REPORT

Inflow Design Flood Control System Plan - Bottom Ash System Diversion Basin

DTE Belle River Power Plant
China Township, Michigan

June 21, 2019
NTH Project No. 62-190124

NTH Consultants, Ltd.
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INTRODUCTION

NTH Consultants, Ltd. (NTH has completed an inflow design flood control system plan for an additional process basin at Belle River Power Plant (BRPP) in accordance with the Environmental Protection Agency's (EPA) final CCR rule Subpart D – "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" 40 CFR Part 257.82. This plan details the hydraulic and hydrologic capacity of the Diversion Basin as part of the overall Bottom Ash Basin CCR impoundment system which was previously analyzed and documented in a report entitled: Inflow Design Flood Control System Plan, Belle River Power Plant, prepared by NTH Consultants, Ltd., dated October 14, 2016. The intent of this plan is to document that the Diversion Basin portion of the Bottom Ash Basin CCR impoundment system has the capacity to manage the discharge from the process flows along with a specified design rainfall event "inflow design flood", based on the hazard potential classification of the basin.

The BRPP was constructed in the 1980's in China Township, just west of the DTE St. Clair Power Plant (STCPP). The power plant is located on the peninsula formed by the St. Clair and Belle Rivers, approximately three miles south of St. Clair, Michigan. The Diversion Basin is a physical sedimentation basin located east of BRPP near the Webster Drain and receives process water from the bottom ash basins and the nearby Range Road Ash Disposal Landfill (RRLF) sedimentation pond. Discharge water flows through a pump station via a force main and other site infrastructure, eventually outfalling with other site wastewater authorized via a National Pollutant Discharge Elimination System (NPDES) permit. An overall site plan is included as Figure 1, in the attachments.

Regulatory Basis

In accordance with 40 CFR Part 257.82, NTH has prepared this inflow design flood control system plan to demonstrate and document the hydrologic and hydraulic capacity and performance requirements for the Diversion Basin. Specifically, this plan details how the Diversion Basin collects and controls the peak discharge from the inflow design flood, in addition to the peak discharge into the impoundment from upstream sources, including the Bottom Ash Basins and

RRLF sedimentation pond. Because the Diversion Basin meets the definition of an incised basin based on 40 CFR 257, the inflow design flood requirements for the capacity evaluation is analyzed to handle a 25-year flood event in addition to the plant process flows in accordance with 40 CFR 257.82(a)(3)(iv). As stipulated in Section VI (H) (3) of the rule preamble, the plan also includes a:

- Characterization of the design storm, catchment area, run-on and run-off routing models;
- Characterization of the intake, decant, and spillway structures and their capacity;
- Characterization of the downstream hydraulic structures which receive the discharge from the CCR surface impoundments; and
- Supporting engineering calculations and analysis results.

MODELING OF CCR IMPOUNDMENT SYSTEM

For the 2016 bottom ash impoundment report, NTH evaluated the system using the Autodesk® Storm and Sanitary Analysis computer modeling software. This software was used to develop runoff hydrographs, or temporal flow distribution models, for the watersheds contributing to the system, as well as to route the inflow hydrographs through the bottom ash CCR impoundment and conveyance structures.

To complete the modeling for the Diversion Basin, we utilized the existing model from 2016 and supplemented it with additional input information specific to the Diversion Basin.

Model Input

In order to compile the data necessary for input into the model, NTH conducted several steps including:

- Performed a site visit to meet DTE personnel, learn about the DTE assets, and field review the existing system conditions;
- Reviewed historic site drawings and flow data provided by DTE plant staff; and

- Procured ground surface topographical elevations from BMJ Inc., a registered land surveyor, on April 29, 2019. BMJ Inc. also sounded the bottom of the basin to allow for accurate capacity calculations and surveyed components of the system, including the basin, the outlet structure, ditch dimensions, and pipe and manhole inverts (see Figure 2 for the detailed survey information).

NTH performed the analysis using design precipitation data adopted from the National Oceanic Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2 (2013). We evaluated the Diversion Basin for a 25-year storm event and utilized the rational method to calculate the stormwater runoff generated from each of the sub-watersheds. The rational method determines the peak discharge rate from each sub-watershed based on the following equation:

$$\mathbf{Q = CiA}$$

Where:

Q = Peak discharge rate (cubic feet per second (CFS))

C = Runoff coefficient (presented in table below)

i = Rainfall intensity from IDF curves based on design storm return period and Tc (in/hr)

A = Sub-watershed drainage area (Acres)

The Bottom Ash CCR impoundment system was divided into sub-watersheds based on existing ground topography to determine the contributing runoff amount for each basin and the downstream conveyance ditches which ultimately receive the discharge from the impoundments. The ditches were broken up into sub-areas based on changing depths, widths, and side slopes. The contributing area, time of concentration, and runoff coefficient were determined for each watershed area. These input parameters are used to determine both the amount and intensity of runoff generated in each watershed during the design storm and the overall amount of runoff collected and conveyed by the stormwater system.

The time of concentration, Tc, is the time required for the entire sub-watershed to contribute runoff to the system and is dependent on flow path, slope and ground type. In general, Tc for each sub-area was very small due to the small nature of the watersheds. Based on state-of-the-practice engineering standards, we utilized a minimum Tc of 15 minutes for each sub-watershed, which is the minimum amount of time used in a typical analysis, even though the actual flow time may be much less. The model was allowed to run for a 2-hour duration to allow enough time for all of the stormwater runoff from the design storm to contribute to the CCR impoundment and the downstream structures.

The runoff coefficient is a function of land use and ground condition. We adopted runoff coefficients from our past experience and generally-accepted industry standards. The runoff coefficients used for this study are summarized in the following table:

Ground Type	Runoff Coefficient (C)
Grass	**0.30**
Pavements/Parking Lots	**0.90**
Compacted Gravel Covered Areas	**0.85**

We selected the hydrodynamic routing method in Storm and Sanitary Analysis software program because it is the most sophisticated method and produces the most theoretically accurate results. It solves the one-dimensional Saint-Venant flow equations which consists of continuity and momentum equations for pipes and ditches and a volume continuity equation at the storage nodes and junctions. This routing method can represent pressurized flows when the piping or ditch becomes full and can model the amount of flooding in storage nodes and junctions.

Model Input Assumptions

NTH utilized information obtained from topographic surveys, historical information, and field investigations to build the model of the CCR impoundment and conveyance network to determine the hydraulic and hydrologic capacity of the downstream Diversion Basin. When available, items such as pipe/manhole diameter, inverts, material of construction, ditch dimensions, and inlet/cover type were utilized to accurately model the conveyance network.

Additionally, NTH reviewed the most recent eight years of historical flow data from DTE plant staff to characterize the process inflows into the CCR Bottom Ash system. This included daily flow readings from an electronic integrator to measure process flows. NTH completed a statistical analysis to determine appropriate parameters for the peak inflows to use for the:

- North Bottom Ash Basin through the (2) 24-inch diameter inlet pipes;
- South Bottom Ash Basin through the (2) 24-inch diameter inlet pipes; and
- Range Road Landfill sedimentation pond flow at manhole MH-1 into the 36-inch diameter pipe inletting into the Diversion Basin.

While every attempt was made to accurately model the existing system, assumptions introduce unknown parameters into the model. Should actual conditions vary from the assumptions utilized in the model, the predicted model results, and subsequent recommendations to correct any deficiencies identified, may be impacted. We have relatively high confidence that the model for the Bottom Ash CCR impoundment system and conveyance structures depicts conservatively anticipated conditions during the modeled flood event.

