ALLIANT ENERGY
Interstate Power and Light Company
Sutherland Generating Station

CCR SURFACE IMPOUNDMENT

INFLOW DESIGN FLOOD CONTROL PLAN

Report Issued: March 05, 2018
Revision 0

HARD HAT SERVICES™
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EXECUTIVE SUMMARY

This Inflow Flood Control Plan (Report) is prepared in accordance with the requirements of the United States Environmental Protection Agency (USEPA) Hazardous and Solid Waste Management System – Disposal of Coal Combustion Residual from Electric Utilities (40 CFR Parts 257 and 261), also known as the CCR Rule.

This Report assesses the hydrologic and hydraulic capacity requirements for each CCR unit at Sutherland Generating Station in Marshalltown, Iowa in accordance with §257.82 and §257.100(a) of the CCR Rule. For purposes of this Report, a CCR unit is defined as any existing or inactive CCR surface impoundment. Primarily, the Report documents how the inflow design flood control system has been designed and constructed to meet the CCR Rule section §257.82 and §257.100(a).

Table of Contents

Figures

Appendices

1 INTRODUCTION

The owner or operator of the Coal Combustion Residual (CCR) unit must conduct an initial and periodic inflow design flood control system plan to determine if each CCR unit adequately manages flow into and from each CCR unit during and following the peak discharge of the inflow design flood. The inflow design flood is selected based on the hazard potential classification (§257.73(a)(2) and §257.100(a)) for each CCR unit.

This Report is prepared in accordance with the requirements of §257.82 and §257.100(a) of the CCR Rule.

1.1 CCR Rule Applicability

The CCR Rule requires an initial and periodic inflow design flood control system plan certified by a qualified professional engineer (PE) for all existing and inactive CCR surface impoundments. This report is the initial inflow design flood control system plan.

1.2 Hydrologic and Hydraulic Capacity Applicability

The Sutherland Generating Station (SGS) in Marshalltown, Iowa (Figure 1 & Figure 2) has four inactive CCR surface impoundments, identified as follows:

- SGS North Primary Pond
- SGS South Primary Pond
- SGS Main Pond
- SGS Polishing Pond

2 FACILITY DESCRIPTION

SGS is located east of the City of Marshalltown and approximately one-half mile west of the Iowa River in Marshall County, at 3001 East Main Street, Marshalltown, Iowa.

SGS was a fossil-fueled electric generating station consisting of three steam turbine electric generating units and three combustion turbine units. SGS initiated operations in 1954. From 1954 to 2012 sub-bituminous coal was the primary fuel for producing steam. As of the end of 2012, SGS ceased using coal and modified facility operations in order to use natural gas as the primary fuel source. SGS ceased natural gas generation as of June 22, 2017 and retired. The external combustion turbines, located west of the main generating station, continue operations and are now associated with the nearby Marshalltown Generating Station.

When coal was the primary fuel for producing steam, a by-product of CCR was produced. The CCR at SGS is categorized into two types, bottom ash and precipitator fly ash.

The precipitator fly ash at SGS was collected by electrostatic precipitators and conveyed dry to a temporary on-site storage area. The precipitator fly ash was then transported off-site for beneficial reuse. If the dry conveying system malfunctioned, an emergency by-pass system would utilize water to sluice the precipitator fly ash from the generating plant to the CCR surface impoundments.

The bottom ash at SGS was sluiced from the generating plant to the CCR surface impoundments. Other influent flows that previously discharged into the CCR surface impoundments consisted of cooling tower blow down water, air compressor cooling water, boiler blow down water, storm water runoff from the former coal pile storage area, and other low-volume waste water streams from the generating plant via a basement sump pump.

General Facility Information:

State CCR Impoundment ID	64-UDP-02-15
Date of Initial Facility Operations	1954
NPDES Permit Number:	IA 6469103
Facility Title V Operating Permit:	98-TV-010R2
Latitude / Longitude:	42°2′51″N 92°51′35″W
Site Coordinates:	Section 32, Township 84 North, Range 17 West

2.1 SGS North Primary Pond and SGS South Primary Pond

The SGS North Primary Pond and SGS South Primary Pond, Figure 2, are located east of the generating plant and west of the SGS Main Pond. The two CCR surface impoundments are incised. The two CCR surface impoundments historically received sluiced bottom ash from the generating plant prior to SGS ceasing coal burning activities. The majority of the CCR that was sluiced from the generating plant settled out in the two primary CCR surface impoundments. The two primary CCR surface impoundments were dredged on a weekly basis with a long-reach excavator. The dredged CCR was stockpiled adjacent to the CCR surface impoundments for dewatering prior to transporting to a temporary stockpile area using a front-end loader. The CCR was then transported off-site for beneficial reuse or to a permitted landfill.

Process flows into the SGS North Primary Pond and SGS South Primary Pond ceased at the time of the facility retirement. The influent during rainfall events included surface water runoff from the former coal pile storage area that is pumped into the impoundments by the lift pumps, Figure 2. The water in the SGS South Primary Pond, in addition to discharging through the corrugated metal pipe, can overflow into a high-density polyethylene corrugated pipe, which discharges into the west end of the SGS Main Pond.

The SGS North Primary Pond and SGS South Primary Pond both have a surface area of approximately 0.25 acres each.

2.2 SGS Main Pond

The SGS Main Pond, Figure 2, is located east of the generating plant and east of the SGS North Primary Pond and SGS South Primary Pond. The SGS Main Pond receives influent flows from the SGS North Primary Pond and SGS South Primary Pond, as well as storm water runoff from the surrounding area. The SGS North Primary Pond discharges into the northwest corner of the SGS Main Pond, while the overflow pipe from the SGS South Primary Pond discharges into the west end of the SGS Main Pond.

The water within the SGS Main Pond flows around a series of intermediate berms to improve suspended solids settlement prior to discharging into the southern end of the SGS Polishing Pond, which is located north of the SGS Main Pond. The water in the SGS Main Pond discharges into the SGS Polishing Pond via a concrete mixing channel located in the northeast corner of the SGS Main Pond, Appendix B. Since SGS ceased coal burning activities, the water within the SGS Main Pond has receded below the invert elevation of the concrete mixing channel at 861.9 feet. Therefore, water no longer discharges into the SGS Polishing Pond during normal conditions.

The SGS Main Pond has a surface area of approximately 4.8 acres and has an embankment height of approximately 8 feet from the crest to the toe of the downstream slope. The top elevation of the embankment is elevation 865 feet. From the July 14, 2017 Annual Inspection Report, the total volume of impounded CCR and water within the SGS Main Pond is approximately 34,000 cubic yards.

