data

	Figure	Value from Graph (mph)	Normal Pool over water (mph)	Max Flood Pool over water (mph)
Fastest Mile from Figures 1-4 (1 minute)		62	65	52
Season of the year:	Spring			
Fastest Mile from Figures 5-8 (1 hour)		40	42	33
Season of the year:	Summer			
Fastest Mile (2 hour) = 0.96 x (1 hour)		38	40	32

Wind Velocity and Duration Data Points from Figure 9

Fetch N	*Fetch F*
0.133	**0.133**

Wind (mph)@ 25' above the water for duration (minutes)

Interpolate Wind velocity values for Normal Pool and Max. Flood Pool from Figure 9 using the appropriate Fetch.

Find at least 5 points and bracket wind velocities found in table above using Figures 1-8.

Values will be used to plot Wind Velocity over Water vs Duration.

See Plots of Normal & Flood

Duration (min)	**Normal Pool over water (mph)**	**Max Flood Pool over water (mph)**
1.0	80.0	80.0
4.0	48.0	48.0
5.0	28.0	28.0
6.0	18.0	18.0
7.0	13.0	13.0
8.0		
9.0		
10.0		
15.0		
20.0		
25.0		
30.0		
40.0		
50.0		
60.0		
70.0		
80.0		
90.0		
100.0		
120.0		
140.0		
160.0		
180.0		
200.0		

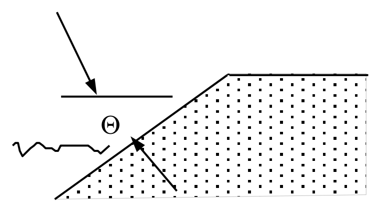
	Normal	*Flood*
From Figure 9, determine the significant wave height H_s =	1.1	0.85

From USBR page 15, for Normal Freeboard, Modify H_s to account for average of highest 10% of waves = 1.27 x H_s = **1.4**

Calculate Wave Runup and Wave Setup

	Normal		Flood
From USBR Fig. 10, Determine the	1.7	seconds	1.55
From USBR Eq. 2, the wave length L =	**14.8**	feet	**12.3**
$L = 5.12 * T^2$ assumes deep water conditions where the reservoir depth is greater than 1/2 L =	7.4	feet	6.2

	Earth Dam
Average Pool depth, D @ Central Radial (ft)	26
Is D > L/2 to ignore bottom effects?	*YES*
U/s surface slope	0.4
Angle (deg) of u/s face of dam with the horizon Θ > 11.3°	21.80
Cot Θ =	2.50



OK

Eq. 3 Runup for Significant Wave Height " Rs " (ft)

	Normal	Flood
Riprap	**1.4**	**1.0**
Correction for Angle Offset if direction of wave propagation is not normal to the embankment	**1.4**	**1.0**

Angle (degrees) (1<α<50)	1
Smooth Face Correction Factor	1.2

From USBR pg. 13, Earth dam w/ smooth face. (Factor <1.5)

Not a Rockfill Dam

Eq. 4 Wind Setup " S " (ft) For:

From Plotted graph of Wind Velocity over water vs Duration	Velocity (mph)	Duration (minutes)
Normal Pool	64.1014438	2.49048964
Flood Pool	50.8958757	3.72851166