Existing System Components

The Diversion Basin receives flow from two bottom ash basins at BRPP, the north basin and the south basin. Based on a review of historical construction drawings, and consistent with field observations, these upstream bottom ash basins have constructed side slopes of 2H:1V inclination. They are riprap protected and a portion of their exterior dikes were constructed above-grade of compacted clay. The north basin has a capacity of 2.4 million gallons and the south basin has a capacity of 2.5 million gallons. Water containing bottom ash enters on the east side of each basin through two 24-inch pipes. DTE staff provided the previous eight years of flow data for the basins, which NTH reviewed to determine the peak flow into the north basin was 22.3 cubic feet per second (cfs) and the peak flow into the south basin was 23.8 cfs.

The basins each discharge over an outlet weir into a box structure on the west side of the basins. The weirs span the entire width of the basins (approximately 90 feet) and each box structure flows into a 24-inch reinforced concrete pipe (RCP) which discharges into a surface ditch. The ditches combine into a larger ditch located along the north side of the north basin and the water is then routed into a 36-inch underground RCP through a series of three manholes before discharging into the Diversion Basin. Additional flow is pumped from the sedimentation pond at the RRLF, approximately 1.5 miles north of the plant facility, with a peak flow of 4.97 cfs, based on a review of historical flow data provided by DTE staff.

The water levels in the bottom ash basins are controlled by the fixed elevation of the outlet weirs, establishing a high water level in the basins at 590.0 feet, which is higher than the surrounding grade outside the embankments. The basins were originally designed to outfall directly to the Webster Drain through a set of knife gate structures, but were modified in the late 1980s soon after operations at the plant began so that the gates divert the flow through the ditch and piping system to the Diversion Basin. The gate structures can be opened to allow emergency overflow for the basins but are always closed under normal conditions.

The Diversion Basin inlet ditch is an open channel with approximately 1.8H:1V constructed side slopes that runs from the outlet of the 36-inch RCP to the edge of the Diversion Basin, east of the Belle River Power Plant. The basin itself is an approximately 15-foot deep, incised basin with side slopes approximately 2H:1V. The pond has an estimated capacity of about 5.2 million gallons and an effective storage capacity of about 4.5 million gallons under normal operations, discharging through a pump station in the southeast corner of the pond, through a 14-inch a fiberglass-reinforced pipe (FRP) force main, tied to additional site infrastructure and ultimately outfalling with other site stormwater and wastewater via a site NPDES permit to the St. Clair River.

Model Output

The model produces output from the basin watersheds that includes inflow, outflow, peak outflow rate, and total runoff inflow/outflow volumes. The model also provides output from the CCR impoundment and conveyance structures including peak flow rates / velocities, maximum hydraulic grade lines, flow depths, and flooding/surcharged structures. To determine where system deficiencies exist, if any, the results were analyzed for:

1. Locations where the modeled water surface elevation exceeded the rim/ground surface elevation at the basins, ditches, and manholes (i.e. Flooding);
2. Locations where the modeled water surface exceeded the crown of the pipes within the manholes (i.e. Surcharging); or
3. Locations where the anticipated flow in a conveyance structure was greater than its design capacity (i.e. flow is > capacity).

While items noted as surcharging or below capacity identify a system deficiency, this does not necessarily require upgrades or improvements. These system deficiencies show that the system is still operating acceptably, but as a pressure flow system, instead of a gravity flow system. If no flooding is observed, the flow is still contained within the conveyance system, and the modeling software calculates theoretically accurate downstream and upstream system results based on the operating condition of these components. After the Diversion Basin pump station, water flows through a FRP force main system under pressurized conditions. These pipes are reported as surcharged, but this is to be expected under pumped flow.

Analysis of Design Flood Event – Existing Conditions

The model results show that during the design flood event, the depth of the water within the Diversion Basin rises 7.53 feet above the lowest point of the Diversion Basin (to an elevation of 581.26 feet), which still provides approximately 10.6 feet of freeboard to the crest elevation of the Diversion Basin (elevation 591.85), more than the industry standard freeboard. The peak inflow of the Diversion Basin is 42.78 cubic feet per second (cfs) during a 25-year storm event from all of the upstream contributions of the North Basin, South Basin, RRLF, and direct inflow. The 6-foot x 2-foot intake orifice at the Diversion Basin pump station adequately manages the peak flow that passes through the orifice under design conditions (38.79 cfs) into the pump station without negatively impacting the storage capacity of the Diversion Basin.

Within the pump station, each of the three, 100HP, Flygt model CP-3305 pumps turns on in succession based on water levels indicated on the ultrasonic float level as the water in the Diversion Basin rises during the 25-year design storm. As each pump turns on, the rate of flow through the downstream 14-inch force main increases; however, the Diversion Basin has sufficient storage capacity under the modeled conditions. The pumps are each set to shut off as the water depth is pumped down to 8 feet of depth in the Pump Station (elevation 578) under normal operating conditions.

Downstream from the Diversion Basin pump station, water flows through the 14-inch FRP force main system under pressurized conditions for roughly 875 feet at a rate up to 40.86 cfs into the Seal Well where it mixes with other plant process water prior to the ultimate discharge to the St. Clair River. The force main pipes are reported as surcharged in the model, which is to be expected under pumped conditions.

The model output result file provides additional information regarding the output and results. Refer to Figure 2 for additional information on the existing bottom ash CCR surface impoundment components.

CONCLUSIONS

NTH has prepared this inflow design flood control system plan to demonstrate and document the hydrologic and hydraulic capacity and performance requirements for the Diversion Basin as part of the Bottom Ash CCR surface impoundments of the BRPP in accordance with 40 CFR 257.82.

The existing Bottom Ash CCR impoundment system at BRPP currently conveys both bottom ash and other plant process water, on-site stormwater, as well as stormwater and process water from RRLF. The overall hydraulic system comprises the two bottom ash basins, overflow outfall weirs, and downstream conveyance ditches, piping, and manholes, flowing into the Diversion Basin and ultimately outfalling to the St. Clair River under an NPDES permit. Our analysis indicates that the existing downstream conveyance system, which outflows water from the bottom ash basins, does not experience deficiencies when modeled at the specified 25-year design event. The Diversion Basin is sized appropriately for the design event, and the downstream conveyance system, including the three pumps and FRP force main, can adequately handle the flows from the two bottom ash basins, plant process water, on-site stormwater, and stormwater/process water from RRLF.

STATEMENT OF CERTIFICATION

I, David R. Lutz, a Professional Engineer registered in the State of Michigan, certify[1] that NTH Consultants, Ltd. have reviewed available historical information, conducted a field visit, performed engineering and hydraulic/hydrologic analysis, modeling, and calculations on the inflow design flood control system for the Diversion Basin as part of the Bottom Ash CCR surface impoundments at the DTE Belle River Power Plant, located in China Township, Michigan. To the best of my knowledge and belief, the analysis and documentation presented in this report for the Diversion Basin at the aforementioned facility is accurate and has been developed in substantial conformance with the requirements stipulated in 40 CFR Part 257.82; however, the Plan does not meet the criteria established in 40 CFR 257.82(c)(3) as it pertains to the timeframe for developing the initial plan.

6/21/19

David R. Lutz, P.E.
State of Michigan Professional Engineer
Registration No. 57487

([1]) I am rendering my professional opinion based on the information available to me at the time of this report writing. This certification does not comprise a guarantee or warranty that certain conditions exist, nor does it relieve any other party of their requirements to abide by all applicable local, state, and federal regulations, and to honor all express or customary guarantees and warranties associated with their work.