2.3 SGS Polishing Pond

The SGS Polishing Pond, Figure 2, is located east of the generating plant and north of the SGS Main Pond. The SGS Polishing Pond receives influent flows from the SGS Main Pond, as well as storm water runoff from the surrounding area. The water in the SGS Main Pond discharges into the SGS Polishing Pond via a concrete mixing channel located in the northeast corner of the SGS Main Pond. Since SGS ceased coal burning activities the SGS Polishing Pond no longer receives normal inflow from the SGS Main Pond and the water elevation in the pond has receded well below the invert elevation of the influent concrete mixing channel. The water that previously discharged into the SGS Polishing Pond discharged through the facility's National Pollutant Discharge Elimination System (NPDES) Outfall 001, which consists of a Parshall flume and flow metering equipment, Figure 2. The invert elevation of the Parshall flume is 861.3 feet. The water that flows through NPDES Outfall 001 discharges into an outfall pond, which overflow drains towards the east into the Iowa River. The overflow drain is a 2-foot diameter corrugated steel riser pipe with a rim elevation at elevation 860.5 feet.

The SGS Polishing Pond has a surface area of approximately 1.2 acres. The storage volume of the CCR surface impoundment is negligible. The embankment on the east side of the CCR surface impoundment has a crest elevation of 865 feet and maximum height above outside grade of eight feet.

3 HYDROLOGIC AND HYDRAULIC CAPACITY- §257.82(a)

This Report provides hydrologic and hydraulic capacity information for inflow design flood control systems which is intended to:

1. Adequately manage flow into each CCR unit during and following the peak discharge inflow of the specified design flood;
2. Adequately manage flow from each CCR unit during and following the peak discharge inflow of the specified design flood; and
3. Handle discharge from the CCR unit in accordance with NPDES regulations §257.3-3.

3.1 Hazard Classification and Design Storm

The SGS North and South Primary Ponds are incised and are not hazard classified in accordance with §257.73(a)(2) and §257.100(a). The SGS Main Pond and the SGS Polishing Pond are classified as low hazard potential because a release would principally be limited to the facility property and there would likely be low economic loss and environmental damages.

The design storm for the CCR surface impoundments is the 100 year return event SCS Type II 24 hour storm as defined in 40 CFR 257.82(3)(ii). The total rainfall for the event selected from the National Oceanographic and Atmospheric Administration's (NOAAs) probabilistic map for the SGS site coordinates is 6.91 inches, Appendix A.

3.2 Hydrologic and Hydraulic Capacity Methods

The 100 year SCS Type II storm was routed through the SGS Main Pond through its discharge mixing channel, Appendix B. The flow from the SGS Main Pond was then routed through the SGS Polishing Pond through its discharge Parshall flume and into the outfall pond with its overflow drain discharging to the Iowa River. The routing was completed using the program Hydraflow by Intelisolve[1]. Hydraflow uses the unit hydrograph method to generate a Type II distribution rainfall for the drainage area of the

[1] Intelisolve, Pond Routing Software Hydraflow, 2002

CCR surface impoundments. Hydraflow routes the rainfall hydrograph through the outlet structures storing water within the CCR surface impoundments in accordance with the reservoir capacity of the CCR surface impoundments. The proportion of runoff to rainfall for the drainage watershed is input based on characteristics of the watershed area. The drainage areas of the watershed include 20 acres of power plant structures, former coal pile storage area, and land adjacent to the CCR surface impoundments, and 6.5 acres of open water for a total of 26.5 acres draining through the CCR surface impoundments during the design storm event.

3.3 Hydrologic and Hydraulic Capacity Input and Assumptions

This section identifies the input and assumptions for the hydrologic and hydraulic capacity calculations. The areas draining into the CCR surface impoundments are shown on Figure 3. Other areas of the plant site do not drain to the collection pumps in the former coal pile storage area and do not produce inflow during storm events. The input for each sub-drainage area of the CCR surface impoundments are:

Sub-Area	Acreage	Curve Number (CN)	Slope (%)	Hydraulic Length (ft)
Plant Facilities	20	91	0.25	730
CCR Surface Impoundments	6.5	100	N/A	N/A
Weighted Average	26.5	93	0.25	730

The slope and hydraulic length for the former coal pile storage area controls the arrival of the peak water from rainfall.

Figure 2 shows the elevations in the CCR surface impoundments on May 2016 as 859.1 feet and 857.4 feet in the SGS Main Pond and SGS Polishing Pond, respectively. External ground water elevation shown by ponded water just east of the CCR surface impoundments is approximately 857 feet or equal to the water elevation in the SGS Polishing Pond. Water from normal rainfall events is removed by the effects of evaporation or seepage in the SGS Main Pond.

Despite the capacity of the CCR surface impoundments to contain surface water without discharge, there is still the possibility that the CCR surface impoundments could be filled due to inundation by reverse flow into the CCR surface impoundments during high flood stage in the adjacent Iowa River. The backup of the Iowa River into the CCR surface impoundments has been observed in the past and could occur in the future refilling the CCR surface impoundments.

The inflow design flood to the CCR surface impoundments is routed through the CCR surface impoundments under the assumption that the Iowa River has recently back flooded the CCR surface impoundments leaving the CCR surface impoundments filled to the overflow elevation after the flood recedes. The design storm is routed through only the storage of the CCR surface impoundments above the outlet inverts and compared to the residual freeboard capacity of the embankments during the routing. These are conservative modeling assumptions.

The storage capacity of the CCR surface impoundments above the outlet invert elevations is assumed to be linear with height and does not account for the increase in volume due to the side slope of the embankments. The linear assumption is conservative in projecting a higher peak water elevation.

Due to the minimal storage volume in the SGS North Primary Pond and SGS South Primary Pond, the ponds have been ignored. In addition, the pump capacity of the lift pumps in the former coal pile storage area are not considered and the full maximum flow during the peak of the storm is lifted to the SGS Main Pond without storing water in the former coal pile storage area which is lower than the SGS Main Pond water elevation during flood routing. These assumptions are conservative modeling assumptions.

4 INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

During the design storm the SGS Main Pond accumulates 7.45 acre feet of water and the SGS Polishing Pond accumulates 2.40 acre feet of water. At the peak flow of the design storm the water elevation in the SGS Main Pond will be 863.5 feet with a remaining freeboard of 1.5 feet. The peak flow in the SGS Polishing Pond will result in a water elevation of 863.3 feet with a remaining freeboard of 1.7 feet. The calculations of the volumes and storage elevations are included in Appendix C.

5 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

To meet the requirements of 40 CFR §257.82(c)(5) and §257.100(a), I Mark W. Loerop hereby certify that I am a licensed professional engineer in the State of Iowa; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR §257.82 and §257.100(a).

