



**STATE OF IOWA
DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP
DIVISION OF SOIL CONSERVATION AND WATER QUALITY**

**Poc903130C NUTRIENT REDUCTION
WETLAND PROJECT**

**CONSTRUCTION CONTRACT
BID NO. 24-01**

**SECTION 30, TOWNSHIP 90 NORTH, RANGE 31 WEST
POCAHONTAS COUNTY, IOWA**

PREPARED FOR: IOWA DEPARTMENT OF AGRICULTURE & LAND STEWARDSHIP
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
WALLACE STATE OFFICE BUILDING
502 EAST 9TH STREET
DES MOINES, IOWA 50319
515-281-4246

PREPARED BY: DUCKS UNLIMITED
209 EUGENE ST
RADCLIFFE, IA 50230
832-704-3286

March 2023

TABLE OF CONTENTS

GENERAL REQUIREMENTS

		Page(s)
DOCUMENT AA	Notice-to-Bidders	AA 1
DOCUMENT BB	Instruction-to-Bidders	BB 1-5
DOCUMENT CC	Proposal and Schedule of Prices	CC 1-5
DOCUMENT DD	Construction Contract	DD 1-2
DOCUMENT EE	Proposal Guarantee (Bid Bond)	EE 1
DOCUMENT FF	General Conditions	FF 1-27
DOCUMENT GG	Special Conditions	GG 1-3
DOCUMENT NN	Performance Bond	NN 1-3

CONSTRUCTION SPECIFICATIONS

IA-01	Site Preparation	1-1 to 1-3
IA-05	Pollution Control	5-1 to 5-3
IA-06	Seeding and Mulching for Protective Cover	6-1 to 6-4
CS-08	Mobilization & Demobilization Drain Tile	8-1 to 8-3
IA-09	Investigation and Removal	9-1 to 9-5
IA-21	Excavation	21-1 to 21-4
IA-23	Earthfill	23-1 to 23-5
IA-26	Topsoiling	26-1 to 26-2
IA-31	Concrete	31-1 to 31-7
IA-46	Tile Drains for Land Drainage Corrugated	46-1 to 46-4
IA-51	Metal Pipe Conduits	51-1 to 51-6
IA-61	Loose Rock Riprap	61-1 to 61-4
IA-95	Geotextile	95-1 to 95-5

PLANS

Cover Sheet	001
Specifications, Quantities, & Notes	002
Topography ^ Existing Conditions	051
Site Plan	101
Structure, Inlet, Berm, & Riprap Plan	201
Structure, Berm, & Wetland Profiles	202
Clay Core & 10-inch Tile Profiles & Riprap Toe	203
Water Control Structure Plan	204
Tile Plan	205
Water Control Structure Details	301
CMP WCS Details	302
Agri Drain WCS Details	303
Articulating Concrete Block Details	304
Seeding Plan	401

APPENDIX I – ADDENDA & BID TAB***(ADDED AFTER BIDDING)**

Addenda, if applicable	*
Pre-Bid Meeting Minutes	*
Pre-Bid Meeting Attendance List	*
Updated Plan Holders List	*
Bid Tab	*

APPENDIX II – CONSTRUCTION ADMINISTRATION FORMS

DOCUMENT LL	Notice-of-Award	LL 1
DOCUMENT MM	Notice-to-Proceed	MM 1
DOCUMENT JJ	Construction Progress Schedule	JJ 1-2
DOCUMENT SS	Application & Certificate for Payment	SS 1-2
DOCUMENT HH	Change Order Request	HH 1-2
DOCUMENT II	Construction Contract Amendment	II 1-3
DOCUMENT QQ	Iowa Sales & Use Tax Form	QQ 1

APPENDIX III – DESIGN CALCULATIONS

APPENDIX I

ADDENDA & BID TAB

[Page intentionally left blank to serve as a placeholder for any addenda and for the Bid Tab which will be included after the bidding process]

APPENDIX II

CONSTRUCTION & ADMINISTRATION FORMS

March 8, 2024

Contractor name and address

Delivery via email: Contractor Email

RE: **NOTICE-OF-AWARD** – Poc903130C Nutrient Reduction Wetland Project, Contract 24-01

Dear Poc903130C,

This is to notify you that the Division of Soil Conservation and Water Quality has determined Poc903130C is the successful bidder for the Poc903130C Nutrient Reduction Wetland Project. Award is being made for the base bid of Poc903130C.

In accordance with Item #9 of the Instructions to Bidders, Document BB, you have fourteen (14) calendar days from the date of receipt of this notice to obtain the Performance Bond (*Document NN*), submit your Construction Progress Schedule (*Document JJ*) for review, and execute the Contract (*Document DD*). In addition, the Division must be provided with a Certificate of Insurance pursuant to the General Conditions, Insurance and Related Provisions (*Document FF, Part 6-01*).

Please note that Iowa Code Section 91C.7, requires that all construction contractors awarded a contract to perform work for the state or an agency of the state must be registered with the Iowa Division of Labor. The Division of Soil Conservation and Water Quality cannot execute a contract with your firm unless you provide proof of this registration. Be sure to fill in the Division of Labor registration number blank on the Contract (*Document DD*).

Enclosed are the Contract (*Document DD*), Construction Progress Schedule form (*Document JJ*), and the Performance Bond (*Document NN*). Please complete, sign and return scanned electronic copies along with completed Performance Bond. In addition, we must have the Certificate of Insurance pursuant to the General Conditions and/or Special Conditions.

Congratulations on being the successful bidder. We look forward to working with your company on this project. If you have any questions, please contact Tracy Bruun, (515) 344-6279.

Sincerely,

Jake Hansen, Chief
Water Resources Bureau
Division of Soil Conservation and Water Quality

JH/tab
Enclosures
CC:

March 8, 2024

Contractor name and address

Delivery via email: Contractor Email

RE: **NOTICE-TO-PROCEED** – Poc903130C Nutrient Reduction Wetland Project, Contract 24-01

Dear,

The Division of Soil Conservation and Water Quality received the signed construction Contract (*Document DD*), the completed Performance Bond (*Document NN*), and the Certificate of Insurance from your company. These documents were found to be in order and the Division executed this contract with _____ dated _____. A scanned copy of the executed Contract and Performance Bond are enclosed.

The Division has accepted the Construction Progress Schedule (*Document JJ*) included here, with a Construction Start Date of _____. A Preconstruction Conference, as required in Item 13 of the Instructions to Bidders (*Document BB*), must be held within seven (7) days prior to the Construction Start Date established in the Construction Progress Schedule, or earlier if mutually agreed. No work may commence on site prior to the Preconstruction Conference. If the Construction Start Date requires adjustment, that needs to be communicated to the Engineer and Division in a timely manner so as to facilitate scheduling of the Preconstruction Conference.

In accordance with the Contract, _____ must commence work under this contract for the _____ Nutrient Reduction Wetland Project on or before the Construction Start Date scheduled in the Construction Progress Schedule, but not before the Preconstruction Conference. You have until November 01, 2024 to complete all of the work except for seeding, and until December 15, 2024 to complete the seeding.

Also attached is a scanned copy of the Iowa Construction Sales Tax Exempt Certificate and Authorization Letter for this project. Pursuant to Iowa Code Section 423.2(80), this allows you to purchase materials tax free for use on this project. Please read the information provided in the authorization letter. You are authorized with this Notice-to-Proceed to purchase necessary materials for this project and request reimbursement for those items that are stored prior to the Construction Start Date.

If you have any questions, please contact Tracy Bruun, (515) 344-6279.

Sincerely,

Jake Hansen, Chief
Water Resources Bureau
Division of Soil Conservation and Water Quality

JH/tab
Attachments
CC:

STATE OF IOWA
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
CONSTRUCTION PROGRESS SCHEDULE

Project ID: Poc903130C

Date: _____

Contractor: _____

Contract End Dates:

All Construction Work Except Seeding: November 01, 2024

Seeding: December 15, 2024

Scheduled Dates:

Anticipated Construction Start Date: _____

Preconstruction Conference Date Range*: _____

**Preconstruction Conference must be held prior to Construction Start Date, by no more than seven (7) days*

Estimated Completion Date of All Work Except Seeding: _____

Final Walkthrough should be held prior to Contract End Date for all construction work except seeding

Major Construction Work Item(s)	Order of Work	Estimated Duration of Work
<i>(Items to be established/grouped by Division on an individual project basis)</i>		

Dates established in this schedule may be adjusted as described in Document FF, Paragraph 3-21.

FOR THE CONTRACTOR

(Company Representative)

(Date)

(Name of Company)

(Address of Company)

(City, State, Zip code)

FOR THE DIVISION

Mike Bourland, Water Resources Bureau
Division of Soil Conservation and Water Quality

(Date)

Accepted

Adjustment Requested

If adjustment is requested, describe below:

END OF DOCUMENT JJ

APPLICATION AND CERTIFICATE FOR PAYMENT

TO DIVISION:
 Iowa Division of Soil Conservation and Water Quality
 502 East 9th Street
 Des Moines, IA 50319-0050

FROM CONTRACTOR:
 Contractor Name
 Contractor Address Line 1
 Contractor Address Line 2

PROJECT:
 Bid No.
 Project I.D.
 Date:
 Period To:

Summary of Approved Change Orders & Contract Amendments		
Number	Addition	Deduction

ENGINEER
 Engineer Name
 Engineer Address Line 1
 Engineer Address Line 2

Net change by Change Orders and Contract Amendments	\$ -	PAYMENT #1 -Ret DATE	PAYMENT #2 -Ret DATE	PAYMENT #3 -Ret DATE	PAYMENT #4 -Ret DATE	PAYMENT #5 -Ret DATE	PAYMENT #6 - Ret DATE	RETAINAGE ONLY DATE
1. ORIGINAL CONTRACT SUM:	\$ -							
2. Net Changes by Change Orders/Amendments (from table)	\$ -							
3. Contract Sum to Date (Line 1+/-2)	\$ -							
4. Total Completed & Stored to Date (Column G on Continuation Sheet)	\$ -							
5. Retainage (5% of Line 4)	\$ -							
6. Total Earned Less Retainage (Line 4 less Line 5)	\$ -							
7. Previous Certificates For Payment (Line 6 from prior Certificate)	\$ -							
8. Balance to Finish, Plus Retainage (Line 3 less Line 6)	\$ -							
9. Current Payment Due (Line 6 less Line 7)	\$ -							

The undersigned Contractor certifies that to the best of Contractor's knowledge, information, and belief, the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid to Contractor for which previous Certificates for Payment were issued and payments received from the Division and that current payment shown herein is now

By: _____ Date _____
CONTRACTOR

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, Engineer certifies to the Division that to the best of the Engineer's knowledge, information, and belief, the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and Contractor is entitled to payment of the AMOUNT CERTIFIED.

By: _____ Date _____
ENGINEER'S CERTIFICATE FOR PAYMENT

AMOUNT CERTIFIED \$ _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment, and acceptance of payment are without prejudice to any rights of Contracting Officer or Contractor under this Contract.

CONTINUATION SHEET FOR APPLICATION AND CERTIFICATE FOR PAYMENT

DOCUMENT SS

PAGE 2 of 2

A Item No.	B Description of Work	C Scheduled Value	D		E		F Materials Presently Stored Not in D or E	G Total Completed & Stored (D+E+F)	H % Complete (G/C)	I Balance to Finish (C-G)
			Work		Completed					
			From Previous Application (D+E)	This Period						
1	Bid Item 1	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
2	Bid Item 2	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
3	Bid Item 3	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
4	Bid Item 4	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
5	Bid Item 5	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
6	Bid Item 6	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
7	Bid Item 7	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
8	Bid Item 8	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
9	Bid Item 9	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
10	Bid Item 10	\$ -	\$ -	\$ -			\$ -	0%	\$ -	
TOTALS FOR PAYMENT #1		\$ -	\$ -	\$ -			\$ -	0%	\$ -	

STATE OF IOWA
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
CHANGE ORDER REQUEST

Change Order Request No. _____

Project ID: Poc903130C

Date: _____

Name of Project: Poc903130C

Location of Project: Pocahontas County

Name of Contractor: _____

Architect/Engineer: Ducks Unlimited

Contract Plan and
Detail Reference: _____

Change Order Request
Drawing No. and Date: _____

Contract Specification
Reference: _____

Description of Change: _____

BREAKDOWN OF CONTRACT COST:

Original Project Contract Amount: \$ _____

Approved Change Orders No. ___ thru ___: \$ _____

Pending Recommended Change Order Requests Nos. ___: \$ _____

This Change Order Request: \$ _____

Resulting Total Recommended Amount: \$ _____

Reason for Contract Change: _____

Change Requested by: _____

(Signature)

(Date)

CONTRACTOR APPROVAL

(Company)

By: _____
(Signature)

(Address)

(Date)

IDALS PROJECT REPRESENTATIVE RECOMMENDATIONS

_____ Concur

_____ Recommend Rejection (Attach Explanation)

IDALS Project Representative: _____
(Signature)

(Date)

DIVISION OF SOIL CONSERVATION AND WATER QUALITY AUTHORIZATION

Change Order required due to:

Immediate authorization to proceed granted: _____ Yes

_____ No

APPROVED:

DENIED:

Susan Kozak, Director
Division of Soil Conservation and Water Quality
Iowa Department of Agriculture
and Land Stewardship

Susan Kozak, Director
Division of Soil Conservation and Water Quality
Iowa Department of Agriculture
and Land Stewardship

(Date)

(Date)

END OF DOCUMENT HH

State of Iowa
Iowa Department of Agriculture and Land Stewardship
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
Poc903130C Nutrient Reduction Wetland Project Construction Contract Amendment

THIS AMENDMENT, made this _____ day of _____, 2023, by and between the State of Iowa, acting through:

Iowa Department of Agriculture and Land Stewardship
Division of Soil Conservation and Water Quality

hereinafter called the **DIVISION**, and

(Name of Company)

(Address)

(City, State, Zip)

hereinafter called the **CONTRACTOR**.

WITNESSETH: That the **DIVISION** and the **CONTRACTOR** mutually agree to amend the agreement made the _____ day of _____, 20____, for the Pocahontas County Nutrient Reduction Wetland Project (Poc903130C – Bid No. 24-01) in this Amendment Number _____ as described below:

Description of Amendment:

Contract Plan Sheet(s)
and Detail Reference(s):

Amendment No. _____

Drawing No. and Date: _____

Contract Specification
Reference(s): _____

Reason for Revision of
Contract Completion Date(s): _____

Original Contract Completion Date for All Work Except Seeding: November 01, 2024

Original Contract Completion Date for Seeding: December 15, 2024

Current Completion Date for All Work Except Seeding: _____

Current Completion Date for Seeding: _____

Revised Completion Date for All Work Except Seeding, This Amendment: _____

Revised Completion Date for Seeding, This Amendment: _____

IOWA
Department of Revenue
www.state.ia.us/tax

Designated Exempt Entity
Iowa Construction Sales Tax Exemption Certificate

This document may be completed by a designated exempt entity and given to their contractor and/or subcontractor along with an authorization letter. *Seller:* Keep this certificate in your files. *Contractor/Exempt Entity:* Keep a copy of this certificate for your records. **Do not send this to the Department of Revenue**

Designated Exempt Entity Division of Soil Conservation and Water Quality Iowa Department of Agriculture and Land Stewardship		
Address 1 502 East 9th Street		
Address 2		
City Des Moines	State IA	Zip Code 50319
Construction Project Name Poc903130C Nutrient Reduction Wetland Project		
Construction Project Number (if used) Job No. 24-01		

General Contractor or Subcontractor Name Sample		
Address 1 123 Construction Ave		
Address 2		
City Diggerville	State IA	Zip Code 55555

Description of contract/subcontract (please print/type clearly)

Construction of Nutrient Reduction Wetland.

The named contractor may purchase building materials used in the contract, exempt from sales tax. This exemption does NOT apply to materials, equipment and supplies consumed by the contractor or subcontractor.