ATTACHMENTS

- Figure 1: Overall Site Plan
- Figure 2: Topographic Survey
- Autodesk Storm and Sanitary Analysis Model Output

REFERENCE DOCUMENTS

- 6C1258-15-1 "YARD PIPING & DUCT BANK PLAN"
- 6C1258-15-3 "ASH SETTLING SYSTEM PLAN SECTIONS & DETAILS"
- 6C1258-841 "CONCRETE PLAN SECTIONS & DETAILS"
- 6C1258-853 "ASH SETTLING BASIN COLD WEATHER DIVERSION SYSTEM PLAN SHEET 1"
- 6C1258-854 "ASH SETTLING BASIN COLD WEATHER DIVERSION SYSTEM PLAN SHEET 2"
- 6C1258-855 "ASH SETTLING BASIN COLD WEATHER DIVERSION SYSTEM SECTIONS AND DETAILS"
- 6M1258E-364 "PIPING AT PUMPING STATION & SEAL WELL ASH SETTLING BASIN COLD WEATHER DIVERSION SYSTEM"
- BLRPP-JIT- WW 161 – "ISOLATE BEFORE/LINE UP AFTER MAINTENANCE – BOTTOM ASH DIVERSION BASIN"
- BLRPP-OP-1/2-0031-002 – "ASH SETTLING BASIN AND DIVERSION SYSTEM" OPERATING PROCEDURE
- BOTTOM ASH/RRLF FLOW 2011-PRESENT DATA

ATTACHMENTS

1. Figure 1: Overall Site Plan
2. Figure 2: Topographic Survey
3. Autodesk Storm and Sanitary Analysis Model Output

j:\2019\62\190124\production sets\belle river pond analysis\190124-fig-1.dwg Plotted: 6/20/2019 11:21 AM by bbosack

NTH PROJECT No.: 62-160047	CAD FILE NAME: 190124-FIG-1	NTH Consultants, Ltd. Infrastructure Engineering and Environmental Services	SITE LOCATION PLAN	FIGURE: 1
DESIGNED BY: JBB	PLOT DATE: 6/20/2019			
DRAWN BY: JBB	DRAWING SCALE: 1" = 400'		BELLE RIVER POWER PLANT CHINA TOWNSHIP, MI	
CHECKED BY: DRL	INCEPTION DATE: 4/15/2019			

NOTES:
VERTICAL DATUM: NAVD 88

HORIZONTAL DATUM: MICHIGAN STATE PLANE SOUTH ZONE 2113 INTERNATIONAL FEET

BENCHMARKS

BM #3
ELEVATION: 589.70
DESCRIPTION: ATOP CUT CROSS IN 12" DUCTILE IRON CULVERT PIPE ±24' EAST OF ROAD, WEST OF RAIL ROAD TRACKS, & ±50' NORTHEAST OF MONITOR WELL #1.

BM #5
ELEVATION: 591.21
DESCRIPTION: ATOP CUT "X" ON THE SOUTHEAST CORNER OF CONCRETE SLAB OF PUMP STATION FOR OUTFALL STRUCTURE AT THE SOUTHEAST CORNER OF DIVERSION BASIN.

SURVEYOR'S CERTIFICATE:
AS A PROFESSIONAL SURVEYOR IN THE STATE OF MICHIGAN, I HEREBY STATE that the survey work hereon delineated has been performed under my supervision.

STATE OF MICHIGAN ROBERT J. ARNOLD, JR. PROFESSIONAL SURVEYOR No. 52471 LICENSED PROFESSIONAL SURVEYOR

Robert J. Arnold Jr., P.S. No. 52471

LEGEND OF EXISTING FEATURES

Property Marker, Set Iron, Government Corner, Set Monument, Found Monument, Manhole, Electric Manhole, Catch Basin, Drain, Power Pole, Pole w/Light, Street Light, Traffic Light, Lamp Post, Cable Anchor, Fire Hydrant, Valve & Box, Valve & Well, Water Spigot, Water Meter, Water Shutoff, Monitor Well, Sprinkler, Board Sign, RR Switch, RR Gate, RR Signal Box, RR Signal, Rubbish Container, Mailbox, Flagpole, Flood Light, Pilings, Borings, Gas Pumps, Valve Cover Plate, Walk/NoWalk Signal, Pole/Post, Signpost, Parking Meter, Planter/Pedestal, Monument/Statue, Transformer, AC Unit, Antenna (tower), Antenna (dish), LP Gas Tank (small), LP Gas Tank (large), Telephone Riser, Electrical Riser, Cable TV Riser, Gas Meter, Gas Marker, Gas Shut Off, Gas Valve Cover, Clean Out, Down Spout, Culvert Headwall, Round Hand Hole, Square Hand Hole, Signal Hand Hole, x 100.00 Spot Elevation, Large Deciduous Tree, Med Deciduous Tree, Small Deciduous Tree, Large Evergreen Tree, Med Evergreen Tree, Small Evergreen Tree, Shrubbery/Bush, Tree Stump, Ornamental, Boulder, Rock, Sanitary Sewer (8"SS), Sanitary Sewer Forcemain (4"FM), Storm Sewer (8"S), Combined Sewer (24"C), Watermain (8"W), Edge of Hard Surface, Edge of Gravel Surface, Fence, Gasmain (4"G), Liquid Petroleum Gasmain (4"LP), Buried Cable (E-T-C), Overhead Cable (E-T-C), Watercourse, Centerline, Right of Way Line, Property Line (Survey), Property Line (Topo), Section Line, Plat Lines, Parcel Lines, Easement Line, Guardrail, Sea Wall, Retaining Wall, Trail Line, Top of Slope, Toe of Slope, RR Tracks, Hedge or Bushes, Woods Edge, Wetland Boundary, Wetlands (Non-Regulated), Wetlands (Regulated)

CIVIL ENGINEERS & LAND SURVEYORS
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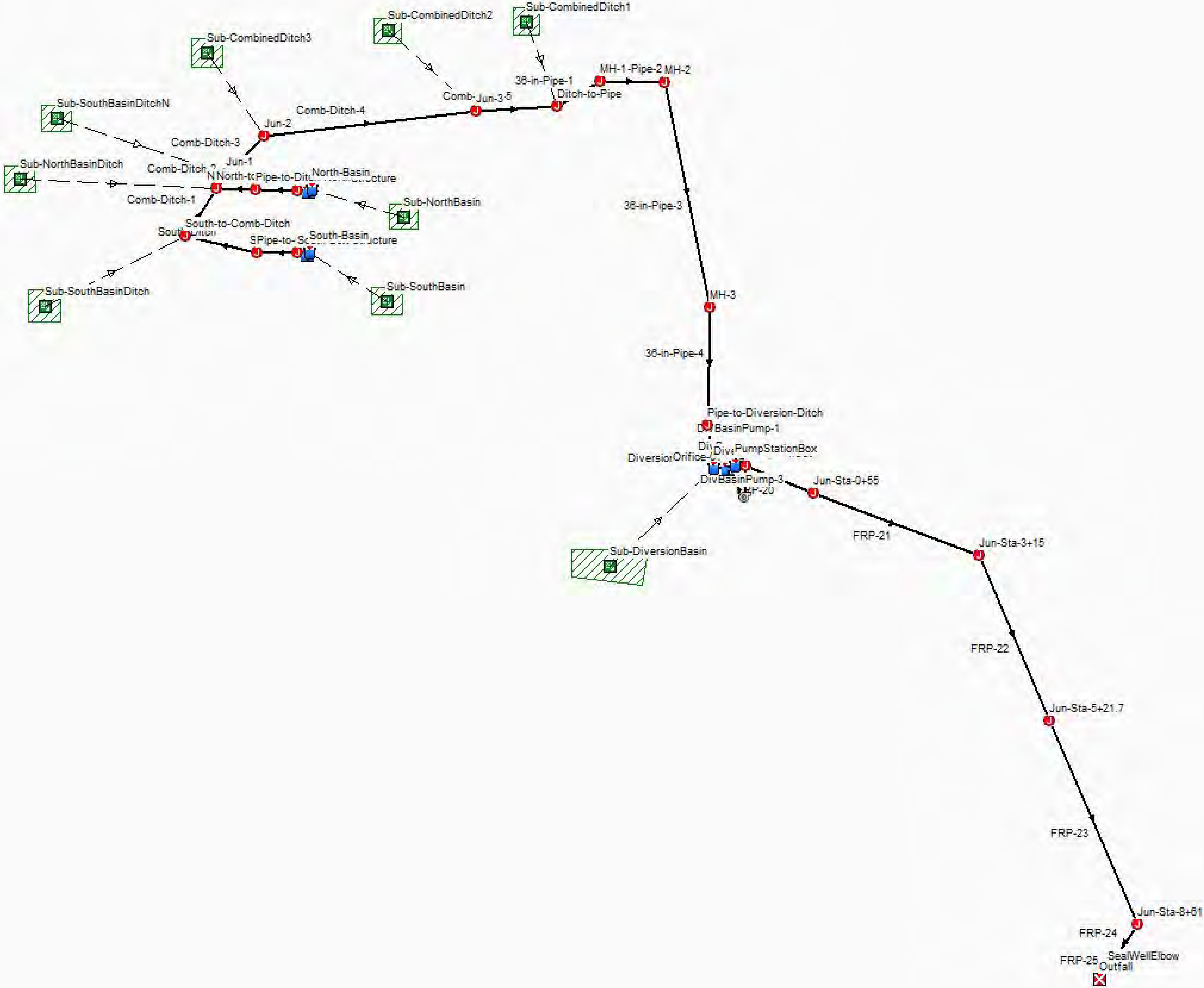
BMJ ENGINEERS & SURVEYORS, INC.