By: ______________________________

Name: MARK LOEROP

Date: MARCH 5, 2018

LICENSED PROFESSIONAL ENGINEER
MARK W. LOEROP
22197
IOWA

FIGURES

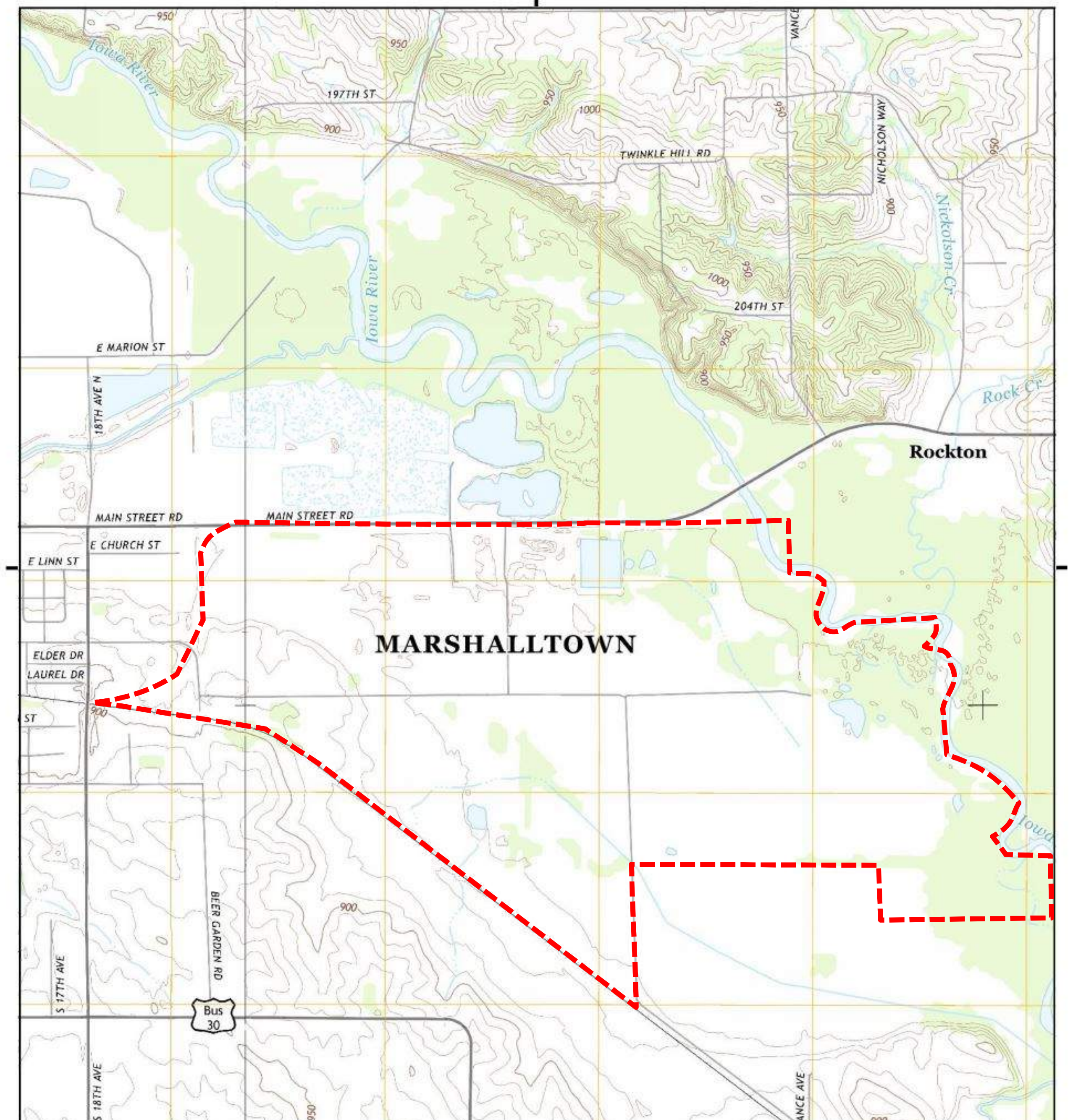
Alliant Energy
Interstate Power and Light Company
Sutherland Generating Station
Marshalltown, Iowa

Inflow Design Flood Control System Plan

EDR

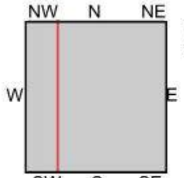
Historical Topo Map

2013



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5



TP, Le Grand, 2013, 7.5-minute
W, Marshalltown, 2013, 7.5-minute

SITE NAME: Sutherland Generating Station
ADDRESS: 3001 East Main Street Road
Marshalltown, IA 50158
CLIENT: Environmental Site Assessors