Designated Exempt Entity Authorized Agent _____ Date: _____

Authorization Letter From Division of Soil Conservation and Water Quality - Agriculture and Land Stewardship

Pursuant to Iowa Code Sections: 422.42 (16) & (17), and 422.47 (5), you are authorized to purchase construction materials tax free for the contract specified above.

The exemption certificate (or a copy of the certificate) may be provided to the suppliers of your construction materials and will authorize them to sell you the materials exempt from Iowa sales tax and any applicable local option sales tax and school infrastructure local option sales tax. Complete information on qualifying materials can be found at www.state.ia.us/tax, the Department of Revenue (IDR) website.

It is your responsibility to have records identifying the materials purchased and verifying they were used on this contract. Any materials purchased tax-free and not used on the construction project are subject to sales and applicable local option taxes. Should this occur, the tax must be paid directly by you to IDR in the same calendar quarter the project is completed. E-mail the department at: idrf@idrf.state.ia.us if you have questions on this requirement.

Contractors should be aware that use of the certificate to claim exemption from tax for items not used on this project or that do not qualify for exemption could result in civil or criminal penalties.

31-013 (12/10/02)

END OF DOCUMENT QQ

APPENDIX III
DESIGN CALCULATIONS

DESIGN REPORT

for

Poc903130C Wetland Project

IA-340-3



January 11, 2024

Prepared by:

Ducks Unlimited, Inc.

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

1-15-24

Andrew Schippers, P.E.

Date

My license number is P26317

My license renewal date is December 31, 2025

Pages of sheets covered by this seal: 1-119

TABLE OF CONTENTS

SECTION 1 - HYDROCAD REPORT

SECTION 2 – HEC-RAS ANALYSIS

SECTION 3 – FEMA FLOODMAP AT ADJACENT ROAD

SECTION 4 – NOAA RAINFALL DATA

SECTION 5 – STREAMSTATS REPORT

SECTION 6 – NRCS SOIL DATA

SECTION 7 – 10-INCH TILE & AGRIDRAIN CALCULATIONS

SECTION 8 – 5-INCH LATERAL TILE CALCULATIONS

SECTION 9 – LATERAL EFFECT CALCULATIONS

SECTION 10 – SEDIMENT ACCUMULATION CALCULATIONS

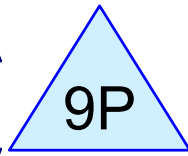
SECTION 11 – CTS GEOTECHNICAL REPORT

SECTION 12 – IDALS RIPRAP TOE RECOMMENDATION

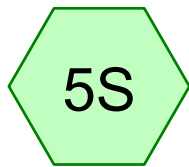
SECTION 1
HYDROCAD REPORT



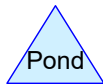
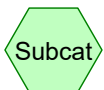
Rainfall into Wetland



Moline Wetland



Watershed to Creek
South of Moline



IA-340-3 - HydroCAD Wetland Model

Prepared by Ducks Unlimited

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Page 2

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-Year	NOAA 24-hr	A	Default	24.00	1	5.54	2
2	100-Year	NOAA 24-hr	A	Default	24.00	1	7.61	2

IA-340-3 - HydroCAD Wetland Model

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Page 3

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1,177.600	68	Pasture/grassland/range, Poor, HSG A (5S)
49.100	78	Row crops, straight row, Good, HSG B (2S)
1,226.700	68	TOTAL AREA

IA-340-3 - HydroCAD Wetland Model

Prepared by Ducks Unlimited

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Page 4

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1,177.600	HSG A	5S
49.100	HSG B	2S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1,226.700		TOTAL AREA

IA-340-3 - HydroCAD Wetland Model

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Page 5

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchmen Numbers
1,177.600	0.000	0.000	0.000	0.000	1,177.600	Pasture/grassland/range, Poor	5
0.000	49.100	0.000	0.000	0.000	49.100	Row crops, straight row, Good	2
1,177.600	49.100	0.000	0.000	0.000	1,226.700	TOTAL AREA	

IA-340-3 - HydroCAD Wetland Model

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Page 6

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	9P	1,205.00	1,205.00	39.0	0.0000	0.021	0.0	18.0	0.0
2	9P	1,205.00	1,205.00	15.0	0.0000	0.020	0.0	18.0	0.0

IA-340-3 - HydroCAD Wetland Model

Prepared by Ducks Unlimited

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Page 7

Notes Listing (all nodes)

Line#	Node Number	Notes
1	5S	CN adjusted to correlate inflow volumetric flowrate with inflow volumetric flowrate for a 100-year event from StreamStats Report.
2		Based on existing 60" CMP culvert at adjacent road, upstream of grade stabilization structure, and FEMA flood map indicating 100-year flood event does not overtop road, it is likely peak flow for 100-year event down ditch/creek will be 240 cfs. Accordingly, modeling diagram and peak elevations for certain events are likely higher than what will actually be experienced on site.
3	9P	Modeling was performed assuming the wetland at FSL at the beginning of the rain event, 1208.0'.

Time span=5.00-60.00 hrs, dt=0.05 hrs, 1101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: Rainfall into Wetland Runoff Area=49.100 ac 0.00% Impervious Runoff Depth=3.18"
Flow Length=300' Slope=0.0030 '/' Tc=15.7 min CN=78 Runoff=188.76 cfs 12.994 af

Subcatchment 5S: Watershed to Runoff Area=1,177.600 ac 0.00% Impervious Runoff Depth=2.27"
Flow Length=12,017' Slope=0.0037 '/' Tc=537.5 min CN=68 Runoff=278.31 cfs 223.053 af

Pond 9P: Moline Wetland Peak Elev=1,209.19' Storage=17.348 af Inflow=280.76 cfs 236.047 af
Primary=7.33 cfs 9.451 af Secondary=272.57 cfs 226.595 af Outflow=279.91 cfs 236.046 af

Total Runoff Area = 1,226.700 ac Runoff Volume = 236.047 af Average Runoff Depth = 2.31"
100.00% Pervious = 1,226.700 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: Rainfall into Wetland

Runoff = 188.76 cfs @ 12.25 hrs, Volume= 12.994 af, Depth= 3.18"
 Routed to Pond 9P : Moline Wetland

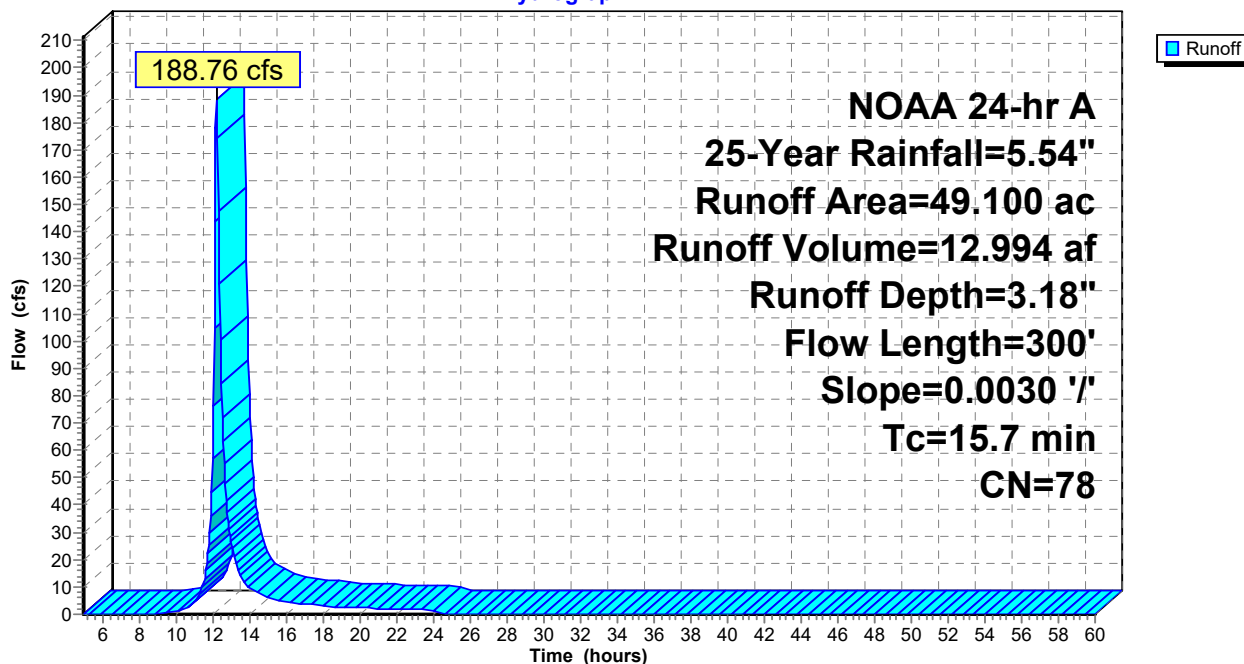
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-60.00 hrs, dt= 0.05 hrs
 NOAA 24-hr A 25-Year Rainfall=5.54"

Area (ac)	CN	Description
49.100	78	Row crops, straight row, Good, HSG B
49.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	300	0.0030	0.32		Sheet Flow, Cultivated: Residue<=20% n= 0.060 P2= 7.61"

Subcatchment 2S: Rainfall into Wetland

Hydrograph



Hydrograph for Subcatchment 2S: Rainfall into Wetland

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.24	0.00	0.00	34.00	5.54	3.18	0.00
5.50	0.27	0.00	0.00	34.50	5.54	3.18	0.00
6.00	0.30	0.00	0.00	35.00	5.54	3.18	0.00
6.50	0.33	0.00	0.00	35.50	5.54	3.18	0.00
7.00	0.37	0.00	0.00	36.00	5.54	3.18	0.00
7.50	0.42	0.00	0.00	36.50	5.54	3.18	0.00
8.00	0.47	0.00	0.00	37.00	5.54	3.18	0.00
8.50	0.53	0.00	0.00	37.50	5.54	3.18	0.00
9.00	0.59	0.00	0.01	38.00	5.54	3.18	0.00
9.50	0.66	0.00	0.31	38.50	5.54	3.18	0.00
10.00	0.76	0.01	0.93	39.00	5.54	3.18	0.00
10.50	0.88	0.03	1.86	39.50	5.54	3.18	0.00
11.00	1.06	0.07	4.18	40.00	5.54	3.18	0.00
11.50	1.38	0.18	10.98	40.50	5.54	3.18	0.00
12.00	2.58	0.84	57.00	41.00	5.54	3.18	0.00
12.50	4.16	2.02	84.12	41.50	5.54	3.18	0.00
13.00	4.48	2.28	26.64	42.00	5.54	3.18	0.00
13.50	4.66	2.43	14.73	42.50	5.54	3.18	0.00
14.00	4.78	2.53	9.83	43.00	5.54	3.18	0.00
14.50	4.88	2.61	8.04	43.50	5.54	3.18	0.00
15.00	4.95	2.67	6.30	44.00	5.54	3.18	0.00
15.50	5.01	2.72	5.11	44.50	5.54	3.18	0.00
16.00	5.07	2.77	4.68	45.00	5.54	3.18	0.00
16.50	5.12	2.81	4.27	45.50	5.54	3.18	0.00
17.00	5.17	2.85	3.85	46.00	5.54	3.18	0.00
17.50	5.21	2.89	3.42	46.50	5.54	3.18	0.00
18.00	5.24	2.92	3.00	47.00	5.54	3.18	0.00
18.50	5.27	2.95	2.70	47.50	5.54	3.18	0.00
19.00	5.30	2.97	2.59	48.00	5.54	3.18	0.00
19.50	5.33	3.00	2.49	48.50	5.54	3.18	0.00
20.00	5.36	3.02	2.39	49.00	5.54	3.18	0.00
20.50	5.39	3.04	2.28	49.50	5.54	3.18	0.00
21.00	5.41	3.07	2.18	50.00	5.54	3.18	0.00
21.50	5.44	3.09	2.06	50.50	5.54	3.18	0.00
22.00	5.46	3.11	1.96	51.00	5.54	3.18	0.00
22.50	5.48	3.13	1.85	51.50	5.54	3.18	0.00
23.00	5.50	3.14	1.74	52.00	5.54	3.18	0.00
23.50	5.52	3.16	1.63	52.50	5.54	3.18	0.00
24.00	5.54	3.18	1.55	53.00	5.54	3.18	0.00
24.50	5.54	3.18	0.06	53.50	5.54	3.18	0.00
25.00	5.54	3.18	0.00	54.00	5.54	3.18	0.00
25.50	5.54	3.18	0.00	54.50	5.54	3.18	0.00
26.00	5.54	3.18	0.00	55.00	5.54	3.18	0.00
26.50	5.54	3.18	0.00	55.50	5.54	3.18	0.00
27.00	5.54	3.18	0.00	56.00	5.54	3.18	0.00
27.50	5.54	3.18	0.00	56.50	5.54	3.18	0.00
28.00	5.54	3.18	0.00	57.00	5.54	3.18	0.00
28.50	5.54	3.18	0.00	57.50	5.54	3.18	0.00
29.00	5.54	3.18	0.00	58.00	5.54	3.18	0.00
29.50	5.54	3.18	0.00	58.50	5.54	3.18	0.00
30.00	5.54	3.18	0.00	59.00	5.54	3.18	0.00
30.50	5.54	3.18	0.00	59.50	5.54	3.18	0.00
31.00	5.54	3.18	0.00	60.00	5.54	3.18	0.00
31.50	5.54	3.18	0.00				
32.00	5.54	3.18	0.00				
32.50	5.54	3.18	0.00				
33.00	5.54	3.18	0.00				
33.50	5.54	3.18	0.00				

Summary for Subcatchment 5S: Watershed to Creek South of Moline

CN adjusted to correlate inflow volumetric flowrate with inflow volumetric flowrate for a 100-year event from StreamStats Report.

Based on existing 60" CMP culvert at adjacent road, upstream of grade stabilization structure, and FEMA flood map indicating 100-year flood event does not overtop road, it is likely peak flow for 100-year event down ditch/creek will be 240 cfs. Accordingly, modeling diagram and peak elevations for certain events are likely higher than what will actually be experienced on site.