TOPOGRAPHIC SURVEY OF DIVERSION BASIN AT DTE BELLE RIVER POWER PLANT
#4505 KING ROAD, EAST CHINA TOWNSHIP, ST. CLAIR COUNTY, MI
FOR: NTH CONSULTANTS, LTD

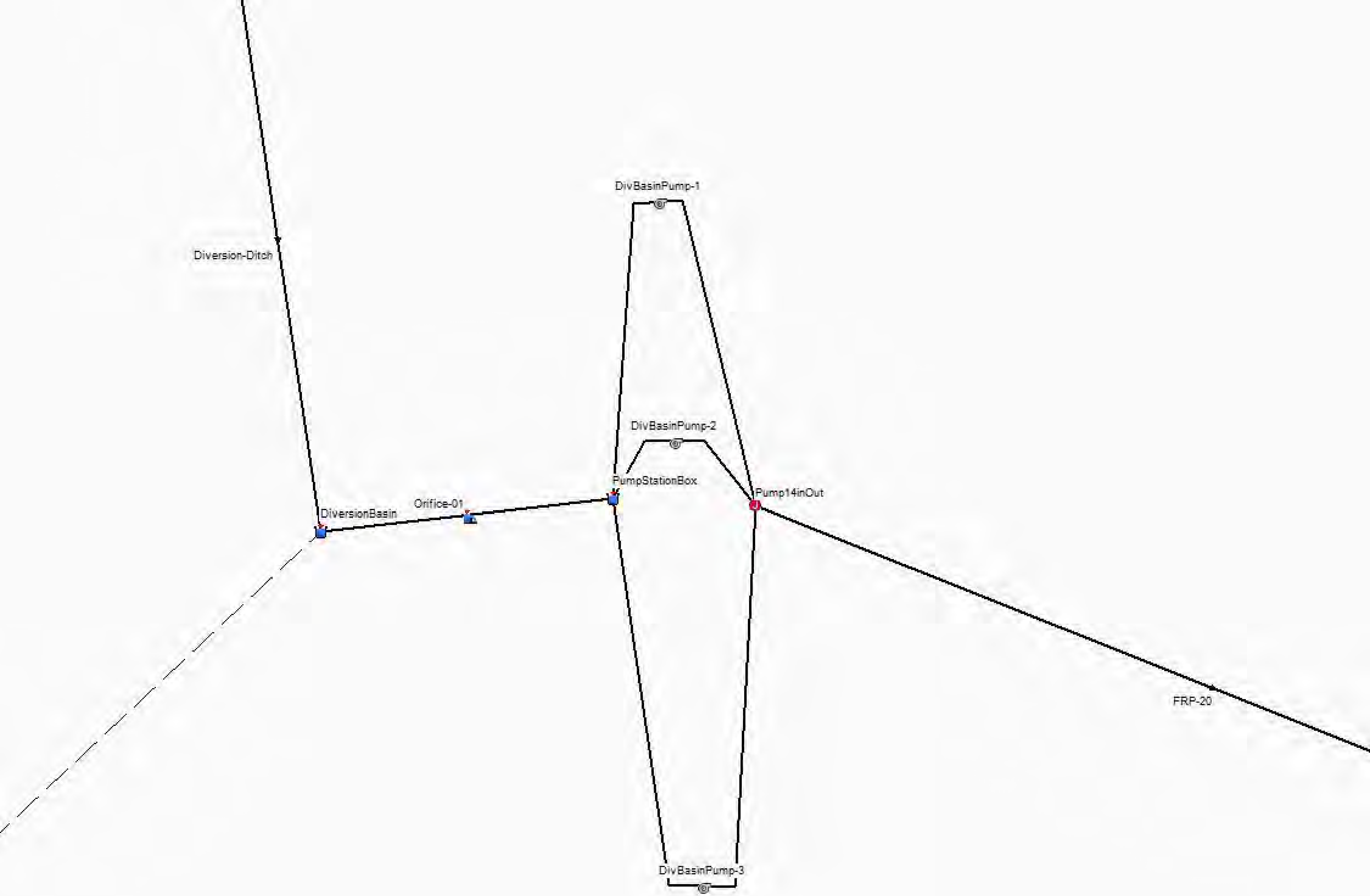
NO.	REVISIONS	DATE

SCALE:	1" = 30'
DATE:	4-22-19
SURVEYED:	AB
DRAWN:	SWS
CHK'D:	RJA
JOB NO.	1904.131
SHT	1 OF 1

NTH FIGURE 2



Sub-CombinedDitch1
Sub-CombinedDitch2
Sub-CombinedDitch3
Sub-SouthBasinDitchN
Sub-NorthBasinDitch
Sub-NorthBasin
Sub-SouthBasin
Sub-SouthBasinDitch
Sub-DiversionBasin
MH-1-Pipe-2
MH-2
36-in-Pipe-1
Ditch-to-Pipe
Jun-3-5
Comb-Ditch-4
Jun-2
Comb-Ditch-3
Jun-1
Comb-Ditch-1
North-Basin
South-to-Comb-Ditch
South-Basin
36-in-Pipe-3
MH-3
36-in-Pipe-4
Pipe-to-Diversion-Ditch
DivBasinPump-1
PumpStationBox
DivBasinPump-3
Jun-Sta-0+55
FRP-21
Jun-Sta-3+15
FRP-22
Jun-Sta-5+21.7
FRP-23
Jun-Sta-8+61
FRP-24
FRP-25
SealWellElbow
Outfall



Diversion-Ditch
DivBasinPump-1
DivBasinPump-2
PumpStationBox
Pump14inOut
Orifice-01
DiversionBasin
FRP-20
DivBasinPump-3