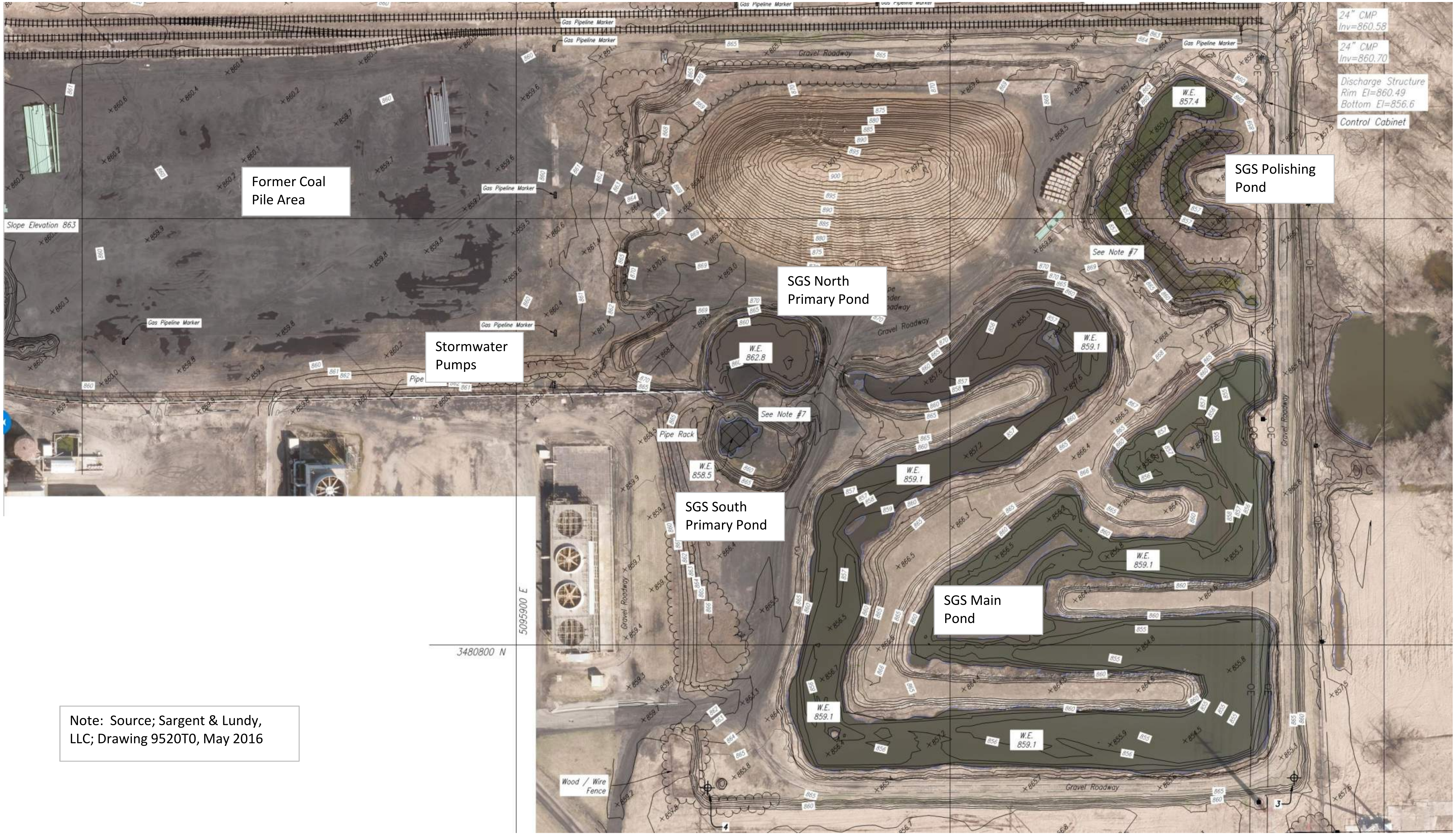
N

5087055 - 1 page 4

Historical Aerial Photo

Approximate Property Boundary

HARD HAT SERVICES™ Engineering, Construction and Management Solutions	Site Location Sutherland Generating Station Interstate Power and Light Company	Drawing Figure 1 Date 1/22/2018



Note: Source; Sargent & Lundy, LLC; Drawing 9520T0, May 2016

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CCR Impoundments
Sutherland Generating Station
Interstate Power and Light Company

Drawing
Figure 2

Date
12/18/2017

CCR Impoundment Drainage Area - 26.5 Acres

Bulk Storage Tanks Previously Removed

HARD HAT SERVICES™ Engineering, Construction and Management Solutions	CCR Impoundment Drainage Area Sutherland Generating Station Interstate Power and Light Company	Drawing Figure 3 Date 2/26/2018

APPENDIX A – NOAA Storm Frequency Tabulation

Alliant Energy
Interstate Power and Light Company
Sutherland Generating Station
Marshalltown, Iowa

Inflow Design Flood Control System Plan

NOAA Atlas 14, Volume 8, Version 2
Location name: Marshalltown, Iowa, USA*
Latitude: 42.0479°, Longitude: -92.8585°
Elevation: 876.38 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.408** (0.351-0.484)	**0.475** (0.408-0.564)	**0.586** (0.502-0.697)	**0.680** (0.579-0.810)	**0.810** (0.669-0.984)	**0.911** (0.737-1.12)	**1.01** (0.795-1.26)	**1.12** (0.845-1.41)	**1.26** (0.918-1.62)	**1.37** (0.973-1.77)
10-min	**0.598** (0.514-0.709)	**0.696** (0.598-0.826)	**0.859** (0.735-1.02)	**0.995** (0.847-1.19)	**1.19** (0.979-1.44)	**1.34** (1.08-1.63)	**1.49** (1.16-1.84)	**1.64** (1.24-2.07)	**1.85** (1.34-2.37)	**2.01** (1.43-2.59)
15-min	**0.729** (0.627-0.865)	**0.849** (0.729-1.01)	**1.05** (0.896-1.24)	**1.21** (1.03-1.45)	**1.45** (1.19-1.76)	**1.63** (1.32-1.99)	**1.81** (1.42-2.25)	**2.00** (1.51-2.52)	**2.25** (1.64-2.89)	**2.45** (1.74-3.16)
30-min	**0.995** (0.855-1.18)	**1.16** (0.999-1.38)	**1.44** (1.23-1.71)	**1.68** (1.43-2.00)	**2.00** (1.65-2.43)	**2.26** (1.82-2.76)	**2.51** (1.97-3.12)	**2.77** (2.09-3.50)	**3.13** (2.27-4.00)	**3.40** (2.41-4.39)
60-min	**1.28** (1.10-1.52)	**1.50** (1.29-1.78)	**1.87** (1.60-2.22)	**2.18** (1.86-2.60)	**2.63** (2.18-3.21)	**2.99** (2.42-3.66)	**3.35** (2.63-4.17)	**3.73** (2.82-4.71)	**4.25** (3.09-5.45)	**4.65** (3.30-6.01)
2-hr	**1.57** (1.36-1.85)	**1.84** (1.59-2.17)	**2.30** (1.98-2.71)	**2.69** (2.31-3.18)	**3.26** (2.72-3.95)	**3.72** (3.03-4.53)	**4.19** (3.31-5.18)	**4.68** (3.57-5.88)	**5.36** (3.94-6.84)	**5.90** (4.22-7.57)
3-hr	**1.76** (1.52-2.05)	**2.05** (1.78-2.40)	**2.57** (2.22-3.01)	**3.02** (2.60-3.55)	**3.67** (3.08-4.44)	**4.21** (3.45-5.11)	**4.76** (3.79-5.87)	**5.36** (4.10-6.70)	**6.18** (4.56-7.85)	**6.82** (4.91-8.72)
6-hr	**2.05** (1.79-2.38)	**2.40** (2.10-2.79)	**3.01** (2.62-3.50)	**3.55** (3.08-4.14)	**4.34** (3.67-5.21)	**4.99** (4.12-6.02)	**5.67** (4.54-6.94)	**6.40** (4.94-7.95)	**7.41** (5.52-9.36)	**8.22** (5.96-10.4)
12-hr	**2.33** (2.05-2.68)	**2.73** (2.40-3.14)	**3.41** (2.99-3.93)	**4.01** (3.50-4.64)	**4.90** (4.17-5.83)	**5.62** (4.68-6.72)	**6.38** (5.15-7.74)	**7.18** (5.59-8.85)	**8.30** (6.23-10.4)	**9.19** (6.72-11.6)
24-hr	**2.64** (2.34-3.02)	**3.06** (2.71-3.49)	**3.78** (3.34-4.32)	**4.42** (3.88-5.06)	**5.35** (4.59-6.30)	**6.11** (5.12-7.24)	**6.91** (5.62-8.31)	**7.76** (6.08-9.49)	**8.94** (6.77-11.1)	**9.88** (7.29-12.4)
2-day	**3.06** (2.73-3.46)	**3.47** (3.10-3.93)	**4.20** (3.74-4.76)	**4.85** (4.29-5.51)	**5.80** (5.01-6.78)	**6.58** (5.57-7.75)	**7.41** (6.08-8.85)	**8.29** (6.55-10.1)	**9.52** (7.27-11.8)	**10.5** (7.81-13.0)
3-day	**3.34** (2.99-3.76)	**3.80** (3.40-4.28)	**4.59** (4.09-5.17)	**5.27** (4.68-5.96)	**6.26** (5.42-7.26)	**7.06** (5.99-8.25)	**7.89** (6.49-9.36)	**8.77** (6.96-10.6)	**9.97** (7.65-12.2)	**10.9** (8.17-13.5)
4-day	**3.59** (3.22-4.02)	**4.09** (3.67-4.59)	**4.93** (4.41-5.54)	**5.65** (5.04-6.37)	**6.68** (5.80-7.71)	**7.50** (6.37-8.71)	**8.34** (6.88-9.84)	**9.22** (7.33-11.1)	**10.4** (8.00-12.7)	**11.3** (8.51-14.0)
7-day	**4.27** (3.86-4.76)	**4.84** (4.37-5.39)	**5.79** (5.21-6.46)	**6.59** (5.90-7.37)	**7.72** (6.73-8.83)	**8.62** (7.36-9.93)	**9.53** (7.90-11.2)	**10.5** (8.38-12.5)	**11.7** (9.08-14.2)	**12.7** (9.62-15.6)
10-day	**4.89** (4.44-5.42)	**5.51** (5.00-6.11)	**6.55** (5.92-7.27)	**7.43** (6.68-8.27)	**8.67** (7.59-9.86)	**9.65** (8.27-11.1)	**10.6** (8.86-12.4)	**11.7** (9.38-13.8)	**13.1** (10.2-15.8)	**14.2** (10.7-17.3)
20-day	**6.67** (6.09-7.33)	**7.47** (6.82-8.21)	**8.81** (8.01-9.69)	**9.94** (9.00-11.0)	**11.5** (10.2-13.0)	**12.8** (11.0-14.5)	**14.0** (11.8-16.2)	**15.4** (12.4-18.1)	**17.1** (13.4-20.5)	**18.5** (14.2-22.4)
30-day	**8.18** (7.50-8.94)	**9.17** (8.40-10.0)	**10.8** (9.86-11.8)	**12.1** (11.0-13.3)	**14.0** (12.4-15.7)	**15.5** (13.4-17.5)	**16.9** (14.3-19.5)	**18.4** (15.0-21.6)	**20.4** (16.1-24.3)	**22.0** (16.9-26.4)
45-day	**10.1** (9.34-11.0)	**11.4** (10.5-12.4)	**13.4** (12.3-14.6)	**15.1** (13.8-16.5)	**17.3** (15.3-19.2)	**19.0** (16.5-21.3)	**20.7** (17.5-23.5)	**22.3** (18.2-25.9)	**24.5** (19.3-29.0)	**26.1** (20.2-31.3)
60-day	**11.9** (11.0-12.8)	**13.3** (12.3-14.5)	**15.7** (14.5-17.1)	**17.6** (16.1-19.2)	**20.1** (17.9-22.2)	**22.0** (19.2-24.6)	**23.8** (20.2-27.0)	**25.6** (20.9-29.5)	**27.8** (22.0-32.7)	**29.4** (22.8-35.1)