Runoff = 278.31 cfs @ 19.69 hrs, Volume= 223.053 af, Depth= 2.27"
 Routed to Pond 9P : Moline Wetland

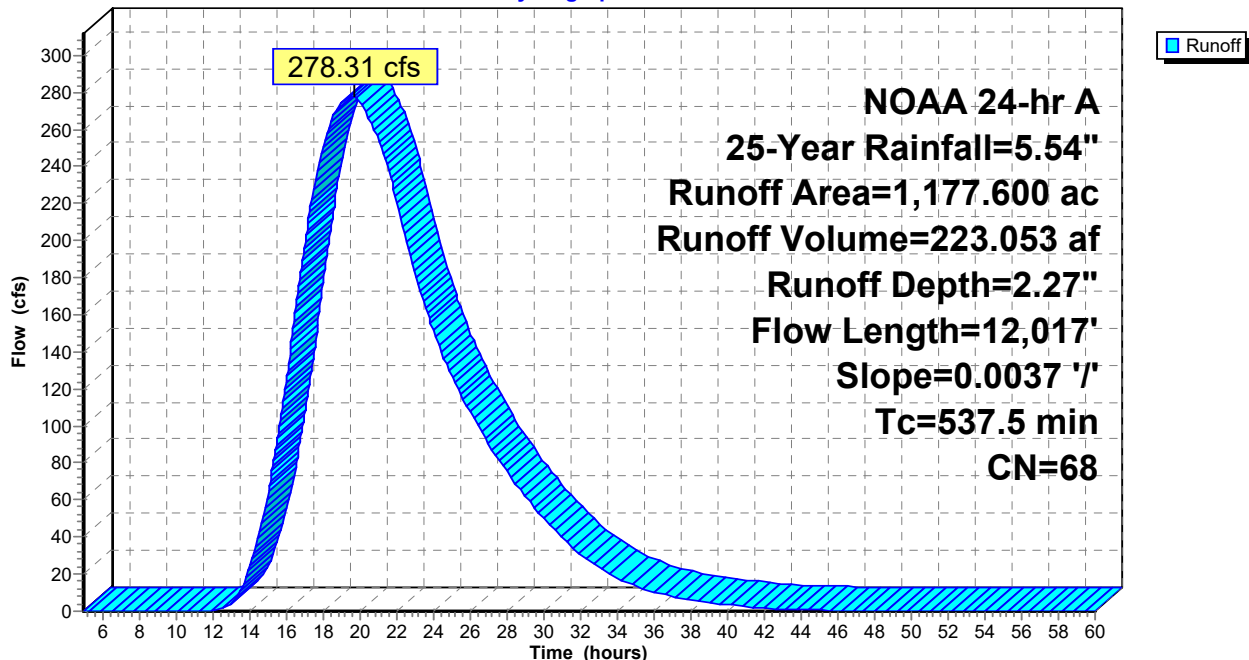
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-60.00 hrs, dt= 0.05 hrs
 NOAA 24-hr A 25-Year Rainfall=5.54"

Area (ac)	CN	Description
1,177.600	68	Pasture/grassland/range, Poor, HSG A
1,177.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
537.5	12,017	0.0037	0.37		Lag/CN Method,

Subcatchment 5S: Watershed to Creek South of Moline

Hydrograph



Hydrograph for Subcatchment 5S: Watershed to Creek South of Moline

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.24	0.00	0.00	34.00	5.54	2.27	17.85
5.50	0.27	0.00	0.00	34.50	5.54	2.27	15.54
6.00	0.30	0.00	0.00	35.00	5.54	2.27	13.59
6.50	0.33	0.00	0.00	35.50	5.54	2.27	11.85
7.00	0.37	0.00	0.00	36.00	5.54	2.27	10.31
7.50	0.42	0.00	0.00	36.50	5.54	2.27	9.03
8.00	0.47	0.00	0.00	37.00	5.54	2.27	7.86
8.50	0.53	0.00	0.00	37.50	5.54	2.27	6.85
9.00	0.59	0.00	0.00	38.00	5.54	2.27	6.00
9.50	0.66	0.00	0.00	38.50	5.54	2.27	5.27
10.00	0.76	0.00	0.00	39.00	5.54	2.27	4.62
10.50	0.88	0.00	0.00	39.50	5.54	2.27	4.02
11.00	1.06	0.00	0.00	40.00	5.54	2.27	3.48
11.50	1.38	0.04	0.00	40.50	5.54	2.27	2.98
12.00	2.58	0.43	0.13	41.00	5.54	2.27	2.53
12.50	4.16	1.31	1.29	41.50	5.54	2.27	2.09
13.00	4.48	1.52	3.86	42.00	5.54	2.27	1.70
13.50	4.66	1.64	10.50	42.50	5.54	2.27	1.36
14.00	4.78	1.73	22.56	43.00	5.54	2.27	1.03
14.50	4.88	1.79	39.94	43.50	5.54	2.27	0.88
15.00	4.95	1.85	61.91	44.00	5.54	2.27	0.74
15.50	5.01	1.89	89.81	44.50	5.54	2.27	0.62
16.00	5.07	1.93	123.44	45.00	5.54	2.27	0.52
16.50	5.12	1.97	160.50	45.50	5.54	2.27	0.44
17.00	5.17	2.00	195.87	46.00	5.54	2.27	0.37
17.50	5.21	2.03	226.14	46.50	5.54	2.27	0.31
18.00	5.24	2.05	249.89	47.00	5.54	2.27	0.26
18.50	5.27	2.08	266.70	47.50	5.54	2.27	0.22
19.00	5.30	2.10	273.91	48.00	5.54	2.27	0.18
19.50	5.33	2.12	277.36	48.50	5.54	2.27	0.15
20.00	5.36	2.14	274.34	49.00	5.54	2.27	0.12
20.50	5.39	2.16	266.13	49.50	5.54	2.27	0.10
21.00	5.41	2.18	255.09	50.00	5.54	2.27	0.08
21.50	5.44	2.20	240.58	50.50	5.54	2.27	0.06
22.00	5.46	2.21	223.00	51.00	5.54	2.27	0.05
22.50	5.48	2.23	202.67	51.50	5.54	2.27	0.03
23.00	5.50	2.24	183.21	52.00	5.54	2.27	0.02
23.50	5.52	2.26	166.22	52.50	5.54	2.27	0.01
24.00	5.54	2.27	151.74	53.00	5.54	2.27	0.01
24.50	5.54	2.27	138.75	53.50	5.54	2.27	0.00
25.00	5.54	2.27	127.25	54.00	5.54	2.27	0.00
25.50	5.54	2.27	117.17	54.50	5.54	2.27	0.00
26.00	5.54	2.27	107.87	55.00	5.54	2.27	0.00
26.50	5.54	2.27	99.06	55.50	5.54	2.27	0.00
27.00	5.54	2.27	90.66	56.00	5.54	2.27	0.00
27.50	5.54	2.27	82.84	56.50	5.54	2.27	0.00
28.00	5.54	2.27	75.85	57.00	5.54	2.27	0.00
28.50	5.54	2.27	68.92	57.50	5.54	2.27	0.00
29.00	5.54	2.27	62.40	58.00	5.54	2.27	0.00
29.50	5.54	2.27	56.16	58.50	5.54	2.27	0.00
30.00	5.54	2.27	50.21	59.00	5.54	2.27	0.00
30.50	5.54	2.27	44.84	59.50	5.54	2.27	0.00
31.00	5.54	2.27	39.55	60.00	5.54	2.27	0.00
31.50	5.54	2.27	34.97				
32.00	5.54	2.27	30.76				
32.50	5.54	2.27	26.94				
33.00	5.54	2.27	23.52				
33.50	5.54	2.27	20.44				

Summary for Pond 9P: Moline Wetland

Modeling was performed assuming the wetland at FSL at the beginning of the rain event, 1208.0'.

Inflow Area = 1,226.700 ac, 0.00% Impervious, Inflow Depth = 2.31" for 25-Year event
 Inflow = 280.76 cfs @ 19.69 hrs, Volume= 236.047 af
 Outflow = 279.91 cfs @ 19.78 hrs, Volume= 236.046 af, Atten= 0%, Lag= 5.2 min
 Primary = 7.33 cfs @ 19.78 hrs, Volume= 9.451 af
 Secondary = 272.57 cfs @ 19.78 hrs, Volume= 226.595 af

Routing by Stor-Ind method, Time Span= 5.00-60.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,208.00' Surf.Area= 6.304 ac Storage= 9.565 af
 Peak Elev= 1,209.19' @ 19.78 hrs Surf.Area= 6.904 ac Storage= 17.348 af (7.783 af above start)

Plug-Flow detention time= 85.5 min calculated for 226.481 af (96% of inflow)
 Center-of-Mass det. time= 27.5 min (1,320.0 - 1,292.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,205.00'	23.614 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,205.00	0.010	0.000	0.000
1,206.00	0.558	0.284	0.284
1,207.00	5.850	3.204	3.488
1,208.00	6.304	6.077	9.565
1,209.10	6.712	7.159	16.724
1,210.00	8.599	6.890	23.614

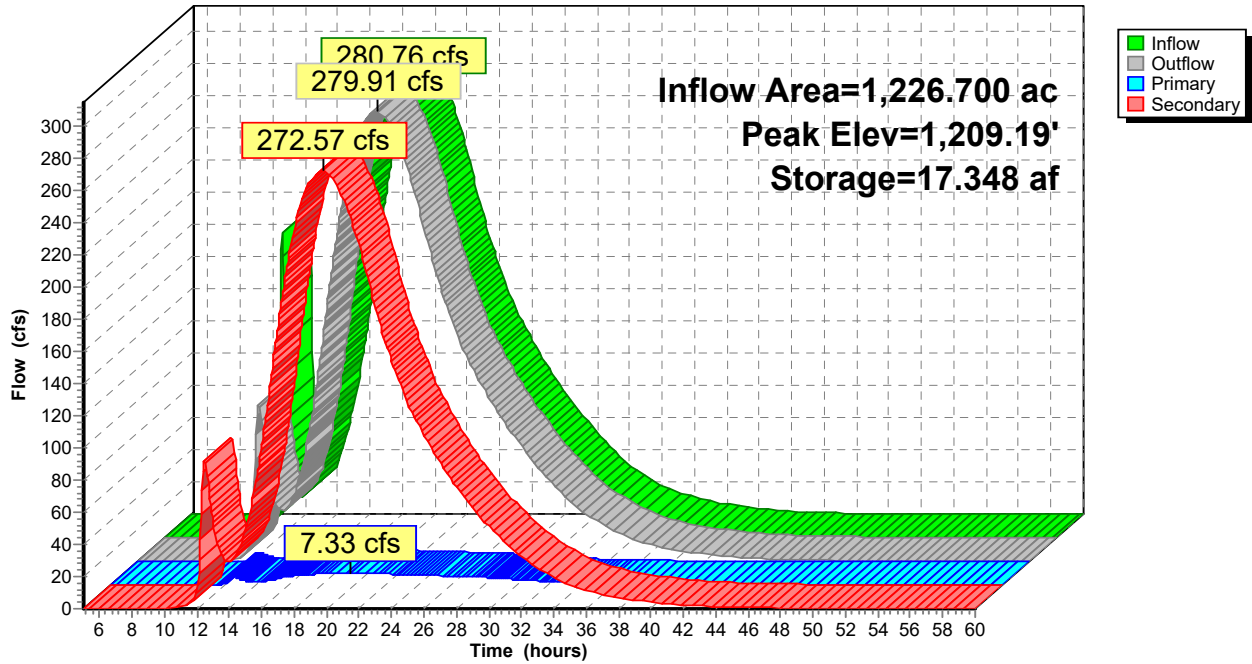
Device	Routing	Invert	Outlet Devices
#1	Primary	1,205.00'	18.0" Round CMP_Round 18" Outlet L= 39.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,205.00' / 1,205.00' S= 0.0000 '/' Cc= 0.900 n= 0.021 Corrugated metal, Flow Area= 1.77 sf
#2	Device 1	1,208.00'	3.5' long 48" Riser Stoplogs 0 End Contraction(s)
#3	Device 2	1,205.00'	18.0" Round CMP_Round 18" Inlet L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,205.00' / 1,205.00' S= 0.0000 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.77 sf
#4	Secondary	1,208.00'	45' Spillway, C= 3.27 Offset (feet) -62.50 -22.50 22.50 62.50 Height (feet) 2.00 0.00 0.00 2.00

Primary OutFlow Max=7.33 cfs @ 19.78 hrs HW=1,209.19' (Free Discharge)
 ↑1=CMP_Round 18" Outlet (Passes 7.33 cfs of 12.00 cfs potential flow)
 ↑2=48" Riser Stoplogs (Passes 7.33 cfs of 14.89 cfs potential flow)
 ↑3=CMP_Round 18" Inlet (Inlet Controls 7.33 cfs @ 4.15 fps)

Secondary OutFlow Max=272.50 cfs @ 19.78 hrs HW=1,209.19' (Free Discharge)
 ↑4=45' Spillway (Weir Controls 272.50 cfs @ 2.47 fps)