DTE Belle River Power Plant Drainage Areas 62-190124					
Area #	**Overland Flow**		**Channel Flow**	**Tc (hrs.)**	**Tc (min.)**
South Basin Ditch	L (ft)	96			
	S (%)	4.70			
	V (ft/s)	1.04			
	T (hrs)	0.026		0.026	**1.5**
Tc	1.5				
North Basin Ditch	L (ft)	174.00			
	S (%)	3.90			
	V (ft/s)	0.95			
	T (hrs)	0.051		0.051	**3.1**
Tc	3.1				
South Basin Ditch North	L (ft)	35.00			
	S (%)	4.10			
	V (ft/s)	0.97			
	T (hrs)	0.010		0.010	**0.6**
Tc	0.6				
Combined Ditch	L (ft)	23.00			
	S (%)	2.40			
	V (ft/s)	0.74			
	T (hrs)	0.009		0.009	**0.5**
Tc	0.5				
South Basin	L (ft)	35.00			
	S (%)	1.50			
	V (ft/s)	0.59			
	T (hrs)	0.017		0.017	**1.0**
Tc	1.0				
North Basin	L (ft)	86.00			
	S (%)	4.00			
	V (ft/s)	0.96			
	T (hrs)	0.025		0.025	**1.5**
Tc	1.5				
Diversion Basin	L (ft)	311.00			
	S (%)	2.00			
	V (ft/s)	0.68			
	T (hrs)	0.127		0.127	**7.6**
Tc	7.6				

L = distance in feet
S = slope in %
T = time of travel in hours = L / (V * 3600)
V=0.48*sqrt(S)-Sheet Flow<300'
V=2.1*sqrt(S)-Channel Flow

Project Description

File Name .... Belle River-EX-Normal Pump Settings.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Jul 08, 2016	00:00:00
End Analysis On	Jul 08, 2016	02:00:00
Start Reporting On	Jul 08, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	9
Nodes	25
Junctions	20
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	4
Links	26
Channels	8
Pipes	12
Pumps	3
Orifices	1
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period........ 25 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ft²)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-CombinedDitch1	7087.52	0.9000	1.11	1.00	0.16	0.65	0 00:15:00
2	Sub-CombinedDitch2	16326.20	0.9000	1.11	1.00	0.37	1.49	0 00:15:00
3	Sub-CombinedDitch3	4052.47	0.9000	1.11	1.00	0.09	0.37	0 00:15:00
4	Sub-DiversionBasin	109264.86	0.6500	1.11	0.72	1.81	7.22	0 00:15:00
5	Sub-NorthBasin	53523.57	0.7100	1.11	0.79	0.97	3.87	0 00:15:00
6	Sub-NorthBasinDitch	18812.34	0.3400	1.11	0.38	0.16	0.65	0 00:15:00
7	Sub-SouthBasin	53922.92	0.7100	1.11	0.79	0.97	3.89	0 00:15:00
8	Sub-SouthBasinDitch	14535.97	0.4400	1.11	0.49	0.16	0.65	0 00:15:00
9	Sub-SouthBasinDitchN	10255.68	0.6400	1.11	0.71	0.17	0.67	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Ditch-to-Pipe	Junction	580.37	590.07	580.97	590.07	0.00	38.41	588.41	0.00	1.66	0 00:00	0.00	0.00
2	Jun-1	Junction	582.28	589.28	582.28	590.28	4525.90	47.91	588.43	0.00	0.85	0 00:00	0.00	0.00
3	Jun-2	Junction	581.86	590.36	581.86	590.36	685.30	47.16	588.42	0.00	1.94	0 00:00	0.00	0.00
4	Jun-3	Junction	580.90	590.60	580.97	590.60	0.00	42.83	588.42	0.00	2.18	0 00:00	0.00	0.00
5	Jun-Sta-0+55	Junction	585.70	586.87	585.70	2000.00	0.00	39.40	1122.98	536.11	0.00	0 00:00	0.00	0.00
6	Jun-Sta-3+15	Junction	580.80	581.97	580.80	2000.00	0.00	40.16	979.55	397.58	0.00	0 00:00	0.00	0.00
7	Jun-Sta-5+21.7	Junction	585.00	586.17	585.00	2000.00	0.00	40.40	857.81	271.64	0.00	0 00:00	0.00	0.00
8	Jun-Sta-8+61	Junction	585.00	586.17	585.00	2000.00	0.00	40.63	668.95	82.78	0.00	0 00:00	0.00	0.00
9	MH-1	Junction	580.60	590.52	580.64	590.52	0.00	42.81	587.54	0.00	2.98	0 00:00	0.00	0.00
10	MH-2	Junction	580.40	587.90	580.45	587.90	0.00	42.81	586.26	0.00	1.64	0 00:00	0.00	0.00
11	MH-3	Junction	580.10	590.52	580.23	582.33	0.00	42.81	583.74	0.00	6.78	0 00:00	0.00	0.00
12	North-Box-Structure	Junction	582.79	592.53	584.30	592.53	0.00	24.72	590.03	0.00	7.59	0 00:00	0.00	0.00
13	North-to-Comb-Ditch	Junction	582.30	589.30	582.30	589.30	17403.30	48.93	588.43	0.00	0.87	0 00:00	0.00	0.00
14	Pipe-to-Ditch-North	Junction	583.54	588.54	583.54	588.54	0.00	24.68	588.43	0.00	1.61	0 00:00	0.00	0.00
15	Pipe-to-Ditch-South	Junction	583.39	589.39	583.39	589.39	0.00	26.27	588.44	0.00	0.95	0 00:00	0.00	0.00
16	Pipe-to-Diversion-Ditch	Junction	580.07	591.47	580.07	591.47	0.00	42.81	581.42	0.00	10.55	0 00:00	0.00	0.00
17	Pump14inOut	Junction	585.70	586.87	585.70	2000.00	0.00	38.76	1165.78	578.91	0.00	0 00:00	0.00	0.00
18	SealWellElbow	Junction	585.00	586.17	585.00	2000.00	0.00	40.76	640.25	54.08	0.00	0 00:00	0.00	0.00
19	South-Box-Structure	Junction	582.81	592.54	584.40	592.54	0.00	26.30	590.11	0.00	7.16	0 00:00	0.00	0.00
20	South-to-Comb-Ditch	Junction	582.33	589.33	582.33	589.33	11105.70	26.04	588.43	0.00	0.90	0 00:00	0.00	0.00
21	Outfall	Outfall	598.00					40.86	598.68					
22	DiversionBasin	Storage Node	573.73	591.85	578.00		0.00	42.78	581.26				0.00	0.00
23	North-Basin	Storage Node	577.69	592.05	590.02		0.00	26.15	590.21				0.00	0.00
24	PumpStationBox	Storage Node	570.00	591.00	578.00		0.00	38.79	581.00				0.00	0.00
25	South-Basin	Storage Node	578.07	591.95	590.03		0.00	27.66	590.22				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)
1	36-in-Pipe-1	Pipe	Ditch-to-Pipe	MH-1	98.65	580.97	580.73	0.2400	36.000	0.0150	37.83	28.51	1.33	5.35	3.00	1.00	105.00
2	36-in-Pipe-2	Pipe	MH-1	MH-2	130.48	580.64	580.47	0.1300	36.000	0.0150	42.81	20.87	2.05	6.06	3.00	1.00	104.00
3	36-in-Pipe-3	Pipe	MH-2	MH-3	471.91	580.45	580.25	0.0400	36.000	0.0130	42.81	13.73	3.12	6.06	3.00	1.00	81.00
4	36-in-Pipe-4	Pipe	MH-3	Pipe-to-Diversion-Ditch	243.15	580.23	580.07	0.0700	36.000	0.0130	42.81	17.11	2.50	7.81	2.17	0.72	0.00
5	FRP-20	Pipe	Pump14inOut	Jun-Sta-0+55	55.00	585.70	585.70	0.0000	14.000	0.0110	39.40	0.27	145.48	36.86	1.17	1.00	96.00
6	FRP-21	Pipe	Jun-Sta-0+55	Jun-Sta-3+15	260.00	585.70	580.80	1.8800	14.000	0.0110	40.16	8.72	4.61	37.57	1.17	1.00	95.00
7	FRP-22	Pipe	Jun-Sta-3+15	Jun-Sta-5+21.7	206.70	580.80	585.00	-2.0300	14.000	0.0110	40.40	9.05	4.46	37.79	1.17	1.00	95.00
8	FRP-23	Pipe	Jun-Sta-5+21.7	Jun-Sta-8+61	339.30	585.00	585.00	0.0000	14.000	0.0110	40.63	0.11	372.65	38.01	1.17	1.00	95.00
9	FRP-24	Pipe	Jun-Sta-8+61	SealWellElbow	14.00	585.00	585.00	0.0000	14.000	0.0110	40.76	0.54	75.93	38.13	1.17	1.00	95.00
10	FRP-25	Pipe	SealWellElbow	Outfall	13.00	585.00	598.00	-100.0000	14.000	0.0110	40.86	63.51	0.64	45.00	0.91	0.79	0.00
11	North-24-in	Pipe	North-Box-Structure	Pipe-to-Ditch-North	85.29	584.06	583.54	0.6100	24.000	0.0130	24.68	17.66	1.40	7.86	2.00	1.00	101.00
12	South-24-in	Pipe	South-Box-Structure	Pipe-to-Ditch-South	84.36	584.00	583.39	0.7200	24.000	0.0130	26.27	19.24	1.37	8.36	2.00	1.00	105.00
13	Comb-Ditch-1	Channel	South-to-Comb-Ditch	North-to-Comb-Ditch	117.44	582.33	582.30	0.0300	84.000	0.0320	24.30	235.42	0.10	0.93	6.12	0.87	0.00
14	Comb-Ditch-2	Channel	North-to-Comb-Ditch	Jun-1	35.60	582.30	582.28	0.0600	84.000	0.0320	47.35	326.20	0.15	2.02	6.14	0.88	0.00
15	Comb-Ditch-3	Channel	Jun-1	Jun-2	112.60	582.28	581.86	0.3700	84.000	0.0320	46.84	647.64	0.07	3.86	6.36	0.91	0.00
16	Comb-Ditch-4	Channel	Jun-2	Jun-3	451.00	581.86	580.90	0.2100	102.000	0.0320	41.39	766.62	0.05	2.54	7.04	0.83	0.00
17	Comb-Ditch-5	Channel	Jun-3	Ditch-to-Pipe	169.05	580.90	580.37	0.3100	116.400	0.0320	38.41	1221.51	0.03	1.67	7.78	0.80	0.00
18	Diversion-Ditch	Channel	Pipe-to-Diversion-Ditch	DiversionBasin	276.61	580.07	576.56	1.2700	142.800	0.0320	42.78	5183.88	0.01	2.65	3.03	0.25	0.00
19	North-Ditch	Channel	Pipe-to-Ditch-North	North-to-Comb-Ditch	81.84	583.54	582.48	1.3000	78.000	0.0320	24.35	794.25	0.03	3.26	5.42	0.83	0.00
20	South-Ditch	Channel	Pipe-to-Ditch-South	South-to-Comb-Ditch	150.24	583.39	582.33	0.7100	72.000	0.0320	25.56	629.04	0.04	2.98	5.52	0.92	0.00
21	Orifice-01	Orifice	DiversionBasin	PumpStationBox		573.73	570.00		24.000		38.79						
22	North-Weir	Weir	North-Basin	North-Box-Structure		577.69	582.79				24.72						
23	South-Weir	Weir	South-Basin	South-Box-Structure		578.07	582.81				26.30						
24	DivBasinPump-1	Pump	PumpStationBox	Pump14inOut		570.00	585.70				12.92						
25	DivBasinPump-2	Pump	PumpStationBox	Pump14inOut		570.00	585.70				12.92						
26	DivBasinPump-3	Pump	PumpStationBox	Pump14inOut		570.00	585.70				12.92						