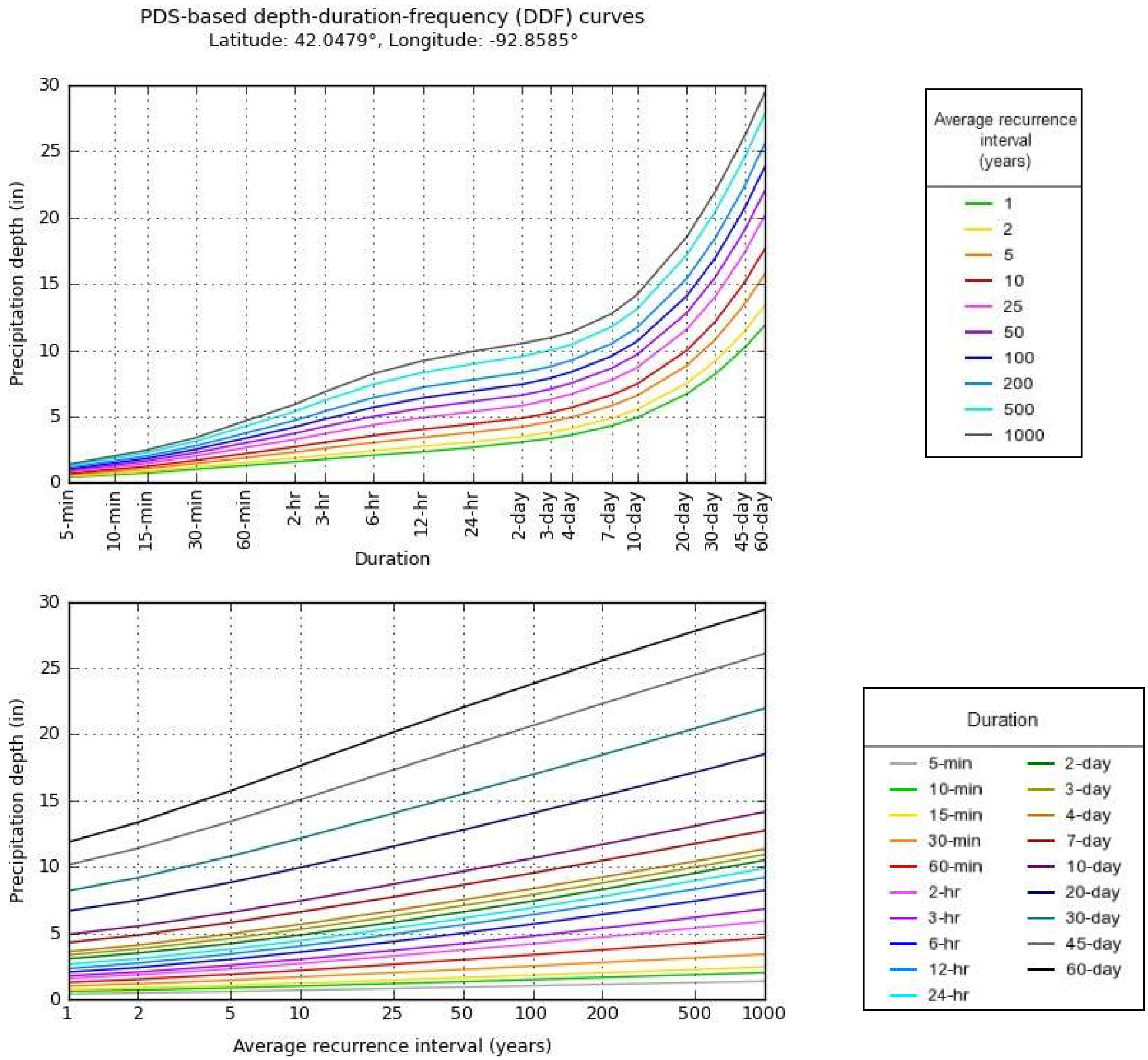
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



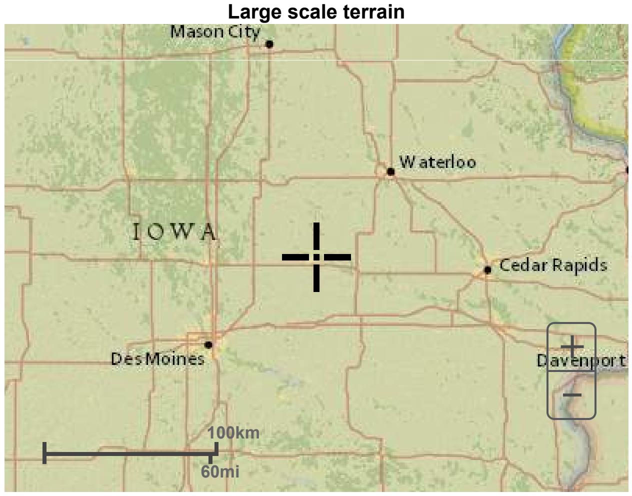
NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Fri Nov 17 19:33:58 2017