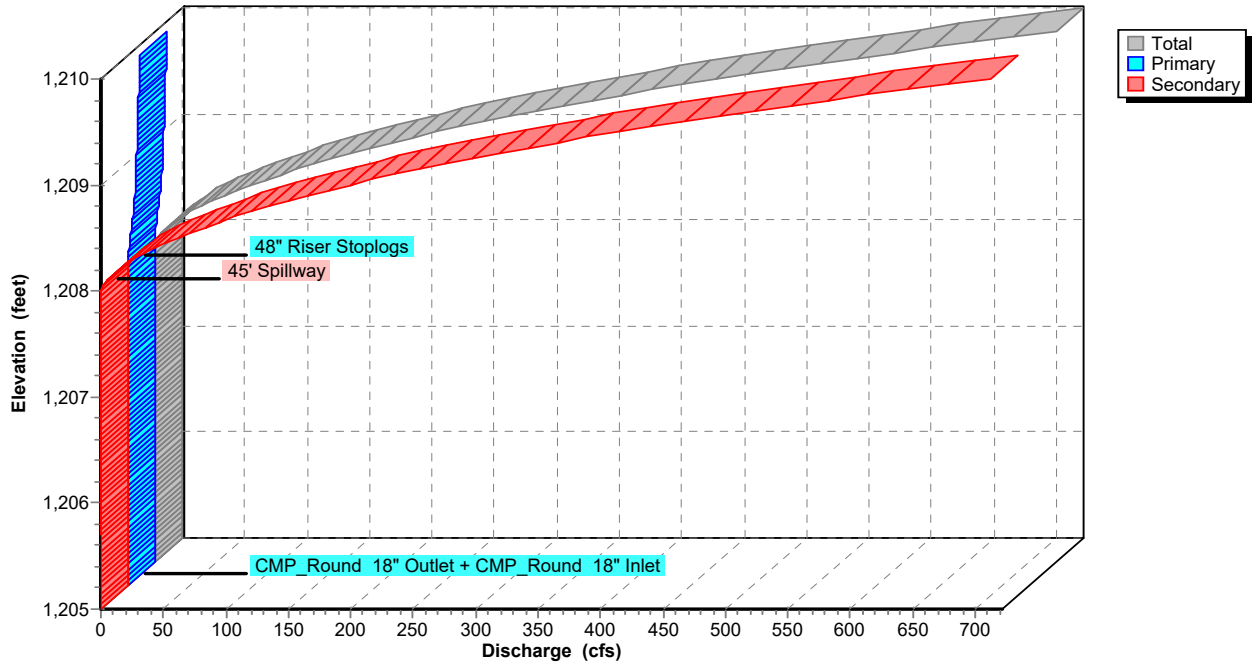
Pond 9P: Moline Wetland

Hydrograph

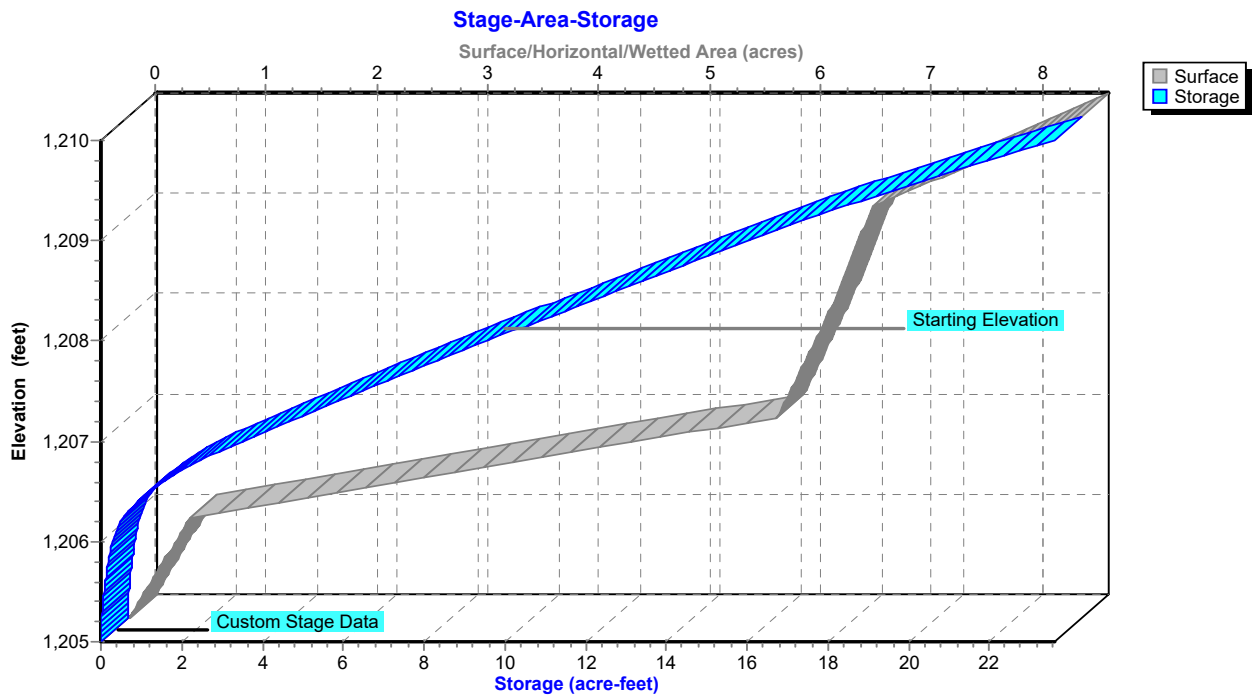


Pond 9P: Moline Wetland

Stage-Discharge



Pond 9P: Moline Wetland



Hydrograph for Pond 9P: Moline Wetland

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
5.00	0.00	9.565	1,208.00	0.00	0.00	0.00
6.00	0.00	9.565	1,208.00	0.00	0.00	0.00
7.00	0.00	9.565	1,208.00	0.00	0.00	0.00
8.00	0.00	9.565	1,208.00	0.00	0.00	0.00
9.00	0.01	9.565	1,208.00	0.00	0.00	0.00
10.00	0.93	9.591	1,208.00	0.15	0.01	0.14
11.00	4.18	9.726	1,208.03	0.92	0.07	0.86
12.00	57.13	10.745	1,208.19	13.61	0.92	12.68
13.00	30.50	12.492	1,208.46	56.67	3.55	53.12
14.00	32.39	11.555	1,208.31	30.68	2.01	28.67
15.00	68.21	12.364	1,208.44	52.76	3.33	49.44
16.00	128.12	13.917	1,208.68	107.30	5.53	101.77
17.00	199.71	15.590	1,208.93	182.27	6.48	175.79
18.00	252.88	16.722	1,209.10	243.12	7.04	236.07
19.00	276.51	17.238	1,209.18	273.34	7.28	266.06
20.00	276.72	17.327	1,209.19	278.65	7.32	271.33
21.00	257.26	17.048	1,209.15	262.07	7.20	254.87
22.00	224.96	16.532	1,209.07	232.38	6.95	225.43
23.00	184.96	15.816	1,208.96	193.77	6.60	187.17
24.00	153.29	15.145	1,208.86	160.55	6.24	154.31
25.00	127.25	14.555	1,208.77	133.78	5.91	127.87
26.00	107.87	14.070	1,208.70	113.30	5.62	107.68
27.00	90.66	13.623	1,208.63	95.98	5.34	90.64
28.00	75.85	13.205	1,208.57	80.64	4.86	75.78
29.00	62.40	12.813	1,208.51	67.01	4.14	62.87
30.00	50.21	12.430	1,208.45	54.72	3.44	51.28
31.00	39.55	12.064	1,208.39	44.00	2.81	41.19
32.00	30.76	11.719	1,208.34	34.75	2.25	32.50
33.00	23.52	11.405	1,208.29	27.11	1.78	25.33
34.00	17.85	11.127	1,208.25	20.95	1.40	19.55
35.00	13.59	10.887	1,208.21	16.19	1.09	15.10
36.00	10.31	10.685	1,208.18	12.59	0.86	11.73
37.00	7.86	10.517	1,208.15	9.70	0.67	9.04
38.00	6.00	10.371	1,208.13	7.63	0.53	7.10
39.00	4.62	10.250	1,208.11	5.92	0.41	5.51
40.00	3.48	10.150	1,208.09	4.67	0.33	4.35
41.00	2.53	10.053	1,208.08	3.65	0.26	3.39
42.00	1.70	9.965	1,208.06	2.70	0.19	2.51
43.00	1.03	9.889	1,208.05	1.89	0.13	1.75
44.00	0.74	9.824	1,208.04	1.48	0.10	1.37
45.00	0.52	9.767	1,208.03	1.15	0.08	1.07
46.00	0.37	9.720	1,208.02	0.88	0.06	0.82
47.00	0.26	9.682	1,208.02	0.67	0.05	0.62
48.00	0.18	9.652	1,208.01	0.50	0.04	0.46
49.00	0.12	9.629	1,208.01	0.36	0.03	0.34
50.00	0.08	9.611	1,208.01	0.26	0.02	0.25
51.00	0.05	9.598	1,208.01	0.19	0.01	0.17
52.00	0.02	9.588	1,208.00	0.13	0.01	0.12
53.00	0.01	9.580	1,208.00	0.09	0.01	0.08
54.00	0.00	9.575	1,208.00	0.05	0.00	0.05
55.00	0.00	9.571	1,208.00	0.03	0.00	0.03
56.00	0.00	9.569	1,208.00	0.02	0.00	0.02
57.00	0.00	9.567	1,208.00	0.01	0.00	0.01
58.00	0.00	9.566	1,208.00	0.01	0.00	0.01
59.00	0.00	9.566	1,208.00	0.01	0.00	0.00
60.00	0.00	9.566	1,208.00	0.00	0.00	0.00

Stage-Discharge for Pond 9P: Moline Wetland

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
1,205.00	0.00	0.00	0.00	1,207.90	0.00	0.00	0.00
1,205.05	0.00	0.00	0.00	1,207.95	0.00	0.00	0.00
1,205.10	0.00	0.00	0.00	1,208.00	0.00	0.00	0.00
1,205.15	0.00	0.00	0.00	1,208.05	1.80	0.13	1.67
1,205.20	0.00	0.00	0.00	1,208.10	5.18	0.36	4.82
1,205.25	0.00	0.00	0.00	1,208.15	9.67	0.66	9.00
1,205.30	0.00	0.00	0.00	1,208.20	15.12	1.02	14.10
1,205.35	0.00	0.00	0.00	1,208.25	21.46	1.43	20.03
1,205.40	0.00	0.00	0.00	1,208.30	28.64	1.88	26.76
1,205.45	0.00	0.00	0.00	1,208.35	36.63	2.37	34.26
1,205.50	0.00	0.00	0.00	1,208.40	45.42	2.90	42.52
1,205.55	0.00	0.00	0.00	1,208.45	54.98	3.45	51.53
1,205.60	0.00	0.00	0.00	1,208.50	65.32	4.05	61.27
1,205.65	0.00	0.00	0.00	1,208.55	76.43	4.67	71.76
1,205.70	0.00	0.00	0.00	1,208.60	88.18	5.20	82.98
1,205.75	0.00	0.00	0.00	1,208.65	100.35	5.42	94.94
1,205.80	0.00	0.00	0.00	1,208.70	113.25	5.62	107.63
1,205.85	0.00	0.00	0.00	1,208.75	126.88	5.82	121.06
1,205.90	0.00	0.00	0.00	1,208.80	141.25	6.01	135.24
1,205.95	0.00	0.00	0.00	1,208.85	156.36	6.19	150.17
1,206.00	0.00	0.00	0.00	1,208.90	172.22	6.37	165.84
1,206.05	0.00	0.00	0.00	1,208.95	188.82	6.55	182.28
1,206.10	0.00	0.00	0.00	1,209.00	206.19	6.72	199.47
1,206.15	0.00	0.00	0.00	1,209.05	224.31	6.88	217.43
1,206.20	0.00	0.00	0.00	1,209.10	243.21	7.05	236.16
1,206.25	0.00	0.00	0.00	1,209.15	262.88	7.20	255.67
1,206.30	0.00	0.00	0.00	1,209.20	283.32	7.36	275.97
1,206.35	0.00	0.00	0.00	1,209.25	304.56	7.51	297.05
1,206.40	0.00	0.00	0.00	1,209.30	326.58	7.66	318.93
1,206.45	0.00	0.00	0.00	1,209.35	349.41	7.80	341.60
1,206.50	0.00	0.00	0.00	1,209.40	373.04	7.95	365.09
1,206.55	0.00	0.00	0.00	1,209.45	397.48	8.09	389.39
1,206.60	0.00	0.00	0.00	1,209.50	422.74	8.23	414.51
1,206.65	0.00	0.00	0.00	1,209.55	448.82	8.36	440.45
1,206.70	0.00	0.00	0.00	1,209.60	475.73	8.50	467.23
1,206.75	0.00	0.00	0.00	1,209.65	503.48	8.63	494.85
1,206.80	0.00	0.00	0.00	1,209.70	532.07	8.76	523.31
1,206.85	0.00	0.00	0.00	1,209.75	561.51	8.89	552.62
1,206.90	0.00	0.00	0.00	1,209.80	591.80	9.01	582.79
1,206.95	0.00	0.00	0.00	1,209.85	622.96	9.14	613.82
1,207.00	0.00	0.00	0.00	1,209.90	654.99	9.26	645.73
1,207.05	0.00	0.00	0.00	1,209.95	687.89	9.38	678.51
1,207.10	0.00	0.00	0.00	1,210.00	721.67	9.50	712.17
1,207.15	0.00	0.00	0.00				
1,207.20	0.00	0.00	0.00				
1,207.25	0.00	0.00	0.00				
1,207.30	0.00	0.00	0.00				
1,207.35	0.00	0.00	0.00				
1,207.40	0.00	0.00	0.00				
1,207.45	0.00	0.00	0.00				
1,207.50	0.00	0.00	0.00				
1,207.55	0.00	0.00	0.00				
1,207.60	0.00	0.00	0.00				
1,207.65	0.00	0.00	0.00				
1,207.70	0.00	0.00	0.00				
1,207.75	0.00	0.00	0.00				
1,207.80	0.00	0.00	0.00				
1,207.85	0.00	0.00	0.00				

Stage-Area-Storage for Pond 9P: Moline Wetland

Elevation (feet)	Surface (acres)	Storage (acre-feet)	Elevation (feet)	Surface (acres)	Storage (acre-feet)
1,205.00	0.010	0.000	1,207.90	6.259	8.937
1,205.05	0.037	0.001	1,207.95	6.281	9.250
1,205.10	0.065	0.004	1,208.00	6.304	9.565
1,205.15	0.092	0.008	1,208.05	6.323	9.881
1,205.20	0.120	0.013	1,208.10	6.341	10.197
1,205.25	0.147	0.020	1,208.15	6.360	10.515
1,205.30	0.174	0.028	1,208.20	6.378	10.833
1,205.35	0.202	0.037	1,208.25	6.397	11.153
1,205.40	0.229	0.048	1,208.30	6.415	11.473
1,205.45	0.257	0.060	1,208.35	6.434	11.794
1,205.50	0.284	0.074	1,208.40	6.452	12.116
1,205.55	0.311	0.088	1,208.45	6.471	12.439
1,205.60	0.339	0.105	1,208.50	6.489	12.763
1,205.65	0.366	0.122	1,208.55	6.508	13.088
1,205.70	0.394	0.141	1,208.60	6.527	13.414
1,205.75	0.421	0.162	1,208.65	6.545	13.741
1,205.80	0.448	0.183	1,208.70	6.564	14.069
1,205.85	0.476	0.206	1,208.75	6.582	14.397
1,205.90	0.503	0.231	1,208.80	6.601	14.727
1,205.95	0.531	0.257	1,208.85	6.619	15.057
1,206.00	0.558	0.284	1,208.90	6.638	15.389
1,206.05	0.823	0.319	1,208.95	6.656	15.721
1,206.10	1.087	0.366	1,209.00	6.675	16.054
1,206.15	1.352	0.427	1,209.05	6.693	16.389
1,206.20	1.616	0.501	1,209.10	6.712	16.724
1,206.25	1.881	0.589	1,209.15	6.817	17.062
1,206.30	2.146	0.690	1,209.20	6.922	17.405
1,206.35	2.410	0.803	1,209.25	7.026	17.754
1,206.40	2.675	0.931	1,209.30	7.131	18.108
1,206.45	2.939	1.071	1,209.35	7.236	18.467
1,206.50	3.204	1.225	1,209.40	7.341	18.832
1,206.55	3.469	1.391	1,209.45	7.446	19.201
1,206.60	3.733	1.571	1,209.50	7.551	19.576
1,206.65	3.998	1.765	1,209.55	7.655	19.956
1,206.70	4.262	1.971	1,209.60	7.760	20.342
1,206.75	4.527	2.191	1,209.65	7.865	20.733
1,206.80	4.792	2.424	1,209.70	7.970	21.128
1,206.85	5.056	2.670	1,209.75	8.075	21.530
1,206.90	5.321	2.929	1,209.80	8.180	21.936
1,206.95	5.585	3.202	1,209.85	8.284	22.347
1,207.00	5.850	3.488	1,209.90	8.389	22.764
1,207.05	5.873	3.781	1,209.95	8.494	23.186
1,207.10	5.895	4.075	1,210.00	8.599	23.614
1,207.15	5.918	4.371			
1,207.20	5.941	4.667			
1,207.25	5.964	4.965			
1,207.30	5.986	5.263			
1,207.35	6.009	5.563			
1,207.40	6.032	5.864			
1,207.45	6.054	6.166			
1,207.50	6.077	6.470			
1,207.55	6.100	6.774			
1,207.60	6.122	7.080			
1,207.65	6.145	7.386			
1,207.70	6.168	7.694			
1,207.75	6.191	8.003			
1,207.80	6.213	8.313			
1,207.85	6.236	8.625			

Time span=5.00-60.00 hrs, dt=0.05 hrs, 1101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: Rainfall into Wetland Runoff Area=49.100 ac 0.00% Impervious Runoff Depth=5.03"
Flow Length=300' Slope=0.0030 '/' Tc=15.7 min CN=78 Runoff=295.99 cfs 20.588 af

Subcatchment 5S: Watershed to Runoff Area=1,177.600 ac 0.00% Impervious Runoff Depth=3.91"
Flow Length=12,017' Slope=0.0037 '/' Tc=537.5 min CN=68 Runoff=483.66 cfs 383.685 af

Pond 9P: Moline Wetland Peak Elev=1,209.62' Storage=20.495 af Inflow=487.23 cfs 404.273 af
Primary=8.55 cfs 11.935 af Secondary=478.12 cfs 392.337 af Outflow=486.67 cfs 404.272 af

Total Runoff Area = 1,226.700 ac Runoff Volume = 404.273 af Average Runoff Depth = 3.95"
100.00% Pervious = 1,226.700 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: Rainfall into Wetland

Runoff = 295.99 cfs @ 12.24 hrs, Volume= 20.588 af, Depth= 5.03"
 Routed to Pond 9P : Moline Wetland

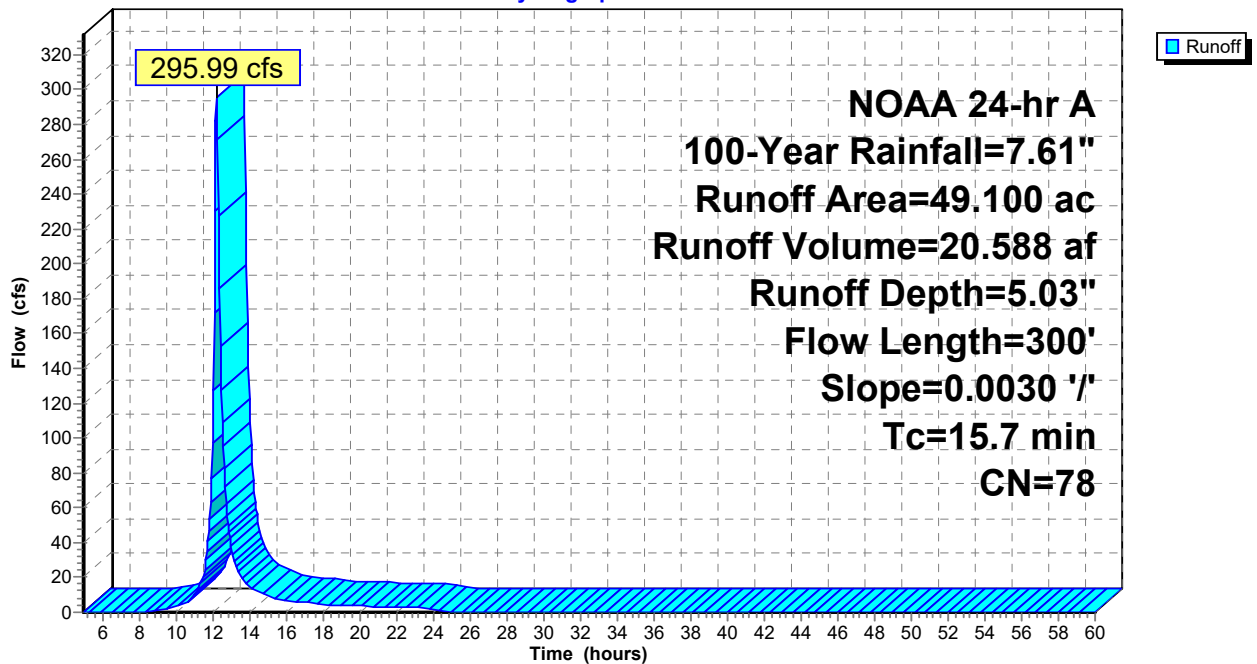
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-60.00 hrs, dt= 0.05 hrs
 NOAA 24-hr A 100-Year Rainfall=7.61"