Reported Condition
SURCHARGED
SURCHARGED
SURCHARGED
> CAPACITY
SURCHARGED
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Calculated
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SURCHARGED

Subbasin Hydrology

Subbasin : Sub-CombinedDitch1

Input Data

Area (ft²) 7087.52
Weighted Runoff Coefficient 0.9000

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
Ditch	7078.50	-	0.90
Composite Area & Weighted Runoff Coeff.	7078.50		0.90

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)

V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): .5

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 1.00
Peak Runoff (cfs) 0.65
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.9000
Time of Concentration (days hh:mm:ss) 0 00:00:30

Subbasin : Sub-CombinedDitch2

Input Data

Area (ft²) 16326.20
Weighted Runoff Coefficient 0.9000

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
-	16326.20	-	0.90
Composite Area & Weighted Runoff Coeff.	16326.20		0.90

Time of Concentration

User-Defined TOC override (minutes): .5

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 1.00
Peak Runoff (cfs) 1.49
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.9000
Time of Concentration (days hh:mm:ss) 0 00:00:30

Subbasin : Sub-CombinedDitch3

Input Data

Area (ft²) 4052.47
Weighted Runoff Coefficient 0.9000

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
-	4052.47	-	0.90
Composite Area & Weighted Runoff Coeff.	4052.47		0.90

Time of Concentration

User-Defined TOC override (minutes): .5

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 1.00
Peak Runoff (cfs) 0.37
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.9000
Time of Concentration (days hh:mm:ss) 0 00:00:30

Subbasin : Sub-DiversionBasin

Input Data

Area (ft²) 109264.86
Weighted Runoff Coefficient 0.6500

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
-	54206.28	-	0.30
-	55056.14	-	1.00
Composite Area & Weighted Runoff Coeff.	109262.42		0.65

Time of Concentration

User-Defined TOC override (minutes): 7.60

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 0.72
Peak Runoff (cfs) 7.22
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.6500
Time of Concentration (days hh:mm:ss) 0 00:07:36

Subbasin : Sub-NorthBasin

Input Data

Area (ft²) 53523.57
Weighted Runoff Coefficient 0.7100

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
DirtRoad	17246.89	-	0.30
Basin	36276.59	-	0.90
Composite Area & Weighted Runoff Coeff.	53523.48		0.71

Time of Concentration

User-Defined TOC override (minutes): 1.5

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 0.79
Peak Runoff (cfs) 3.87
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.7100
Time of Concentration (days hh:mm:ss) 0 00:01:30

Subbasin : Sub-NorthBasinDitch

Input Data

Area (ft²) 18812.34
Weighted Runoff Coefficient 0.3400

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
-	17403.31	-	0.30
-	1408.99	-	0.90
Composite Area & Weighted Runoff Coeff.	18812.30		0.34

Time of Concentration

User-Defined TOC override (minutes): 3.1

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 0.38
Peak Runoff (cfs) 0.65
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.3400
Time of Concentration (days hh:mm:ss) 0 00:03:06

Subbasin : Sub-SouthBasin

Input Data

Area (ft²) 53922.92
Weighted Runoff Coefficient 0.7100

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
DirtRoad	16967.88	-	0.30
Basin	36955.00	-	0.90
Composite Area & Weighted Runoff Coeff.	53922.88		0.71

Time of Concentration

User-Defined TOC override (minutes): 1.00

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 0.79
Peak Runoff (cfs) 3.89
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.7100
Time of Concentration (days hh:mm:ss) 0 00:01:00