Back to Top

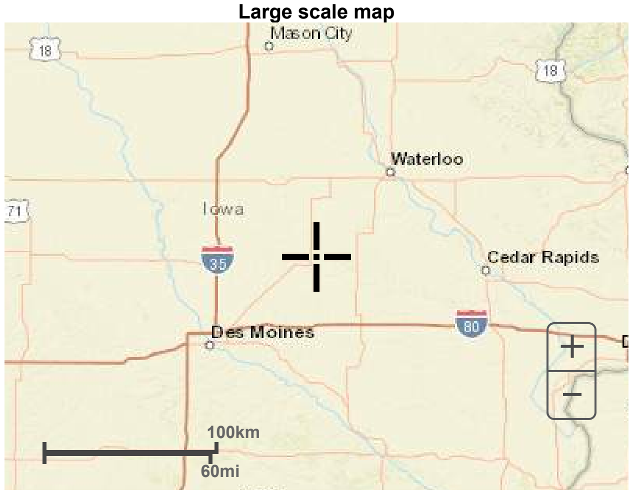
Maps & aerials

Small scale terrain

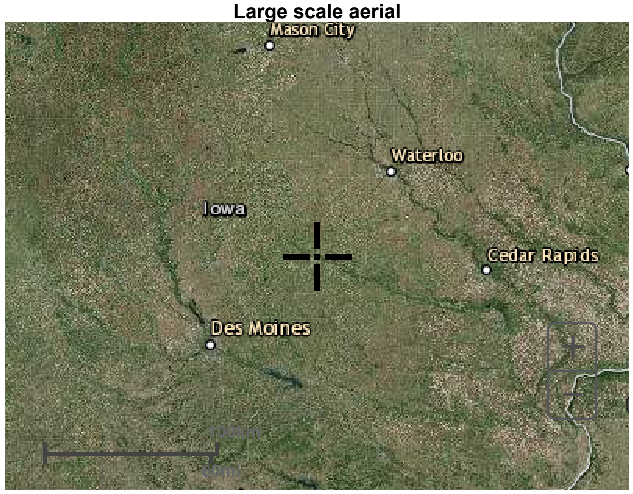
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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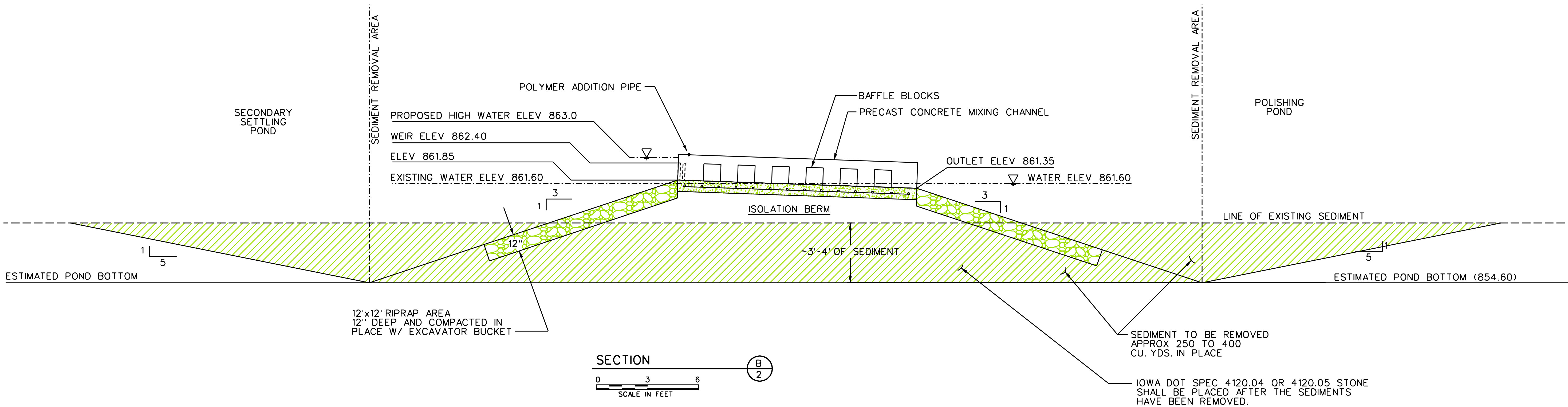
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX B – Outfall Drawings

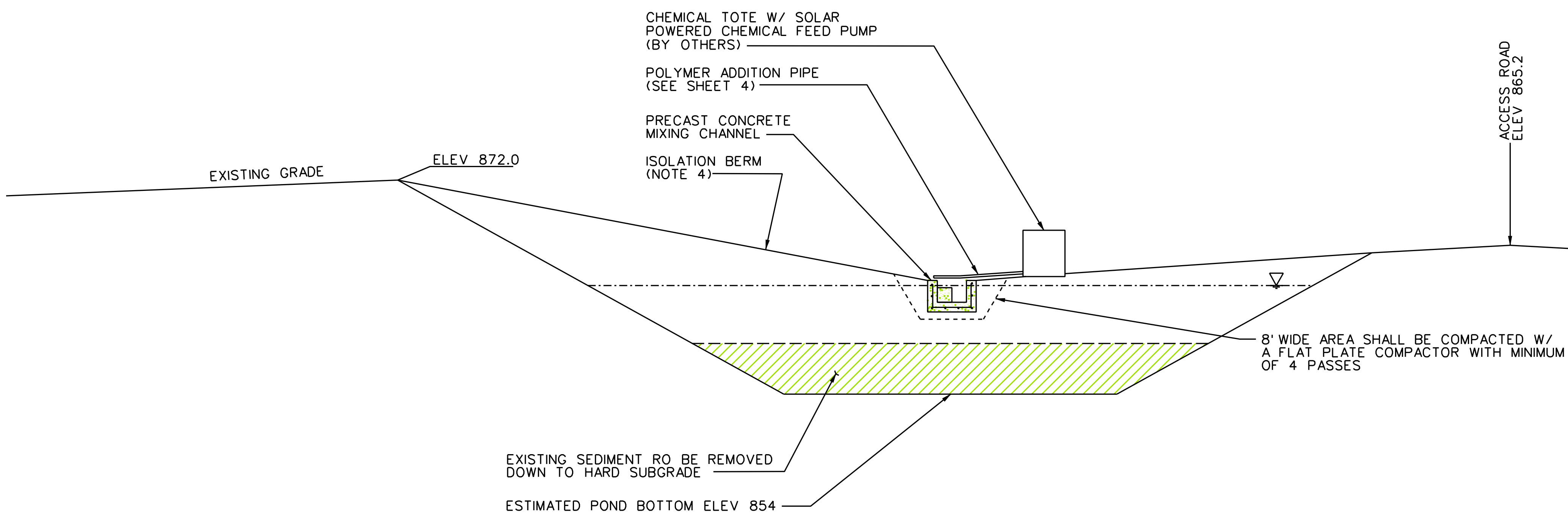
Alliant Energy
Interstate Power and Light Company
Sutherland Generating Station
Marshalltown, Iowa