Area (ac)	CN	Description
49.100	78	Row crops, straight row, Good, HSG B
49.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	300	0.0030	0.32		Sheet Flow, Cultivated: Residue<=20% n= 0.060 P2= 7.61"

Subcatchment 2S: Rainfall into Wetland

Hydrograph



Hydrograph for Subcatchment 2S: Rainfall into Wetland

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.32	0.00	0.00	34.00	7.61	5.03	0.00
5.50	0.37	0.00	0.00	34.50	7.61	5.03	0.00
6.00	0.41	0.00	0.00	35.00	7.61	5.03	0.00
6.50	0.46	0.00	0.00	35.50	7.61	5.03	0.00
7.00	0.51	0.00	0.00	36.00	7.61	5.03	0.00
7.50	0.58	0.00	0.00	36.50	7.61	5.03	0.00
8.00	0.65	0.00	0.23	37.00	7.61	5.03	0.00
8.50	0.72	0.01	0.61	37.50	7.61	5.03	0.00
9.00	0.81	0.02	1.06	38.00	7.61	5.03	0.00
9.50	0.91	0.04	1.85	38.50	7.61	5.03	0.00
10.00	1.04	0.07	3.15	39.00	7.61	5.03	0.00
10.50	1.20	0.12	4.89	39.50	7.61	5.03	0.00
11.00	1.45	0.21	9.35	40.00	7.61	5.03	0.00
11.50	1.89	0.43	21.47	40.50	7.61	5.03	0.00
12.00	3.55	1.54	96.94	41.00	7.61	5.03	0.00
12.50	5.72	3.33	127.83	41.50	7.61	5.03	0.00
13.00	6.16	3.72	39.52	42.00	7.61	5.03	0.00
13.50	6.41	3.94	21.73	42.50	7.61	5.03	0.00
14.00	6.57	4.08	14.45	43.00	7.61	5.03	0.00
14.50	6.70	4.20	11.81	43.50	7.61	5.03	0.00
15.00	6.80	4.30	9.24	44.00	7.61	5.03	0.00
15.50	6.89	4.37	7.48	44.50	7.61	5.03	0.00
16.00	6.96	4.44	6.85	45.00	7.61	5.03	0.00
16.50	7.03	4.51	6.24	45.50	7.61	5.03	0.00
17.00	7.10	4.56	5.62	46.00	7.61	5.03	0.00
17.50	7.15	4.61	4.99	46.50	7.61	5.03	0.00
18.00	7.20	4.66	4.37	47.00	7.61	5.03	0.00
18.50	7.24	4.70	3.94	47.50	7.61	5.03	0.00
19.00	7.29	4.74	3.78	48.00	7.61	5.03	0.00
19.50	7.33	4.77	3.63	48.50	7.61	5.03	0.00
20.00	7.36	4.81	3.47	49.00	7.61	5.03	0.00
20.50	7.40	4.84	3.32	49.50	7.61	5.03	0.00
21.00	7.44	4.87	3.16	50.00	7.61	5.03	0.00
21.50	7.47	4.90	3.00	50.50	7.61	5.03	0.00
22.00	7.50	4.93	2.85	51.00	7.61	5.03	0.00
22.50	7.53	4.96	2.69	51.50	7.61	5.03	0.00
23.00	7.56	4.98	2.53	52.00	7.61	5.03	0.00
23.50	7.58	5.01	2.37	52.50	7.61	5.03	0.00
24.00	7.61	5.03	2.25	53.00	7.61	5.03	0.00
24.50	7.61	5.03	0.09	53.50	7.61	5.03	0.00
25.00	7.61	5.03	0.00	54.00	7.61	5.03	0.00
25.50	7.61	5.03	0.00	54.50	7.61	5.03	0.00
26.00	7.61	5.03	0.00	55.00	7.61	5.03	0.00
26.50	7.61	5.03	0.00	55.50	7.61	5.03	0.00
27.00	7.61	5.03	0.00	56.00	7.61	5.03	0.00
27.50	7.61	5.03	0.00	56.50	7.61	5.03	0.00
28.00	7.61	5.03	0.00	57.00	7.61	5.03	0.00
28.50	7.61	5.03	0.00	57.50	7.61	5.03	0.00
29.00	7.61	5.03	0.00	58.00	7.61	5.03	0.00
29.50	7.61	5.03	0.00	58.50	7.61	5.03	0.00
30.00	7.61	5.03	0.00	59.00	7.61	5.03	0.00
30.50	7.61	5.03	0.00	59.50	7.61	5.03	0.00
31.00	7.61	5.03	0.00	60.00	7.61	5.03	0.00
31.50	7.61	5.03	0.00				
32.00	7.61	5.03	0.00				
32.50	7.61	5.03	0.00				
33.00	7.61	5.03	0.00				
33.50	7.61	5.03	0.00				

Summary for Subcatchment 5S: Watershed to Creek South of Moline

CN adjusted to correlate inflow volumetric flowrate with inflow volumetric flowrate for a 100-year event from StreamStats Report.

Based on existing 60" CMP culvert at adjacent road, upstream of grade stabilization structure, and FEMA flood map indicating 100-year flood event does not overtop road, it is likely peak flow for 100-year event down ditch/creek will be 240 cfs. Accordingly, modeling diagram and peak elevations for certain events are likely higher than what will actually be experienced on site.

Runoff = 483.66 cfs @ 19.68 hrs, Volume= 383.685 af, Depth= 3.91"
 Routed to Pond 9P : Moline Wetland

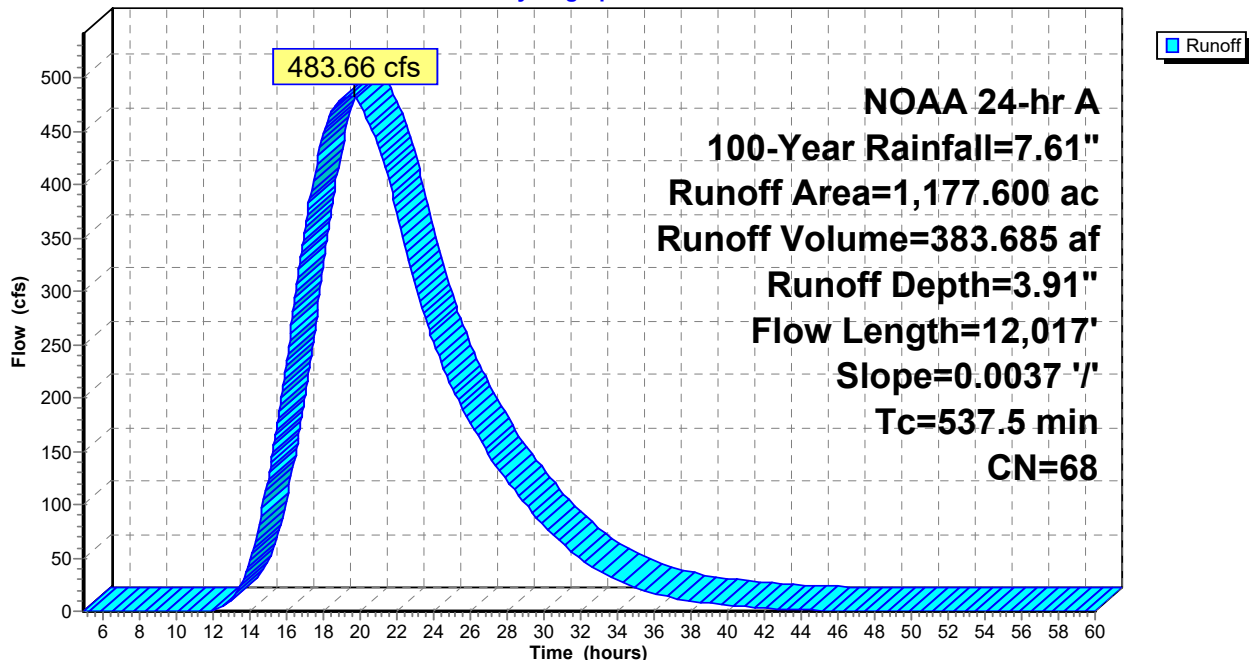
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-60.00 hrs, dt= 0.05 hrs
 NOAA 24-hr A 100-Year Rainfall=7.61"

Area (ac)	CN	Description
1,177.600	68	Pasture/grassland/range, Poor, HSG A
1,177.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
537.5	12,017	0.0037	0.37		Lag/CN Method,

Subcatchment 5S: Watershed to Creek South of Moline

Hydrograph



Hydrograph for Subcatchment 5S: Watershed to Creek South of Moline

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.32	0.00	0.00	34.00	7.61	3.91	28.73
5.50	0.37	0.00	0.00	34.50	7.61	3.91	25.00
6.00	0.41	0.00	0.00	35.00	7.61	3.91	21.86
6.50	0.46	0.00	0.00	35.50	7.61	3.91	19.07
7.00	0.51	0.00	0.00	36.00	7.61	3.91	16.59
7.50	0.58	0.00	0.00	36.50	7.61	3.91	14.52
8.00	0.65	0.00	0.00	37.00	7.61	3.91	12.66
8.50	0.72	0.00	0.00	37.50	7.61	3.91	11.02
9.00	0.81	0.00	0.00	38.00	7.61	3.91	9.66
9.50	0.91	0.00	0.00	38.50	7.61	3.91	8.49
10.00	1.04	0.00	0.00	39.00	7.61	3.91	7.44
10.50	1.20	0.01	0.00	39.50	7.61	3.91	6.46
11.00	1.45	0.05	0.05	40.00	7.61	3.91	5.59
11.50	1.89	0.16	0.19	40.50	7.61	3.91	4.76
12.00	3.55	0.93	0.73	41.00	7.61	3.91	4.01
12.50	5.72	2.40	3.63	41.50	7.61	3.91	3.30
13.00	6.16	2.74	9.79	42.00	7.61	3.91	2.66
13.50	6.41	2.94	23.22	42.50	7.61	3.91	2.11
14.00	6.57	3.06	46.26	43.00	7.61	3.91	1.59
14.50	6.70	3.17	78.74	43.50	7.61	3.91	1.35
15.00	6.80	3.25	119.40	44.00	7.61	3.91	1.13
15.50	6.89	3.32	170.29	44.50	7.61	3.91	0.95
16.00	6.96	3.38	229.84	45.00	7.61	3.91	0.81
16.50	7.03	3.44	294.00	45.50	7.61	3.91	0.67
17.00	7.10	3.49	354.22	46.00	7.61	3.91	0.57
17.50	7.15	3.53	404.83	46.50	7.61	3.91	0.47
18.00	7.20	3.57	443.55	47.00	7.61	3.91	0.40
18.50	7.24	3.61	470.28	47.50	7.61	3.91	0.33
19.00	7.29	3.64	479.90	48.00	7.61	3.91	0.28
19.50	7.33	3.68	483.05	48.50	7.61	3.91	0.23
20.00	7.36	3.71	475.27	49.00	7.61	3.91	0.18
20.50	7.40	3.74	458.66	49.50	7.61	3.91	0.15
21.00	7.44	3.77	437.13	50.00	7.61	3.91	0.12
21.50	7.47	3.79	409.72	50.50	7.61	3.91	0.09
22.00	7.50	3.82	377.72	51.00	7.61	3.91	0.07
22.50	7.53	3.84	341.83	51.50	7.61	3.91	0.05
23.00	7.56	3.87	307.78	52.00	7.61	3.91	0.03
23.50	7.58	3.89	278.15	52.50	7.61	3.91	0.02
24.00	7.61	3.91	253.00	53.00	7.61	3.91	0.01
24.50	7.61	3.91	230.55	53.50	7.61	3.91	0.01
25.00	7.61	3.91	210.74	54.00	7.61	3.91	0.00
25.50	7.61	3.91	193.34	54.50	7.61	3.91	0.00
26.00	7.61	3.91	177.38	55.00	7.61	3.91	0.00
26.50	7.61	3.91	162.35	55.50	7.61	3.91	0.00
27.00	7.61	3.91	148.13	56.00	7.61	3.91	0.00
27.50	7.61	3.91	134.95	56.50	7.61	3.91	0.00
28.00	7.61	3.91	123.24	57.00	7.61	3.91	0.00
28.50	7.61	3.91	111.73	57.50	7.61	3.91	0.00
29.00	7.61	3.91	100.98	58.00	7.61	3.91	0.00
29.50	7.61	3.91	90.72	58.50	7.61	3.91	0.00
30.00	7.61	3.91	80.98	59.00	7.61	3.91	0.00
30.50	7.61	3.91	72.24	59.50	7.61	3.91	0.00
31.00	7.61	3.91	63.67	60.00	7.61	3.91	0.00
31.50	7.61	3.91	56.27				
32.00	7.61	3.91	49.48				
32.50	7.61	3.91	43.34				
33.00	7.61	3.91	37.84				
33.50	7.61	3.91	32.88				

Summary for Pond 9P: Moline Wetland

Modeling was performed assuming the wetland at FSL at the beginning of the rain event, 1208.0'.