Subbasin : Sub-SouthBasinDitch

Input Data

Area (ft²) 14535.97
Weighted Runoff Coefficient 0.4400

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
GrassyArea	11106.80	-	0.30
Ditch	3429.09	-	0.90
Composite Area & Weighted Runoff Coeff.	14535.89		0.44

Time of Concentration

User-Defined TOC override (minutes): 1.5

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 0.49
Peak Runoff (cfs) 0.65
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.4400
Time of Concentration (days hh:mm:ss) 0 00:01:30

Subbasin : Sub-SouthBasinDitchN

Input Data

Area (ft²) 10255.68
Weighted Runoff Coefficient 0.6400

Runoff Coefficient

Soil/Surface Description	Area (ft²)	Soil Group	Runoff Coeff.
GrassyArea	4525.80	-	0.30
Ditch	5729.80	-	0.90
Composite Area & Weighted Runoff Coeff.	10255.60		0.64

Time of Concentration

User-Defined TOC override (minutes): .6

Subbasin Runoff Results

Total Rainfall (in) 1.11
Total Runoff (in) 0.71
Peak Runoff (cfs) 0.67
Rainfall Intensity 4.430
Weighted Runoff Coefficient 0.6400
Time of Concentration (days hh:mm:ss) 0 00:00:36

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Ditch-to-Pipe	580.37	590.07	9.70	580.97	0.60	590.07	0.00	0.00	0.00
2	Jun-1	582.28	589.28	7.00	582.28	0.00	590.28	1.00	4525.90	0.00
3	Jun-2	581.86	590.36	8.50	581.86	0.00	590.36	0.00	685.30	0.00
4	Jun-3	580.90	590.60	9.70	580.97	0.07	590.60	0.00	0.00	0.00
5	Jun-Sta-0+55	585.70	586.87	1.17	585.70	0.00	2000.00	1413.13	0.00	0.00
6	Jun-Sta-3+15	580.80	581.97	1.17	580.80	0.00	2000.00	1418.03	0.00	0.00
7	Jun-Sta-5+21.7	585.00	586.17	1.17	585.00	0.00	2000.00	1413.83	0.00	0.00
8	Jun-Sta-8+61	585.00	586.17	1.17	585.00	0.00	2000.00	1413.83	0.00	0.00
9	MH-1	580.60	590.52	9.92	580.64	0.04	590.52	0.00	0.00	0.00
10	MH-2	580.40	587.90	7.50	580.45	0.05	587.90	0.00	0.00	0.00
11	MH-3	580.10	590.52	10.42	580.23	0.13	582.33	-8.19	0.00	0.00
12	North-Box-Structure	582.79	592.53	9.74	584.30	1.51	592.53	0.00	0.00	0.00
13	North-to-Comb-Ditch	582.30	589.30	7.00	582.30	0.00	589.30	0.00	17403.30	0.00
14	Pipe-to-Ditch-North	583.54	588.54	5.00	583.54	0.00	588.54	0.00	0.00	0.00
15	Pipe-to-Ditch-South	583.39	589.39	6.00	583.39	0.00	589.39	0.00	0.00	0.00
16	Pipe-to-Diversion-Ditch	580.07	591.47	11.40	580.07	0.00	591.47	0.00	0.00	0.00
17	Pump14inOut	585.70	586.87	1.17	585.70	0.00	2000.00	1413.13	0.00	0.00
18	SealWellElbow	585.00	586.17	1.17	585.00	0.00	2000.00	1413.83	0.00	0.00
19	South-Box-Structure	582.81	592.54	9.73	584.40	1.59	592.54	0.00	0.00	0.00
20	South-to-Comb-Ditch	582.33	589.33	7.00	582.33	0.00	589.33	0.00	11105.70	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Ditch-to-Pipe	38.41	0.65	588.41	8.04	0.00	1.66	586.88	6.51	0 02:00	0 00:00	0.00	0.00
2	Jun-1	47.91	0.67	588.43	6.15	0.00	0.85	587.07	4.79	0 02:00	0 00:00	0.00	0.00
3	Jun-2	47.16	0.37	588.42	6.56	0.00	1.94	587.00	5.14	0 02:00	0 00:00	0.00	0.00
4	Jun-3	42.83	1.49	588.42	7.52	0.00	2.18	586.89	5.99	0 02:00	0 00:00	0.00	0.00
5	Jun-Sta-0+55	39.40	0.00	1122.98	537.28	536.11	0.00	769.61	183.91	0 01:44	0 00:00	0.00	0.00
6	Jun-Sta-3+15	40.16	0.00	979.55	398.75	397.58	0.00	722.48	141.68	0 01:44	0 00:00	0.00	0.00
7	Jun-Sta-5+21.7	40.40	0.00	857.81	272.81	271.64	0.00	684.27	99.27	0 01:44	0 00:00	0.00	0.00
8	Jun-Sta-8+61	40.63	0.00	668.95	83.95	82.78	0.00	626.02	41.02	0 01:44	0 00:00	0.00	0.00
9	MH-1	42.81	4.98	587.54	6.94	0.00	2.98	586.23	5.63	0 02:00	0 00:00	0.00	0.00
10	MH-2	42.81	0.00	586.26	5.86	0.00	1.64	585.22	4.82	0 02:00	0 00:00	0.00	0.00
11	MH-3	42.81	0.00	583.74	3.64	0.00	6.78	583.26	3.16	0 02:00	0 00:00	0.00	0.00
12	North-Box-Structure	24.72	0.00	590.03	7.24	0.00	7.59	588.75	5.96	0 02:00	0 00:00	0.00	0.00
13	North-to-Comb-Ditch	48.93	0.65	588.43	6.13	0.00	0.87	587.09	4.79	0 02:00	0 00:00	0.00	0.00
14	Pipe-to-Ditch-North	24.68	0.00	588.43	4.89	0.00	1.61	587.15	3.61	0 02:00	0 00:00	0.00	0.00
15	Pipe-to-Ditch-South	26.27	0.00	588.44	5.05	0.00	0.95	587.15	3.76	0 02:00	0 00:00	0.00	0.00
16	Pipe-to-Diversion-Ditch	42.81	0.00	581.42	1.35	0.00	10.55	581.27	1.20	0 02:00	0 00:00	0.00	0.00
17	Pump14inOut	38.76	0.00	1165.78	580.08	578.91	0.00	785.86	200.16	0 01:44	0 00:00	0.00	0.00
18	SealWellElbow	40.76	0.00	640.25	55.25	54.08	0.00	615.87	30.87	0 01:44	0 00:00	0.00	0.00
19	South-Box-Structure	26.30	0.00	590.11	7.30	0.00	7.16	588.95	6.14	0 02:00	0 00:00	0.00	0.00
20	South-to-Comb-Ditch	26.04	0.65	588.43	6.10	0.00	0.90	587.10	4.77	0 02:00	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	Comb-Ditch-1	117.44	582.33	0.00	582.30	0.00	0.03	0.0300	Triangular	7.000	40.800	0.0320	0.5000	0.5000	0.0000	0.00	No
2	Comb-Ditch-2	35.60	582.30	0.00	582.28	0.00	0.02	0.0600	Triangular	7.000	38.300	0.0320	0.5000	0.5000	0.0000	0.00	No
3	Comb-Ditch-3	112.60	582.28	0.00	581.86	0.00	0.42	0.3700	Triangular	7.000	30.200	0.0320	0.5000	0.5000	0.0000	0.00	No
4	Comb-Ditch-4	451.00	581.86	0.00	580.90	0.00	0.96	0.2100	Triangular	8.500	34.500	0.0320	0.5000	0.5000	0.0000	0.00	No
5	Comb-Ditch-5	169.05	580.90	0.00	580.37	0.00	0.53	0.3100	Triangular	9.700	36.700	0.0320	0.5000	0.5000	0.0000	0.00	No
6	Diversion-Ditch	276.61	580.07	0.00	576.56	2.83	3.51	1.2700	Trapezoidal	11.900	48.030	0.0320	0.5000	0.5000	0.0000	0.00	No
7	North-Ditch	81.84	583.54	0.00	582.48	0.18	1.06	1.3000	Triangular	6.500	23.100	0.0320	0.5000	0.5000	0.0000	0.00	No
8	South-Ditch	150.24	583.39	0.00	582.33	0.00	1.06	0.7100	Triangular	6.000	27.400	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Comb-Ditch-1	24.30	0 00:17	235.42	0.10	0.93	2.10	6.12	0.87	0.00		
2	Comb-Ditch-2	47.35	0 00:17	326.20	0.15	2.02	0.29	6.14	0.88	0.00		
3	Comb-Ditch-3	46.84	0 00:17	647.64	0.07	3.86	0.49	6.36	0.91	0.00		
4	Comb-Ditch-4	41.39	0 00:15	766.62	0.05	2.54	2.96	7.04	0.83	0.00		
5	Comb-Ditch-5	38.41	0 02:00	1221.51	0.03	1.67	1.69	7.78	0.80	0.00		
6	Diversion-Ditch	42.78	0 02:00	5183.88	0.01	2.65	1.74	3.03	0.25	0.00		
7	North-Ditch	24.35	0 00:20	794.25	0.03	3.26	0.42	5.42	0.83	0.00		
8	South-Ditch	25.56	0 00:19	629.04	0.04	2.98	0.84	5.52	0.92	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	36-in-Pipe-1	98.65	580.97	0.60	580.73	0.13	0.24	0.2400	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	36-in-Pipe-2	130.48	580.64	0.04	580.47	0.07	0.17	0.1300	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
3	36-in-Pipe-3	471.91	580.45	0.05	580.25	0.15	0.20	0.0400	CIRCULAR	36.000	36.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
4	36-in-Pipe-4	243.15	580.23	0.13	580.07	0.00	0.16	0.0700	CIRCULAR	36.000	36.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
5	FRP-20	55.00	585.70	0.00	585.70	0.00	0.00	0.0000	CIRCULAR	14.040	14.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
6	FRP-21	260.00	585.70	0.00	580.80	0.00	4.90	1.8800	CIRCULAR	14.040	14.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
7	FRP-22	206.70	580.80	0.00	585.00	0.00	-4.20	-2.0300	CIRCULAR	14.040	14.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
8	FRP-23	339.30	585.00	0.00	585.00	0.00	0.00	0.0000	CIRCULAR	14.040	14.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
9	FRP-24	14.00	585.00	0.00	585.00	0.00	0.00	0.0000	CIRCULAR	14.040	14.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
10	FRP-25	13.00	585.00	0.00	598.00	0.00	-13.00	-100.0000	CIRCULAR	14.040	14.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
11	North-24-in	85.29	584.06	1.27	583.54	0.00	0.52	0.6100	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
12	South-24-in	84.36	584.00	1.19	583.39	0.00	0.61	0.7200	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	36-in-Pipe-1	37.83	0 02:00	28.51	1.33	5.35	0.31	3.00	1.00	105.00		SURCHARGED
2	36-in-Pipe-2	42.81	0 02:00	20.87	2.05	6.06	0.36	3.00	1.00	104.00		SURCHARGED
3	36-in-Pipe-3	42.81	0 02:00	13.73	3.12	6.06	1.30	3.00	1.00	81.00		SURCHARGED
4	36-in-Pipe-4	42.81	0 02:00	17.11	2.50	7.81	0.52	2.17	0.72	0.00		> CAPACITY
5	FRP-20	39.40	0 01:44	0.27	145.48	36.86	0.02	1.17	1.00	96.00		SURCHARGED
6	FRP-21	40.16	0 01:44	8.72	4.61	37.57	0.12	1.17	1.00	95.00		SURCHARGED
7	FRP-22	40.40	0 01:44	9.05	4.46	37.79	0.09	1.17	1.00	95.00		SURCHARGED
8	FRP-23	40.63	0 01:44	0.11	372.65	38.01	0.15	1.17	1.00	95.00		SURCHARGED
9	FRP-24	40.76	0 01:44	0.54	75.93	38.13	0.01	1.17	1.00	95.00		SURCHARGED
10	FRP-25	40.86	0 01:44	63.51	0.64	45.00	0.00	0.91	0.79	0.00		Calculated
11	North-24-in	24.68	0 00:20	17.66	1.40	7.86	0.18	2.00	1.00	101.00		SURCHARGED
12	South-24-in	26.27	0 00:20	19.24	1.37	8.36	0.17	2.00	1.00	105.00		SURCHARGED