Inflow Design Flood Control System Plan



SECTION B/2

0 3 6
SCALE IN FEET



NOTES:

1. SEDIMENT SHALL BE REMOVED UNTIL HARD BOTTOM OR UNDISTURBED MATERIAL IS OBSERVED. SEDIMENT REMOVAL WILL BE APPROVED BY CLIENT.
2. CONTRACTOR SHALL PROVIDE GRADATION FOR PROPOSED STONE FOR APPROVAL BY THE CLIENT BEFORE IT IS BROUGHT ON SITE.
3. AFTER STONE IS PLACED ABOVE THE WATERLINE, IT SHALL BE COMPACTED WITH A VIBRATORY ROLLER OR COMPACTOR PLATE IN 6-INCH COMPACTED LIFTS AT NO LESS THAN 4 PASSES.
4. ISOLATION BERM TO BE CONSTRUCTED WITH IDOT SPEC 4120.04 OR 4120.05 GRANULAR STONE W/ FINES, EXCEPT FOR RIPRAP AT THE CHANNEL INLET AND OUTLET
5. APPROXIMATE QUANTITY OF IOWA DOT SPEC 4120.04 OR 4120.05 IS 470 CU YDS AND 11 CU YDS OF RIPRAP.

SECTION A/2

0 5 10
SCALE IN FEET

2/17/2006 ...\SECTIONS.dgn

REV	DATE	BY	DESCRIPTION

SCALE: AS SHOWN

DESIGNED: M. Loerop
DRAWN: HHSI
CHECKED: T. Blair

HARD HAT SERVICES™
Engineering, Construction and Management Solutions
940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

CLIENT: ALLIANT ENERGY
SUTHERLAND GENERATING STATION

TITLE: PHASE 1 - POLISHING POND DESIGN
ISOLATION BERM SECTIONS

SHEET 3

APPENDIX C – Inflow Flood Control Analysis

Alliant Energy
Interstate Power and Light Company
Sutherland Generating Station
Marshalltown, Iowa

Inflow Design Flood Control System Plan

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	SCS Runoff	126.36	10	730	12.592	----	------	------	Sutherland Station
2	Reservoir	25.90	10	760	12.588	1	863.45	7.448	Through Secondary Pond
3	Reservoir	13.43	10	850	12.468	2	863.29	2.394	Polishing Pond
4	Reservoir	13.44	10	860	12.467	3	861.24	0.022	Discharge Pond

Proj. file: Marshalltown2017.gpw	Return Period: 100 yr	Run date: 11-29-2017

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Hyd. No. 1

Sutherland Station

Hydrograph type	= SCS Runoff	Peak discharge	= 126.36 cfs
Storm frequency	= 100 yrs	Time interval	= 10 min
Drainage area	= 26.50 ac	Curve number	= 93
Basin Slope	= 0.3 %	Hydraulic length	= 730 ft
Tc method	= LAG	Time of conc. (Tc)	= 30.5 min
Total precip.	= 6.91 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 12.592 acft

Hydrograph Discharge Table

Time (hrs	-- Outflow cfs)	Time (hrs	-- Outflow cfs)	Time (hrs	-- Outflow cfs)	Time (hrs	-- Outflow cfs)
5.33	1.33	11.00	9.04	16.67	3.78	22.33	2.05
5.50	1.40	11.17	10.07	16.83	3.71	22.50	2.04
5.67	1.48	11.33	11.59	17.00	3.64	22.67	2.02
5.83	1.56	11.50	13.93	17.17	3.56	22.83	2.01
6.00	1.64	11.67	22.89	17.33	3.49	23.00	2.00
6.17	1.73	11.83	53.65	17.50	3.42	23.17	1.98
6.33	1.81	12.00	107.83	17.67	3.35	23.33	1.97
6.50	1.89	12.17	126.36 <<	17.83	3.28	23.50	1.95
6.67	1.97	12.33	86.93	18.00	3.21	23.67	1.94
6.83	2.05	12.50	47.70	18.17	3.14	23.83	1.93
7.00	2.13	12.67	20.66	18.33	3.07	24.00	1.91
7.17	2.21	12.83	16.21	18.50	3.00	24.17	1.52
7.33	2.29	13.00	13.42	18.67	2.93		
7.50	2.37	13.17	11.68	18.83	2.85		
7.67	2.45	13.33	10.48	19.00	2.78	*...End*	
7.83	2.53	13.50	9.51	19.17	2.71		
8.00	2.61	13.67	8.70	19.33	2.64		
8.17	2.71	13.83	7.99	19.50	2.57		
8.33	2.85	14.00	7.37	19.67	2.50		
8.50	3.06	14.17	6.82	19.83	2.43		
8.67	3.31	14.33	6.40	20.00	2.36		
8.83	3.57	14.50	6.11	20.17	2.29		
9.00	3.84	14.67	5.88	20.33	2.24		
9.17	4.09	14.83	5.69	20.50	2.21		
9.33	4.27	15.00	5.49	20.67	2.19		
9.50	4.39	15.17	5.29	20.83	2.18		
9.67	4.49	15.33	5.09	21.00	2.17		
9.83	4.69	15.50	4.89	21.17	2.15		
10.00	5.01	15.67	4.69	21.33	2.14		
10.17	5.44	15.83	4.49	21.50	2.12		
10.33	5.96	16.00	4.30	21.67	2.11		
10.50	6.55	16.17	4.11	21.83	2.10		
10.67	7.23	16.33	3.96	22.00	2.08		
10.83	8.06	16.50	3.86	22.17	2.07		

Reservoir Report

Hydraflow Hydrographs by Intelisolve

Reservoir No. 1 - Secondary

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	861.90	00	0.000	0.000
1.00	862.90	00	4.800	4.800
2.00	863.90	00	4.800	9.600
3.00	864.90	00	4.800	14.400

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 0.0	0.0	0.0	0.0
Span in	= 0.0	0.0	0.0	0.0
No. Barrels	= 0	0	0	0
Invert El. ft	= 0.00	0.00	0.00	0.00
Length ft	= 0.0	0.0	0.0	0.0
Slope %	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len ft	= 2.00	20.00	0.00	0.00
Crest El. ft	= 861.90	863.00	0.00	0.00
Weir Coeff.	= 2.60	2.60	0.00	0.00
Weir Type	= Broad	Broad	---	---
Multi-Stage	= No	No	No	No