Inflow Area = 1,226.700 ac, 0.00% Impervious, Inflow Depth = 3.95" for 100-Year event
 Inflow = 487.23 cfs @ 19.68 hrs, Volume= 404.273 af
 Outflow = 486.67 cfs @ 19.72 hrs, Volume= 404.272 af, Atten= 0%, Lag= 2.5 min
 Primary = 8.55 cfs @ 19.72 hrs, Volume= 11.935 af
 Secondary = 478.12 cfs @ 19.72 hrs, Volume= 392.337 af

Routing by Stor-Ind method, Time Span= 5.00-60.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,208.00' Surf.Area= 6.304 ac Storage= 9.565 af
 Peak Elev= 1,209.62' @ 19.72 hrs Surf.Area= 7.802 ac Storage= 20.495 af (10.930 af above start)

Plug-Flow detention time= 57.5 min calculated for 394.349 af (98% of inflow)
 Center-of-Mass det. time= 22.3 min (1,304.8 - 1,282.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,205.00'	23.614 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,205.00	0.010	0.000	0.000
1,206.00	0.558	0.284	0.284
1,207.00	5.850	3.204	3.488
1,208.00	6.304	6.077	9.565
1,209.10	6.712	7.159	16.724
1,210.00	8.599	6.890	23.614

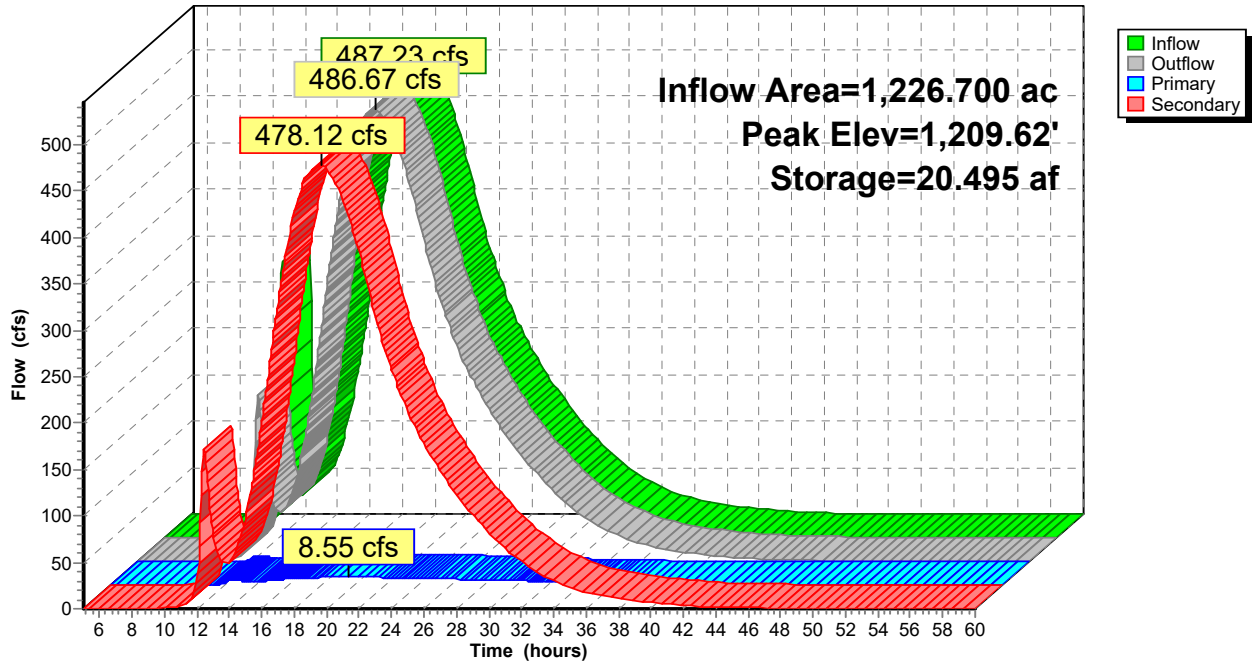
Device	Routing	Invert	Outlet Devices
#1	Primary	1,205.00'	18.0" Round CMP_Round 18" Outlet L= 39.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,205.00' / 1,205.00' S= 0.0000 '/' Cc= 0.900 n= 0.021 Corrugated metal, Flow Area= 1.77 sf
#2	Device 1	1,208.00'	3.5' long 48" Riser Stoplogs 0 End Contraction(s)
#3	Device 2	1,205.00'	18.0" Round CMP_Round 18" Inlet L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,205.00' / 1,205.00' S= 0.0000 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.77 sf
#4	Secondary	1,208.00'	45' Spillway, C= 3.27 Offset (feet) -62.50 -22.50 22.50 62.50 Height (feet) 2.00 0.00 0.00 2.00

Primary OutFlow Max=8.55 cfs @ 19.72 hrs HW=1,209.62' (Free Discharge)
 ↑ **1=CMP_Round 18" Outlet** (Passes 8.55 cfs of 12.92 cfs potential flow)
 ↑ **2=48" Riser Stoplogs** (Passes 8.55 cfs of 23.59 cfs potential flow)
 ↑ **3=CMP_Round 18" Inlet** (Inlet Controls 8.55 cfs @ 4.84 fps)

Secondary OutFlow Max=478.00 cfs @ 19.72 hrs HW=1,209.62' (Free Discharge)
 ↑ **4=45' Spillway** (Weir Controls 478.00 cfs @ 2.69 fps)

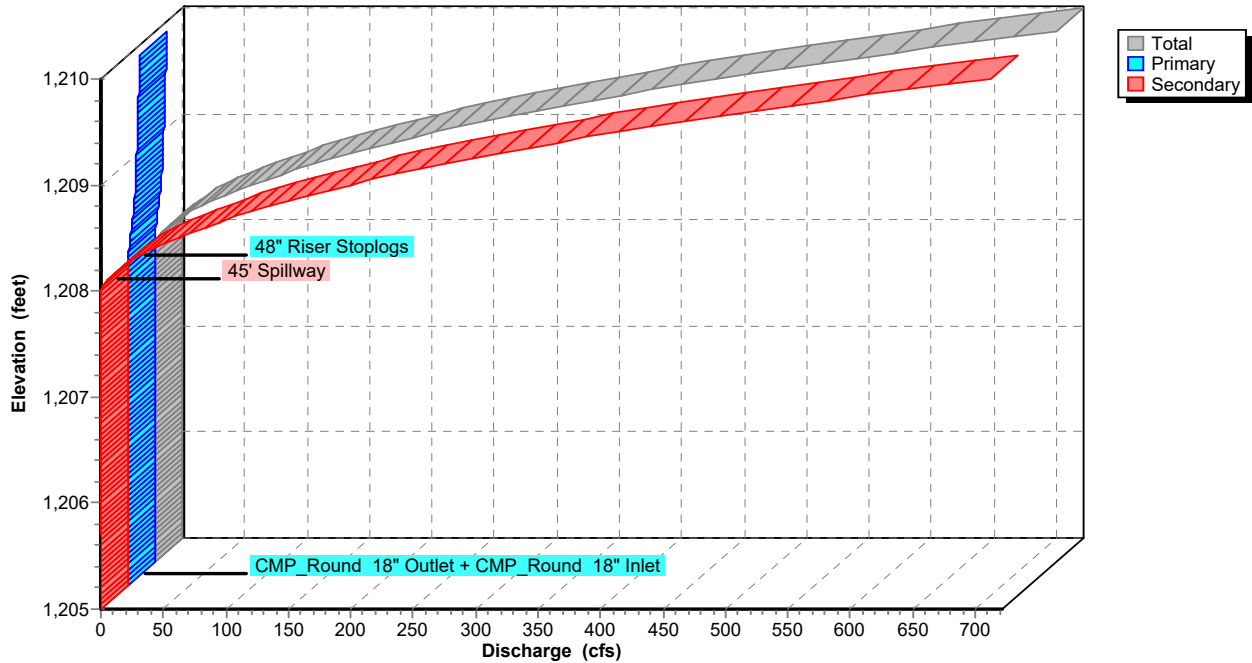
Pond 9P: Moline Wetland

Hydrograph

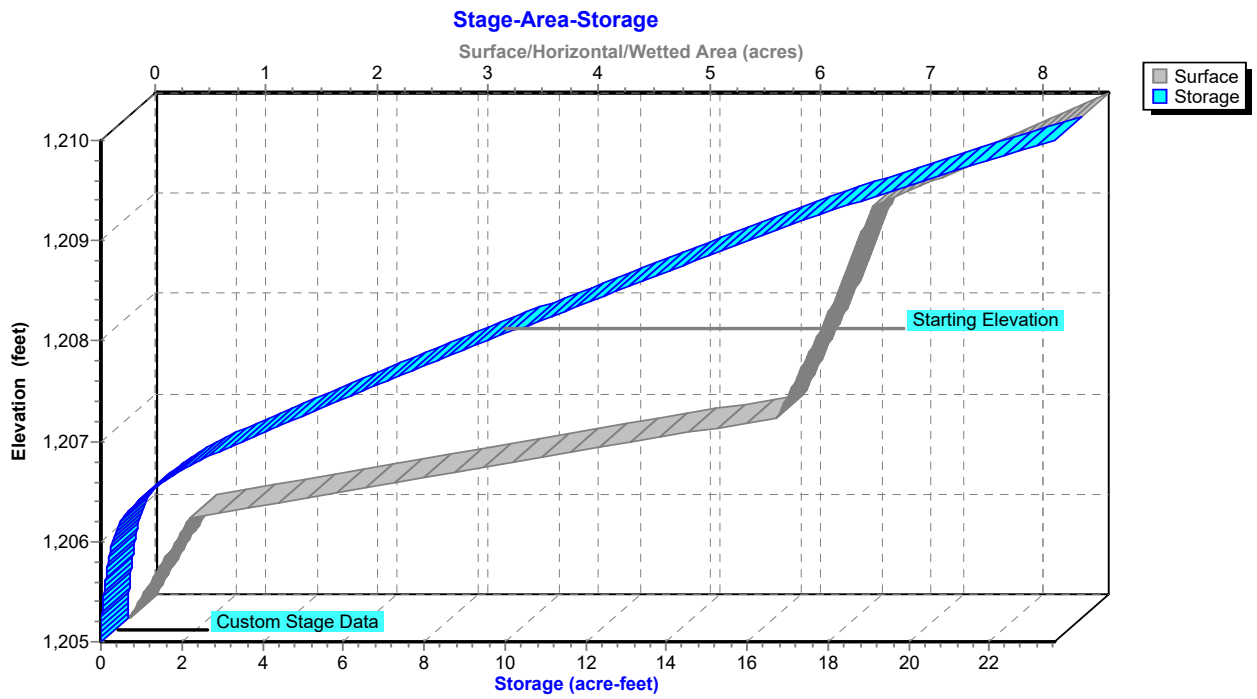


Pond 9P: Moline Wetland

Stage-Discharge



Pond 9P: Moline Wetland



Hydrograph for Pond 9P: Moline Wetland

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
5.00	0.00	9.565	1,208.00	0.00	0.00	0.00
6.00	0.00	9.565	1,208.00	0.00	0.00	0.00
7.00	0.00	9.565	1,208.00	0.00	0.00	0.00
8.00	0.23	9.568	1,208.00	0.02	0.00	0.02
9.00	1.06	9.610	1,208.01	0.26	0.02	0.24
10.00	3.15	9.726	1,208.03	0.92	0.07	0.85
11.00	9.40	10.023	1,208.07	3.32	0.23	3.09
12.00	97.67	11.628	1,208.32	32.49	2.12	30.37
13.00	49.31	13.355	1,208.59	86.06	5.11	80.96
14.00	60.71	12.367	1,208.44	52.84	3.33	49.51
15.00	128.64	13.843	1,208.67	104.38	5.48	98.90
16.00	236.68	16.100	1,209.01	208.65	6.74	201.91
17.00	359.84	18.277	1,209.32	337.34	7.73	329.61
18.00	447.92	19.759	1,209.52	435.25	8.29	426.96
19.00	483.68	20.406	1,209.61	480.25	8.52	471.74
20.00	478.75	20.440	1,209.61	482.71	8.53	474.18
21.00	440.29	19.950	1,209.55	448.35	8.36	439.99
22.00	380.56	19.120	1,209.44	392.09	8.06	384.04
23.00	310.31	18.051	1,209.29	323.02	7.64	315.39
24.00	255.25	17.102	1,209.16	265.26	7.22	258.04
25.00	210.74	16.301	1,209.04	219.56	6.84	212.72
26.00	177.38	15.642	1,208.94	184.85	6.51	178.35
27.00	148.13	15.034	1,208.85	155.27	6.18	149.09
28.00	123.24	14.465	1,208.76	129.81	5.86	123.95
29.00	100.98	13.921	1,208.68	107.44	5.53	101.91
30.00	80.98	13.388	1,208.60	87.25	5.16	82.09
31.00	63.67	12.891	1,208.52	69.68	4.29	65.39
32.00	49.48	12.430	1,208.45	54.72	3.44	51.28
33.00	37.84	12.014	1,208.38	42.61	2.73	39.89
34.00	28.73	11.644	1,208.33	32.90	2.14	30.76
35.00	21.86	11.327	1,208.28	25.37	1.68	23.70
36.00	16.59	11.059	1,208.24	19.60	1.31	18.29
37.00	12.66	10.834	1,208.20	15.13	1.02	14.11
38.00	9.66	10.639	1,208.17	11.80	0.80	10.99
39.00	7.44	10.481	1,208.14	9.20	0.63	8.57
40.00	5.59	10.341	1,208.12	7.21	0.50	6.71
41.00	4.01	10.215	1,208.10	5.43	0.38	5.05
42.00	2.66	10.096	1,208.08	4.10	0.29	3.81
43.00	1.59	9.983	1,208.07	2.89	0.20	2.69
44.00	1.13	9.896	1,208.05	1.97	0.14	1.83
45.00	0.81	9.833	1,208.04	1.53	0.11	1.42
46.00	0.57	9.777	1,208.03	1.21	0.09	1.12
47.00	0.40	9.728	1,208.03	0.93	0.07	0.87
48.00	0.28	9.688	1,208.02	0.70	0.05	0.65
49.00	0.18	9.657	1,208.01	0.52	0.04	0.49
50.00	0.12	9.632	1,208.01	0.38	0.03	0.36
51.00	0.07	9.613	1,208.01	0.27	0.02	0.25
52.00	0.03	9.598	1,208.01	0.19	0.01	0.18
53.00	0.01	9.587	1,208.00	0.13	0.01	0.12
54.00	0.00	9.579	1,208.00	0.08	0.01	0.07
55.00	0.00	9.574	1,208.00	0.05	0.00	0.05
56.00	0.00	9.570	1,208.00	0.03	0.00	0.03
57.00	0.00	9.568	1,208.00	0.02	0.00	0.02
58.00	0.00	9.567	1,208.00	0.01	0.00	0.01
59.00	0.00	9.566	1,208.00	0.01	0.00	0.01
60.00	0.00	9.566	1,208.00	0.00	0.00	0.00

Stage-Discharge for Pond 9P: Moline Wetland

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
1,205.00	0.00	0.00	0.00	1,207.90	0.00	0.00	0.00
1,205.05	0.00	0.00	0.00	1,207.95	0.00	0.00	0.00
1,205.10	0.00	0.00	0.00	1,208.00	0.00	0.00	0.00
1,205.15	0.00	0.00	0.00	1,208.05	1.80	0.13	1.67
1,205.20	0.00	0.00	0.00	1,208.10	5.18	0.36	4.82
1,205.25	0.00	0.00	0.00	1,208.15	9.67	0.66	9.00
1,205.30	0.00	0.00	0.00	1,208.20	15.12	1.02	14.10
1,205.35	0.00	0.00	0.00	1,208.25	21.46	1.43	20.03
1,205.40	0.00	0.00	0.00	1,208.30	28.64	1.88	26.76
1,205.45	0.00	0.00	0.00	1,208.35	36.63	2.37	34.26
1,205.50	0.00	0.00	0.00	1,208.40	45.42	2.90	42.52
1,205.55	0.00	0.00	0.00	1,208.45	54.98	3.45	51.53
1,205.60	0.00	0.00	0.00	1,208.50	65.32	4.05	61.27
1,205.65	0.00	0.00	0.00	1,208.55	76.43	4.67	71.76
1,205.70	0.00	0.00	0.00	1,208.60	88.18	5.20	82.98
1,205.75	0.00	0.00	0.00	1,208.65	100.35	5.42	94.94
1,205.80	0.00	0.00	0.00	1,208.70	113.25	5.62	107.63
1,205.85	0.00	0.00	0.00	1,208.75	126.88	5.82	121.06
1,205.90	0.00	0.00	0.00	1,208.80	141.25	6.01	135.24
1,205.95	0.00	0.00	0.00	1,208.85	156.36	6.19	150.17
1,206.00	0.00	0.00	0.00	1,208.90	172.22	6.37	165.84
1,206.05	0.00	0.00	0.00	1,208.95	188.82	6.55	182.28
1,206.10	0.00	0.00	0.00	1,209.00	206.19	6.72	199.47
1,206.15	0.00	0.00	0.00	1,209.05	224.31	6.88	217.43
1,206.20	0.00	0.00	0.00	1,209.10	243.21	7.05	236.16
1,206.25	0.00	0.00	0.00	1,209.15	262.88	7.20	255.67
1,206.30	0.00	0.00	0.00	1,209.20	283.32	7.36	275.97
1,206.35	0.00	0.00	0.00	1,209.25	304.56	7.51	297.05
1,206.40	0.00	0.00	0.00	1,209.30	326.58	7.66	318.93
1,206.45	0.00	0.00	0.00	1,209.35	349.41	7.80	341.60
1,206.50	0.00	0.00	0.00	1,209.40	373.04	7.95	365.09
1,206.55	0.00	0.00	0.00	1,209.45	397.48	8.09	389.39
1,206.60	0.00	0.00	0.00	1,209.50	422.74	8.23	414.51
1,206.65	0.00	0.00	0.00	1,209.55	448.82	8.36	440.45
1,206.70	0.00	0.00	0.00	1,209.60	475.73	8.50	467.23
1,206.75	0.00	0.00	0.00	1,209.65	503.48	8.63	494.85
1,206.80	0.00	0.00	0.00	1,209.70	532.07	8.76	523.31
1,206.85	0.00	0.00	0.00	1,209.75	561.51	8.89	552.62
1,206.90	0.00	0.00	0.00	1,209.80	591.80	9.01	582.79
1,206.95	0.00	0.00	0.00	1,209.85	622.96	9.14	613.82
1,207.00	0.00	0.00	0.00	1,209.90	654.99	9.26	645.73
1,207.05	0.00	0.00	0.00	1,209.95	687.89	9.38	678.51
1,207.10	0.00	0.00	0.00	1,210.00	721.67	9.50	712.17
1,207.15	0.00	0.00	0.00				
1,207.20	0.00	0.00	0.00				
1,207.25	0.00	0.00	0.00				
1,207.30	0.00	0.00	0.00				
1,207.35	0.00	0.00	0.00				
1,207.40	0.00	0.00	0.00				
1,207.45	0.00	0.00	0.00				
1,207.50	0.00	0.00	0.00				
1,207.55	0.00	0.00	0.00				
1,207.60	0.00	0.00	0.00				
1,207.65	0.00	0.00	0.00				
1,207.70	0.00	0.00	0.00				
1,207.75	0.00	0.00	0.00				
1,207.80	0.00	0.00	0.00				
1,207.85	0.00	0.00	0.00				