Storage Nodes

Storage Node : DiversionBasin

Input Data

Invert Elevation (ft) 573.73
Max (Rim) Elevation (ft) 591.85
Max (Rim) Offset (ft) 18.12
Initial Water Elevation (ft) 578.00
Initial Water Depth (ft) 4.27
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-01	Side	Rectangular	No		24.00	72.00	575.50	0.63

Output Summary Results

Peak Inflow (cfs) 42.78
Peak Lateral Inflow (cfs) 7.22
Peak Outflow (cfs) 38.79
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 581.26
Max HGL Depth Attained (ft) 7.53
Average HGL Elevation Attained (ft) 580.19
Average HGL Depth Attained (ft) 6.46
Time of Max HGL Occurrence (days hh:mm) 0 02:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : North-Basin

Input Data

Invert Elevation (ft) 577.69
Max (Rim) Elevation (ft) 592.05
Max (Rim) Offset (ft) 14.36
Initial Water Elevation (ft) 590.02
Initial Water Depth (ft) 12.33
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	North-Weir	Rectangular	No	590.02	12.33	92.00	2.50	3.33

Output Summary Results

Peak Inflow (cfs) 26.15
Peak Lateral Inflow (cfs) 26.15
Peak Outflow (cfs) 24.72
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 590.21
Max HGL Depth Attained (ft) 12.52
Average HGL Elevation Attained (ft) 590.19
Average HGL Depth Attained (ft) 12.5
Time of Max HGL Occurrence (days hh:mm) 0 00:20
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : PumpStationBox

Input Data

Invert Elevation (ft)	570.00
Max (Rim) Elevation (ft)	591.00
Max (Rim) Offset (ft)	21.00
Initial Water Elevation (ft)	578.00
Initial Water Depth (ft)	8.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	38.79
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	38.76
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	581.00
Max HGL Depth Attained (ft)	11
Average HGL Elevation Attained (ft)	580.02
Average HGL Depth Attained (ft)	10.02
Time of Max HGL Occurrence (days hh:mm)	0 01:44
Total Exfiltration Volume (1000-ft^3)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : South-Basin

Input Data

Invert Elevation (ft) 578.07
Max (Rim) Elevation (ft) 591.95
Max (Rim) Offset (ft) 13.88
Initial Water Elevation (ft) 590.03
Initial Water Depth (ft) 11.96
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	South-Weir	Rectangular	No	590.03	11.96	92.00	2.50	3.33

Output Summary Results

Peak Inflow (cfs) 27.66
Peak Lateral Inflow (cfs) 27.66
Peak Outflow (cfs) 26.30
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 590.22
Max HGL Depth Attained (ft) 12.15
Average HGL Elevation Attained (ft) 590.21
Average HGL Depth Attained (ft) 12.14
Time of Max HGL Occurrence (days hh:mm) 0 00:20
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00