Normal Pool

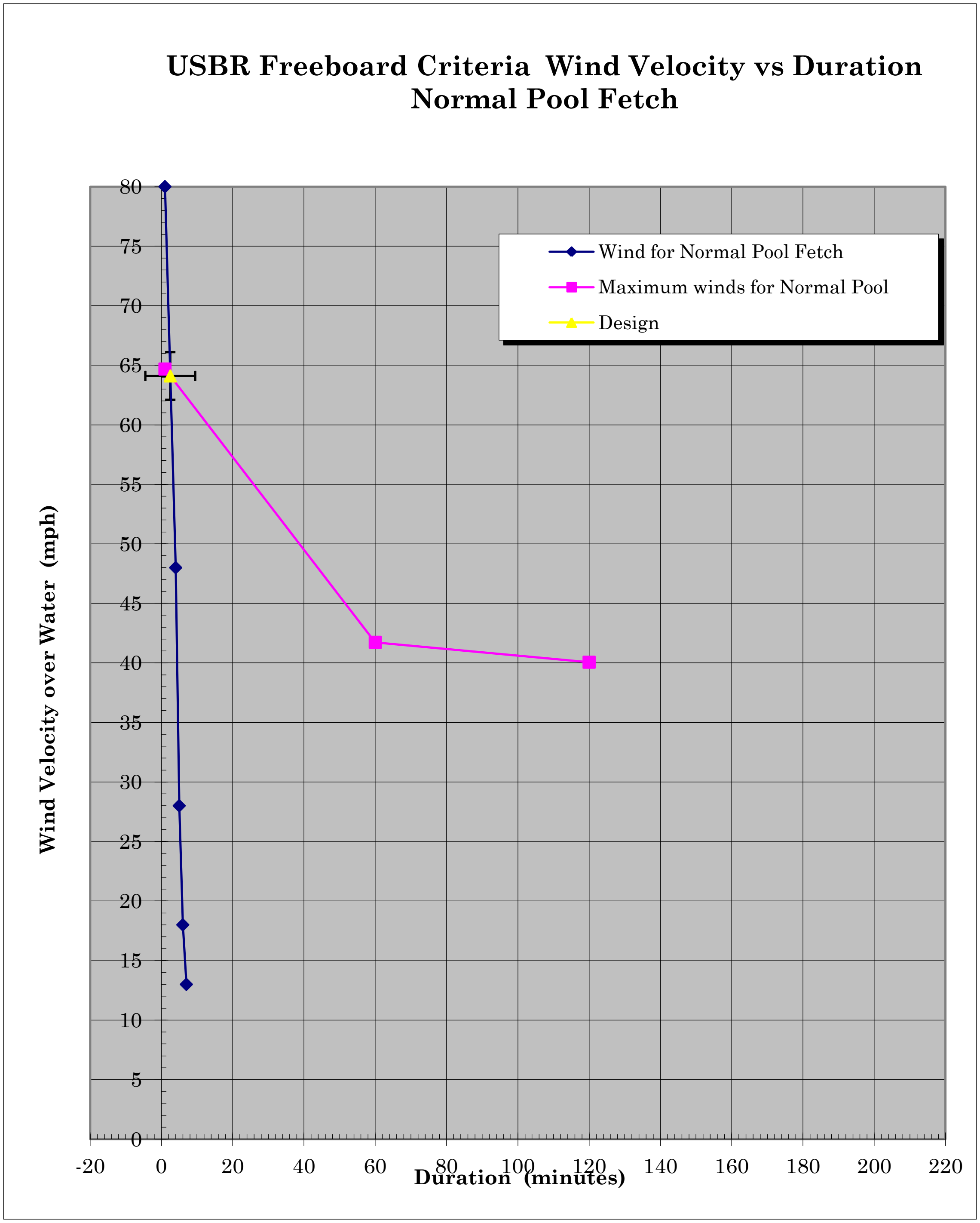
Setup = **0.03** feet

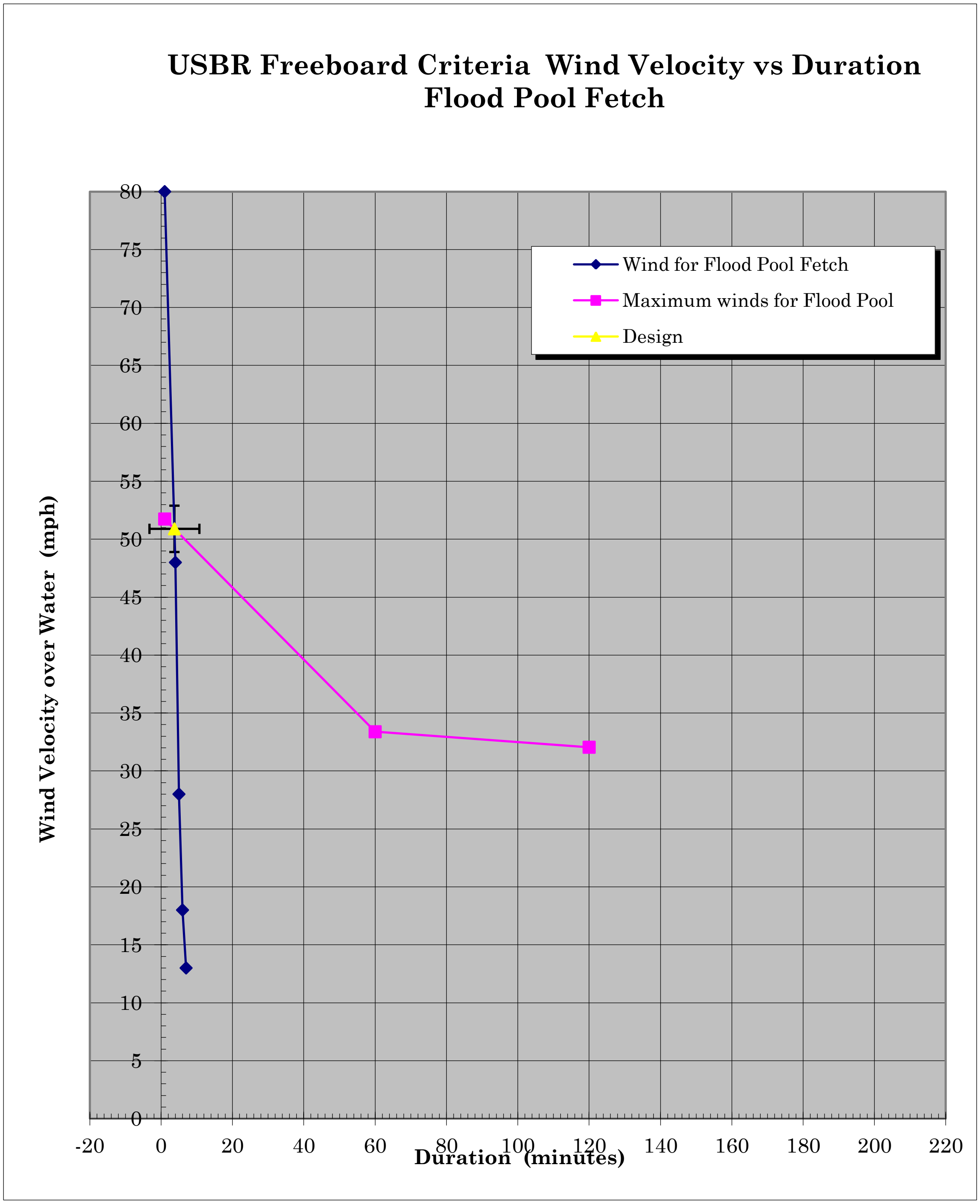
Flood Pool

Setup = **0.02** feet

Minimum Freeboard Requirement (feet)

	Earth Dam
Normal Pool	**1.46**
Flood Pool	**0.98**


USBR Freeboard Criteria Wind Velocity vs Duration
Normal Pool Fetch
Wind for Normal Pool Fetch
Maximum winds for Normal Pool
Design
Wind Velocity over Water (mph)
Duration (minutes)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-20
0
20
40
60
80
100
120
140
160
180
200
220


USBR Freeboard Criteria Wind Velocity vs Duration
Flood Pool Fetch
Wind for Flood Pool Fetch
Maximum winds for Flood Pool
Design
Wind Velocity over Water (mph)
Duration (minutes)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-20
0
20
40
60
80
100
120
140
160
180
200
220

Calculate the effective fetch, Fe, from existing topographic map of project. Construct a central radial and 7 radial lines at 6 degree intervals on each side. Draw the central radial from a point on the face of the dam to a point on the opposite shoreline in the direction to yield the longest distance over open water.

Radial Number	Angle α	Cos α	Cos^2 α	X_i scale distance (ft)	Cos^2 α * X_i
1	42	0.7431	0.5523	781	431.32
2	36	0.8090	0.6545	779	509.86
3	30	0.8660	0.7500	785	588.75
4	24	0.9135	0.8346	799	666.82
5	18	0.9511	0.9045	823	744.41