Stage-Area-Storage for Pond 9P: Moline Wetland

Elevation (feet)	Surface (acres)	Storage (acre-feet)	Elevation (feet)	Surface (acres)	Storage (acre-feet)
1,205.00	0.010	0.000	1,207.90	6.259	8.937
1,205.05	0.037	0.001	1,207.95	6.281	9.250
1,205.10	0.065	0.004	1,208.00	6.304	9.565
1,205.15	0.092	0.008	1,208.05	6.323	9.881
1,205.20	0.120	0.013	1,208.10	6.341	10.197
1,205.25	0.147	0.020	1,208.15	6.360	10.515
1,205.30	0.174	0.028	1,208.20	6.378	10.833
1,205.35	0.202	0.037	1,208.25	6.397	11.153
1,205.40	0.229	0.048	1,208.30	6.415	11.473
1,205.45	0.257	0.060	1,208.35	6.434	11.794
1,205.50	0.284	0.074	1,208.40	6.452	12.116
1,205.55	0.311	0.088	1,208.45	6.471	12.439
1,205.60	0.339	0.105	1,208.50	6.489	12.763
1,205.65	0.366	0.122	1,208.55	6.508	13.088
1,205.70	0.394	0.141	1,208.60	6.527	13.414
1,205.75	0.421	0.162	1,208.65	6.545	13.741
1,205.80	0.448	0.183	1,208.70	6.564	14.069
1,205.85	0.476	0.206	1,208.75	6.582	14.397
1,205.90	0.503	0.231	1,208.80	6.601	14.727
1,205.95	0.531	0.257	1,208.85	6.619	15.057
1,206.00	0.558	0.284	1,208.90	6.638	15.389
1,206.05	0.823	0.319	1,208.95	6.656	15.721
1,206.10	1.087	0.366	1,209.00	6.675	16.054
1,206.15	1.352	0.427	1,209.05	6.693	16.389
1,206.20	1.616	0.501	1,209.10	6.712	16.724
1,206.25	1.881	0.589	1,209.15	6.817	17.062
1,206.30	2.146	0.690	1,209.20	6.922	17.405
1,206.35	2.410	0.803	1,209.25	7.026	17.754
1,206.40	2.675	0.931	1,209.30	7.131	18.108
1,206.45	2.939	1.071	1,209.35	7.236	18.467
1,206.50	3.204	1.225	1,209.40	7.341	18.832
1,206.55	3.469	1.391	1,209.45	7.446	19.201
1,206.60	3.733	1.571	1,209.50	7.551	19.576
1,206.65	3.998	1.765	1,209.55	7.655	19.956
1,206.70	4.262	1.971	1,209.60	7.760	20.342
1,206.75	4.527	2.191	1,209.65	7.865	20.733
1,206.80	4.792	2.424	1,209.70	7.970	21.128
1,206.85	5.056	2.670	1,209.75	8.075	21.530
1,206.90	5.321	2.929	1,209.80	8.180	21.936
1,206.95	5.585	3.202	1,209.85	8.284	22.347
1,207.00	5.850	3.488	1,209.90	8.389	22.764
1,207.05	5.873	3.781	1,209.95	8.494	23.186
1,207.10	5.895	4.075	1,210.00	8.599	23.614
1,207.15	5.918	4.371			
1,207.20	5.941	4.667			
1,207.25	5.964	4.965			
1,207.30	5.986	5.263			
1,207.35	6.009	5.563			
1,207.40	6.032	5.864			
1,207.45	6.054	6.166			
1,207.50	6.077	6.470			
1,207.55	6.100	6.774			
1,207.60	6.122	7.080			
1,207.65	6.145	7.386			
1,207.70	6.168	7.694			
1,207.75	6.191	8.003			
1,207.80	6.213	8.313			
1,207.85	6.236	8.625			

Events for Subcatchment 2S: Rainfall into Wetland

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
25-Year	5.54	188.76	12.994	3.18
100-Year	7.61	295.99	20.588	5.03

Events for Subcatchment 5S: Watershed to Creek South of Moline

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
25-Year	5.54	278.31	223.053	2.27
100-Year	7.61	483.66	383.685	3.91

Events for Pond 9P: Moline Wetland

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
25-Year	280.76	279.91	7.33	272.57	1,209.19	17.348
100-Year	487.23	486.67	8.55	478.12	1,209.62	20.495

TABLE OF CONTENTS

Project Reports

- 1 Routing Diagram
- 2 Rainfall Events Listing (selected events)
- 3 Area Listing (all nodes)
- 4 Soil Listing (all nodes)
- 5 Ground Covers (all nodes)
- 6 Pipe Listing (all nodes)
- 7 Notes Listing (all nodes)

25-Year Event

- 8 Node Listing
- 9 Subcat 2S: Rainfall into Wetland
- 11 Subcat 5S: Watershed to Creek South of Moline
- 13 Pond 9P: Moline Wetland

100-Year Event

- 19 Node Listing
- 20 Subcat 2S: Rainfall into Wetland
- 22 Subcat 5S: Watershed to Creek South of Moline
- 24 Pond 9P: Moline Wetland

Multi-Event Tables

- 30 Subcat 2S: Rainfall into Wetland
- 31 Subcat 5S: Watershed to Creek South of Moline
- 32 Pond 9P: Moline Wetland

SECTION 2
HEC-RAS ANALYSIS

EXISTING-MIXED FLOW

3/16/21 1/2

HEC-RAS Plan: Plan 02 River: molene creek Reach: wetland												
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Crl
wetland	16	PF 1	100.00	1211.00	1214.75	1213.26	1214.88	0.001697	2.91	34.38	17.61	0.37
wetland	16	PF 2	200.00	1211.00	1215.78	1214.25	1215.96	0.002086	3.46	58.05	30.08	0.42
wetland	16	PF 3	300.00	1211.00	1216.45	1214.89	1216.68	0.001836	3.83	82.15	41.81	0.41
wetland	16	PF 4	400.00	1211.00	1216.93	1215.49	1217.20	0.001792	4.22	104.32	50.75	0.42
wetland	16	PF 5	500.00	1211.00	1217.33	1215.89	1217.64	0.001752	4.54	125.12	52.00	0.43
wetland	15	PF 1	100.00	1210.20	1214.63		1214.71	0.001385	2.26	44.32	29.67	0.33
wetland	15	PF 2	200.00	1210.20	1215.72		1215.80	0.000921	2.33	89.29	53.33	0.28
wetland	15	PF 3	300.00	1210.20	1216.44		1216.53	0.000727	2.49	129.76	57.76	0.26
wetland	15	PF 4	400.00	1210.20	1216.94		1217.05	0.000706	2.74	159.12	59.76	0.27
wetland	15	PF 5	500.00	1210.20	1217.35		1217.48	0.000718	2.99	183.96	61.40	0.28
wetland	14	PF 1	100.00	1211.00	1213.79	1213.60	1214.39	0.011888	6.18	16.18	10.39	0.87
wetland	14	PF 2	200.00	1211.00	1214.58	1214.58	1215.51	0.014741	7.72	25.89	14.26	1.01
wetland	14	PF 3	300.00	1211.00	1215.34	1215.34	1216.28	0.013594	7.74	38.77	21.04	1.01
wetland	14	PF 4	400.00	1211.00	1215.86	1215.86	1216.80	0.013097	7.76	51.54	28.14	1.01
wetland	14	PF 5	500.00	1211.00	1216.21	1216.21	1217.22	0.012048	8.09	62.30	35.02	0.99
wetland	13	PF 1	100.00	1210.00	1213.87		1213.99	0.001234	2.90	43.58	40.96	0.33
wetland	13	PF 2	200.00	1210.00	1214.53	1213.59	1214.71	0.001572	3.84	76.17	57.22	0.39
wetland	13	PF 3	300.00	1210.00	1214.99	1214.19	1215.21	0.001738	4.43	105.06	67.85	0.42
wetland	13	PF 4	400.00	1210.00	1215.36	1214.53	1215.60	0.001784	4.79	129.88	68.00	0.43
wetland	13	PF 5	500.00	1210.00	1215.63	1214.81	1215.90	0.001947	5.24	148.06	68.00	0.45
wetland	12	PF 1	100.00	1210.00	1213.16	1213.16	1213.69	0.015743	5.85	17.10	16.08	1.00
wetland	12	PF 2	200.00	1210.00	1214.09		1214.43	0.008315	4.70	42.60	38.88	0.77
wetland	12	PF 3	300.00	1210.00	1214.61		1214.96	0.005279	4.77	66.53	57.94	0.65
wetland	12	PF 4	400.00	1210.00	1215.02		1215.36	0.004064	4.85	97.31	90.00	0.59
wetland	12	PF 5	500.00	1210.00	1215.35		1215.68	0.003356	4.86	127.23	90.00	0.55
wetland	11	PF 1	100.00	1209.00	1212.94	1211.20	1213.04	0.001582	2.49	40.20	25.79	0.35
wetland	11	PF 2	200.00	1209.00	1213.98		1214.09	0.001455	2.67	74.91	41.49	0.35
wetland	11	PF 3	300.00	1209.00	1214.53		1214.67	0.001337	3.04	102.06	58.10	0.35
wetland	11	PF 4	400.00	1209.00	1214.94		1215.11	0.001336	3.38	128.60	71.87	0.36
wetland	11	PF 5	500.00	1209.00	1215.25		1215.45	0.001388	3.70	151.47	74.00	0.37
wetland	10	PF 1	100.00	1208.90	1212.06		1212.70	0.012148	6.41	15.60	9.16	0.87
wetland	10	PF 2	200.00	1208.90	1212.98	1212.98	1213.74	0.014159	6.99	28.77	20.60	1.00
wetland	10	PF 3	300.00	1208.90	1213.57	1213.57	1214.36	0.009933	7.26	45.92	37.56	0.88
wetland	10	PF 4	400.00	1208.90	1213.99	1213.99	1214.81	0.008558	7.60	64.08	49.64	0.85
wetland	10	PF 5	500.00	1208.90	1214.39	1214.39	1215.16	0.007023	7.60	87.09	64.65	0.78
wetland	9	PF 1	100.00	1207.60	1210.66		1211.01	0.009491	4.76	21.03	18.81	0.79
wetland	9	PF 2	200.00	1207.60	1211.27	1211.04	1211.83	0.009286	6.04	33.76	28.81	0.83
wetland	9	PF 3	300.00	1207.60	1211.39	1211.76	1212.47	0.016218	8.35	37.83	35.48	1.11
wetland	9	PF 4	400.00	1207.60	1211.64	1212.06	1212.98	0.017708	9.44	48.34	48.63	1.18
wetland	9	PF 5	500.00	1207.60	1211.81	1212.31	1213.42	0.020133	10.54	56.57	51.66	1.27
wetland	8	PF 1	100.00	1207.00	1210.01		1210.35	0.005133	4.68	21.37	13.69	0.62
wetland	8	PF 2	200.00	1207.00	1211.23		1211.41	0.001801	3.93	78.31	63.01	0.40
wetland	8	PF 3	300.00	1207.00	1211.88	1210.99	1212.04	0.001402	3.95	124.56	78.76	0.36
wetland	8	PF 4	400.00	1207.00	1212.30	1211.29	1212.46	0.001312	4.11	158.87	81.84	0.36
wetland	8	PF 5	500.00	1207.00	1212.62	1211.52	1212.79	0.001325	4.34	185.08	82.00	0.37
wetland	7	PF 1	100.00	1206.00	1209.74		1209.96	0.002518	3.80	26.31	11.08	0.43
wetland	7	PF 2	200.00	1206.00	1210.77		1211.16	0.003007	5.05	44.27	31.16	0.50
wetland	7	PF 3	300.00	1206.00	1211.22	1210.29	1211.78	0.003856	6.25	63.07	55.99	0.58
wetland	7	PF 4	400.00	1206.00	1211.47	1211.47	1212.18	0.004787	7.28	77.70	60.00	0.65
wetland	7	PF 5	500.00	1206.00	1211.76	1211.76	1212.51	0.004943	7.75	94.96	60.00	0.67
wetland	6	PF 1	100.00	1206.00	1208.45	1208.45	1209.26	0.014373	7.21	13.88	8.72	1.01
wetland	6	PF 2	200.00	1206.00	1209.67	1209.67	1210.41	0.013643	6.90	29.01	19.93	1.01
wetland	6	PF 3	300.00	1206.00	1210.32	1210.32	1210.99	0.011091	6.61	47.46	45.54	0.94
wetland	6	PF 4	400.00	1206.00	1210.66	1210.74	1211.36	0.009118	6.86	69.22	79.38	0.88
wetland	6	PF 5	500.00	1206.00	1210.84	1211.08	1211.64	0.009736	7.52	84.83	96.62	0.92
wetland	5	PF 1	100.00	1205.00	1206.94	1206.94	1207.61	0.013643	6.52	15.33	11.77	1.01
wetland	5	PF 2	200.00	1205.00	1207.62	1207.77	1208.68	0.015915	8.28	24.16	14.47	1.13
wetland	5	PF 3	300.00	1205.00	1208.21	1208.39	1209.46	0.014932	8.97	33.44	16.84	1.12
wetland	5	PF 4	400.00	1205.00	1208.81	1208.89	1210.08	0.012493	9.03	44.29	19.24	1.05
wetland	5	PF 5	500.00	1205.00	1209.37	1209.44	1210.61	0.009684	8.98	57.87	33.91	0.95
wetland	4	PF 1	100.00	1202.00	1203.47	1203.84	1204.77	0.031502	9.15	10.92	9.20	1.48
wetland	4	PF 2	200.00	1202.00	1204.34	1204.76	1205.94	0.023552	10.14	19.72	10.93	1.33
wetland	4	PF 3	300.00	1202.00	1204.99	1205.46	1206.89	0.021917	11.06	27.13	12.19	1.31
wetland	4	PF 4	400.00	1202.00	1205.48	1206.23	1207.71	0.022100	11.99	33.37	13.16	1.33
wetland	4	PF 5	500.00	1202.00	1205.88	1206.80	1208.46	0.023850	12.89	38.80	14.50	1.39
wetland	3	PF 1	100.00	1201.00	1203.25	1202.87	1203.66	0.006646	5.13	19.51	12.32	0.72
wetland	3	PF 2	200.00	1201.00	1204.14	1203.73	1204.76	0.007151	6.32	31.66	15.26	0.77
wetland	3	PF 3	300.00	1201.00	1204.03	1204.38	1205.58	0.018497	9.99	30.03	14.85	1.24
wetland	3	PF 4	400.00	1201.00	1204.40	1204.93	1206.34	0.020644	11.17	35.82	16.25	1.33
wetland	3	PF 5	500.00	1201.00	1204.75	1205.37	1206.98	0.021654	12.00	41.65	17.54	1.37
wetland	2	PF 1	100.00	1200.00	1202.43	1202.43	1203.14	0.014878	6.77	14.77	10.60	1.01
wetland	2	PF 2	200.00	1200.00	1203.34	1203.34	1204.24	0.013075	7.61	26.28	14.60	1.00
wetland	2	PF 3	300.00	1200.00	1203.98	1203.98	1205.03	0.012339	8.23	36.47	17.39	1.00
wetland	2	PF 4	400.00	1200.00	1204.48	1204.48	1205.67	0.012044	8.75	45.69	19.58	1.01
wetland	2	PF 5	500.00	1200.00	1204.92	1204.92	1206.22	0.011685	9.14	54.68	21.50	1.01
wetland	1	PF 1	100.00	1198.00	1200.93	1201.02	1201.78	0.017014	7.42	13.48	9.20	1.08

MATCHES W/ →
PROPOSED AT
THIS STA.