Exfiltration Rate = 0.00 in/hr/sqft Tailwater Elev. = 0.00 ft

Note: All outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0.000	861.90	---	---	---	---	0.00	0.00	---	---	---	0.00
1.00	4.800	862.90	---	---	---	---	5.20	0.00	---	---	---	5.20
2.00	9.600	863.90	---	---	---	---	14.71	44.40	---	---	---	59.11
3.00	14.400	864.90	---	---	---	---	27.02	136.19	---	---	---	163.21

Reservoir Report

Hydraflow Hydrographs by Intelisolve

Reservoir No. 2 - Polishing

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	861.30	00	0.000	0.000
1.00	862.30	00	1.200	1.200
2.00	863.30	00	1.200	2.400
3.00	864.30	00	1.200	3.600
4.00	865.30	00	1.200	4.800

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 0.0	0.0	0.0	0.0
Span in	= 0.0	0.0	0.0	0.0
No. Barrels	= 0	0	0	0
Invert El. ft	= 0.00	0.00	0.00	0.00
Length ft	= 0.0	0.0	0.0	0.0
Slope %	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len ft	= 0.00	0.00	0.00	0.00
Crest El. ft	= 861.30	0.00	0.00	0.00
Weir Coeff.	= 2.39	3.33	0.00	0.00
Weir Type	= V-notch	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration Rate = 0.00 in/hr/sqft Tailwater Elev. = 0.00 ft

Note: All outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0.000	861.30	---	---	---	---	---	---	---	---	---	0.00
1.00	1.200	862.30	---	---	---	---	2.39	---	---	---	---	2.39
2.00	2.400	863.30	---	---	---	---	13.52	---	---	---	---	13.52
3.00	3.600	864.30	---	---	---	---	37.26	---	---	---	---	37.26
4.00	4.800	865.30	---	---	---	---	76.48	---	---	---	---	76.48

Reservoir Report

Hydraflow Hydrographs by Intelisolve

Reservoir No. 3 - Discharge Pond

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	860.50	00	0.000	0.000
1.00	861.50	00	0.029	0.029
2.00	862.50	00	0.029	0.058
3.00	863.50	00	0.029	0.087
4.00	864.50	00	0.029	0.116

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 0.0	0.0	0.0	0.0
Span in	= 0.0	0.0	0.0	0.0
No. Barrels	= 0	0	0	0
Invert El. ft	= 0.00	0.00	0.00	0.00
Length ft	= 0.0	0.0	0.0	0.0
Slope %	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

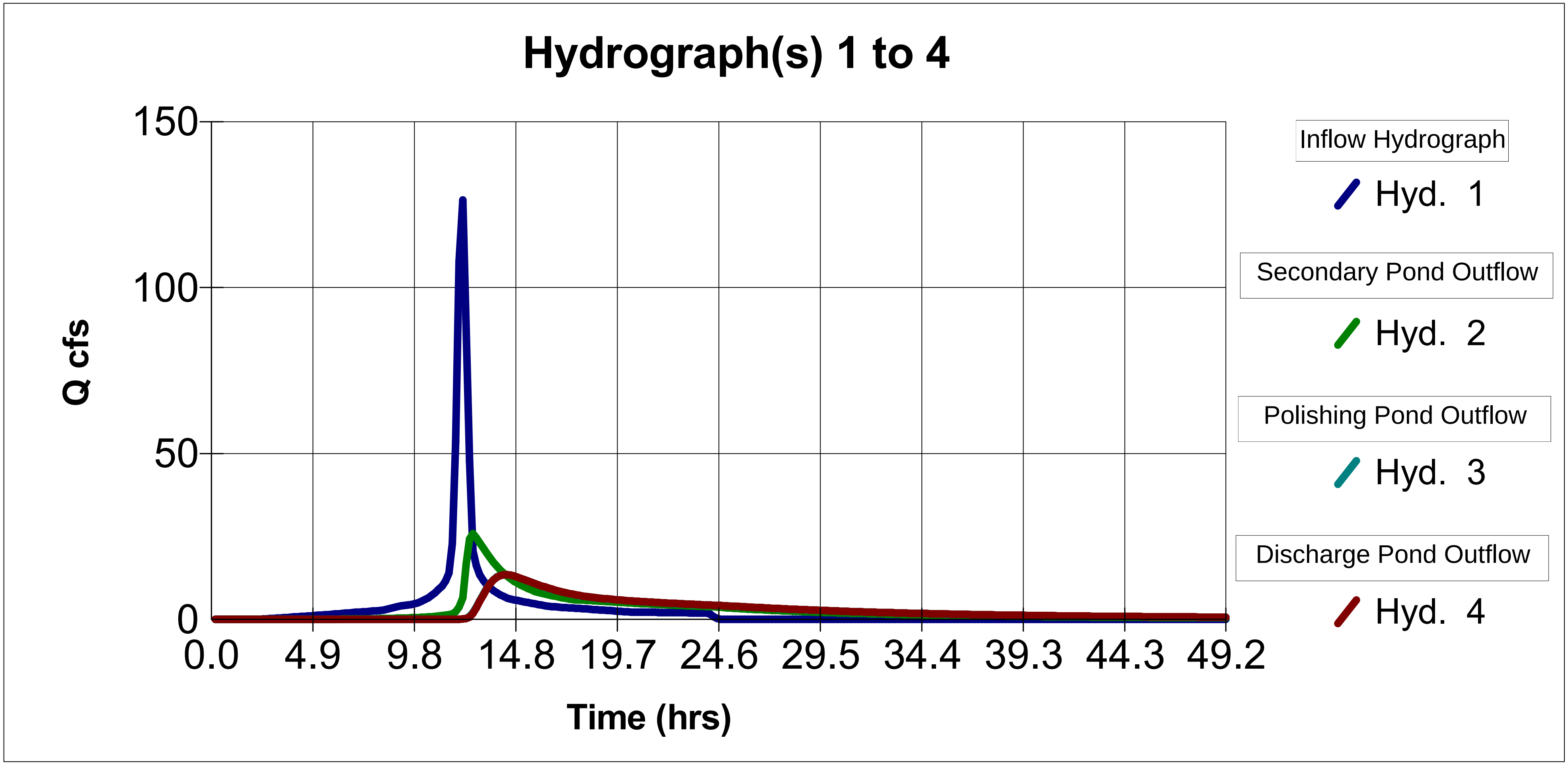
	[A]	[B]	[C]	[D]
Crest Len ft	= 6.30	0.00	0.00	0.00
Crest El. ft	= 860.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration Rate = 0.00 in/hr/sqft Tailwater Elev. = 0.00 ft

Note: All outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0.000	860.50	---	---	---	---	0.00	---	---	---	---	0.00
1.00	0.029	861.50	---	---	---	---	20.98	---	---	---	---	20.98
2.00	0.058	862.50	---	---	---	---	59.34	---	---	---	---	59.34
3.00	0.087	863.50	---	---	---	---	109.01	---	---	---	---	109.01
4.00	0.116	864.50	---	---	---	---	167.83	---	---	---	---	167.83



Note: Hydrographs 3 & 4 are almost identical.