6	12	0.9781	0.9568	859	821.87
7	6	0.9945	0.9891	907	897.09
8	0	1.0000	1.0000	971	971.00
9	6	0.9945	0.9891	920	909.95
10	12	0.9781	0.9568	975	932.85
11	18	0.9511	0.9045	841	760.69
12	24	0.9135	0.8346	816	681.01
13	30	0.8660	0.7500	478	358.50
14	36	0.8090	0.6545	191	125.01
15	42	0.7431	0.5523	116	64.06
		Σ 13.5109		Σ 11041	9463.19

Effective Fetch (F_e) = 700.41 ft.

Trial 1 or **0.13** miles

Check (F_e) = 0.14 miles

Calculate the effective fetch, Fe, from existing topographic map of project. Construct a central radial and 7 radial lines at 6 degree intervals on each side. Draw the central radial from a point on the face of the dam to a point on the opposite shoreline in the direction to yield the longest distance over open water.

Radial Number	Angle α	Cos α	$Cos^2 \alpha$	X_i scale distance (ft)	$Cos^2 \alpha * X_i$
1	42	0.7431	0.5523	781	431.32
2	36	0.8090	0.6545	779	509.86
3	30	0.8660	0.7500	785	588.75
4	24	0.9135	0.8346	799	666.82
5	18	0.9511	0.9045	823	744.41
6	12	0.9781	0.9568	859	821.87
7	6	0.9945	0.9891	907	897.09
8	0	1.0000	1.0000	971	971.00
9	6	0.9945	0.9891	920	909.95
10	12	0.9781	0.9568	975	932.85
11	18	0.9511	0.9045	841	760.69
12	24	0.9135	0.8346	816	681.01
13	30	0.8660	0.7500	478	358.50
14	36	0.8090	0.6545	191	125.01
15	42	0.7431	0.5523	116	64.06
	Σ	13.5109	Σ	11041	9463.19

700.41 ft.

Trial 2 or **0.13** miles

0.14 miles