★ HEC-RAS ANALYSIS PERFORMED BY K.S.

EXISTING MIXED FLOW

3/16/21 2/2

HEC-RAS Plan: Plan 02 River: molene creek Reach: wetland (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
wetland	1	PF 2	200.00	1198.00	1201.84	1201.99	1203.00	0.015939	8.61	23.22	12.08	1.10
wetland	1	PF 3	300.00	1198.00	1202.55	1202.69	1203.87	0.014619	9.23	32.52	14.30	1.08
wetland	1	PF 4	400.00	1198.00	1203.16	1203.26	1204.58	0.013217	9.55	41.90	16.23	1.05
wetland	1	PF 5	500.00	1198.00	1203.70	1203.75	1205.19	0.012251	9.81	50.96	17.90	1.03
wetland	0	PF 1	100.00	1197.00	1198.71	1198.81	1199.39	0.017705	6.59	15.18	14.57	1.14
wetland	0	PF 2	200.00	1197.00	1199.18	1199.51	1200.39	0.023855	8.80	22.73	17.64	1.37
wetland	0	PF 3	300.00	1197.00	1199.52	1200.03	1201.18	0.027991	10.36	28.97	19.82	1.51
wetland	0	PF 4	400.00	1197.00	1199.78	1200.44	1201.88	0.031459	11.64	34.37	21.54	1.62
wetland	0	PF 5	500.00	1197.00	1200.00	1200.81	1202.50	0.034077	12.69	39.41	23.02	1.71

PROPOSED - 45' WEIR W/ELEV. @ 1208'

1/2

HEC-RAS Plan Plan 01 River: molene creek Reach: wetland

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
wetland	16	PF 1	100.00	1211.00	1214.75	1213.26	1214.88	0.001697	2.91	34.38	17.61	0.37
wetland	16	PF 2	200.00	1211.00	1215.78	1214.25	1215.96	0.002086	3.46	58.05	30.08	0.42
wetland	16	PF 3	300.00	1211.00	1216.45	1214.89	1216.68	0.001836	3.83	82.15	41.81	0.41
wetland	16	PF 4	400.00	1211.00	1216.93	1215.49	1217.20	0.001792	4.22	104.32	50.75	0.42
wetland	16	PF 5	500.00	1211.00	1217.33	1215.89	1217.64	0.001762	4.54	125.12	52.00	0.43
wetland	15	PF 1	100.00	1210.20	1214.63		1214.71	0.001385	2.26	44.32	29.67	0.33
wetland	15	PF 2	200.00	1210.20	1215.72		1215.80	0.000921	2.33	89.29	53.33	0.28
wetland	15	PF 3	300.00	1210.20	1216.44		1216.53	0.000727	2.49	129.76	57.76	0.26
wetland	15	PF 4	400.00	1210.20	1216.94		1217.05	0.000706	2.74	159.12	59.76	0.27
wetland	15	PF 5	500.00	1210.20	1217.35		1217.48	0.000718	2.99	183.96	61.40	0.28
wetland	14	PF 1	100.00	1211.00	1213.79	1213.60	1214.39	0.011888	6.18	16.18	10.39	0.87
wetland	14	PF 2	200.00	1211.00	1214.58	1214.58	1215.51	0.014741	7.72	25.89	14.26	1.01
wetland	14	PF 3	300.00	1211.00	1215.34	1215.34	1216.28	0.013594	7.74	38.77	21.04	1.01
wetland	14	PF 4	400.00	1211.00	1215.86	1215.86	1216.80	0.013097	7.76	51.54	28.14	1.01
wetland	14	PF 5	500.00	1211.00	1216.21	1216.21	1217.22	0.012048	8.09	62.30	35.02	0.99
wetland	13	PF 1	100.00	1210.00	1213.87		1213.99	0.001234	2.90	43.59	40.97	0.33
wetland	13	PF 2	200.00	1210.00	1214.53	1213.59	1214.71	0.001572	3.84	76.17	57.22	0.39
wetland	13	PF 3	300.00	1210.00	1214.99	1214.19	1215.21	0.001738	4.43	105.06	67.85	0.42
wetland	13	PF 4	400.00	1210.00	1215.36	1214.53	1215.60	0.001784	4.79	129.88	68.00	0.43
wetland	13	PF 5	500.00	1210.00	1215.63	1214.81	1215.90	0.001947	5.24	148.06	68.00	0.45
wetland	12	PF 1	100.00	1210.00	1213.16	1213.16	1213.69	0.015781	5.86	17.08	16.04	1.00
wetland	12	PF 2	200.00	1210.00	1214.09		1214.43	0.008315	4.70	42.60	38.88	0.77
wetland	12	PF 3	300.00	1210.00	1214.61		1214.96	0.005279	4.77	66.53	57.94	0.65
wetland	12	PF 4	400.00	1210.00	1215.02		1215.36	0.004064	4.85	97.31	90.00	0.59
wetland	12	PF 5	500.00	1210.00	1215.35		1215.68	0.003356	4.86	127.23	90.00	0.55
wetland	11	PF 1	100.00	1209.00	1212.94	1211.20	1213.04	0.001581	2.49	40.20	25.79	0.35
wetland	11	PF 2	200.00	1209.00	1213.98		1214.09	0.001455	2.67	74.91	41.49	0.35
wetland	11	PF 3	300.00	1209.00	1214.53		1214.67	0.001337	3.04	102.08	58.10	0.35
wetland	11	PF 4	400.00	1209.00	1214.94		1215.11	0.001336	3.38	128.60	71.87	0.36
wetland	11	PF 5	500.00	1209.00	1215.25		1215.45	0.001388	3.70	151.47	74.00	0.37
wetland	10	PF 1	100.00	1208.90	1212.06		1212.70	0.012130	6.40	15.62	9.18	0.87
wetland	10	PF 2	200.00	1208.90	1212.98	1212.98	1213.74	0.014159	6.99	28.77	20.80	1.00
wetland	10	PF 3	300.00	1208.90	1213.57	1213.57	1214.36	0.009933	7.26	45.92	37.56	0.88
wetland	10	PF 4	400.00	1208.90	1213.99	1213.99	1214.81	0.008558	7.60	64.08	49.64	0.85
wetland	10	PF 5	500.00	1208.90	1214.39	1214.39	1215.16	0.007023	7.60	87.09	64.65	0.78
wetland	9	PF 1	100.00	1207.60	1210.65		1211.01	0.009516	4.76	21.01	18.81	0.79
wetland	9	PF 2	200.00	1207.60	1211.27	1211.04	1211.83	0.009284	6.04	33.77	28.82	0.83
wetland	9	PF 3	300.00	1207.60	1211.39	1211.76	1212.47	0.016218	8.35	37.83	35.48	1.11
wetland	9	PF 4	400.00	1207.60	1211.64	1212.06	1212.98	0.017708	9.44	48.34	48.83	1.18
wetland	9	PF 5	500.00	1207.60	1211.81	1212.31	1213.42	0.020133	10.54	56.57	51.66	1.27
wetland	8	PF 1	100.00	1207.00	1209.99	1209.35	1210.34	0.005320	4.74	21.10	11.97	0.63
wetland	8	PF 2	200.00	1207.00	1211.23	1211.41	1211.41	0.001801	3.93	78.31	63.01	0.40
wetland	8	PF 3	300.00	1207.00	1211.88	1210.99	1212.04	0.001402	3.95	124.56	78.76	0.36
wetland	8	PF 4	400.00	1207.00	1212.30	1211.29	1212.46	0.001312	4.11	158.87	81.84	0.36
wetland	8	PF 5	500.00	1207.00	1212.62	1211.52	1212.79	0.001325	4.34	185.08	82.00	0.37
wetland	7	PF 1	100.00	1206.00	1209.70		1209.93	0.002615	3.85	25.94	11.01	0.44
wetland	7	PF 2	200.00	1206.00	1210.77		1211.16	0.003006	5.05	44.27	31.16	0.50
wetland	7	PF 3	300.00	1206.00	1211.22	1210.29	1211.78	0.003858	6.25	63.06	55.99	0.58
wetland	7	PF 4	400.00	1206.00	1211.47	1211.47	1212.18	0.004787	7.28	77.00	60.00	0.65
wetland	7	PF 5	500.00	1206.00	1211.76	1211.76	1212.51	0.004943	7.75	94.96	60.00	0.67
wetland	6	PF 1	100.00	1206.00	1208.58	1208.45	1209.27	0.011682	6.68	14.98	9.01	0.91
wetland	6	PF 2	200.00	1206.00	1209.67	1209.67	1210.41	0.013656	6.90	28.99	19.92	1.01
wetland	6	PF 3	300.00	1206.00	1210.32	1210.32	1210.99	0.011091	6.81	47.46	45.54	0.94
wetland	6	PF 4	400.00	1206.00	1210.66	1210.74	1211.36	0.009118	6.86	69.22	79.38	0.88
wetland	6	PF 5	500.00	1206.00	1210.84	1211.08	1211.64	0.009736	7.52	84.83	96.62	0.92
wetland	5	PF 1	100.00	1205.00	1208.77		1208.85	0.000821	2.30	43.48	19.07	0.27
wetland	5	PF 2	200.00	1205.00	1209.13	1207.77	1209.37	0.002103	3.95	50.98	25.03	0.44
wetland	5	PF 3	300.00	1205.00	1209.35	1208.39	1209.80	0.003567	5.43	57.27	33.23	0.58
wetland	5	PF 4	400.00	1205.00	1209.53	1208.89	1210.22	0.005034	6.73	63.90	40.11	0.69
wetland	5	PF 5	500.00	1205.00	1209.65	1209.44	1210.62	0.006727	8.00	69.17	44.82	0.81
wetland	4.7											
wetland	4.6	PF 1	87.95	1208.00	1208.48	1208.48	1208.71	0.017207	3.86	22.81	49.81	1.00
wetland	4.6	PF 2	176.33	1208.00	1208.76	1208.76	1209.11	0.014826	4.76	37.02	52.59	1.00
wetland	4.6	PF 3	266.45	1208.00	1208.99	1208.99	1209.44	0.013844	5.41	49.25	54.86	1.01
wetland	4.6	PF 4	356.93	1208.00	1209.19	1209.19	1209.73	0.013037	5.87	60.82	57.31	1.00
wetland	4.6	PF 5	447.75	1208.00	1209.38	1209.38	1209.99	0.012573	6.26	71.53	59.51	1.01

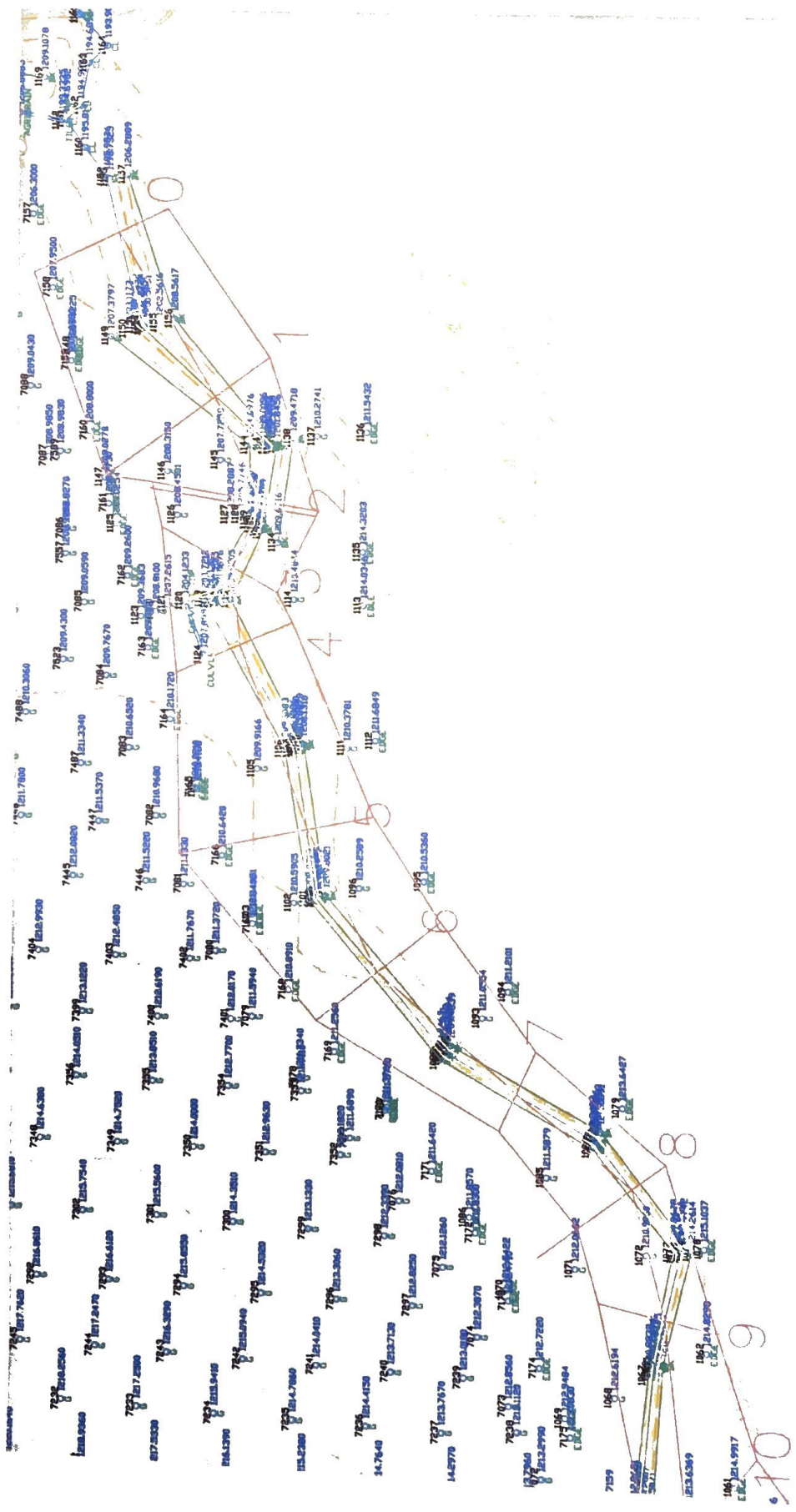
MATCHES
W/ EXISTING
AT THIS STA.

★ 1209.38' PEAK ELEV, FOR 100-YEAR EVENT

★ HEC-RAS ANALYSIS PERFORMED BY K.S.

HEC-RAS Plan: Plan 01 River: molene creek Reach: wetland (Continued)

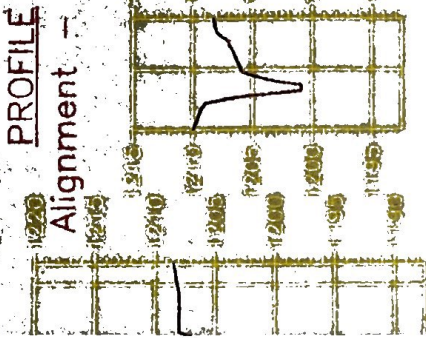
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
wetland	4	PF 1	87.95	1202.00	1202.98	1203.72	1205.67	0.102836	13.16	6.69	8.23	2.57
wetland	4	PF 2	176.33	1202.00	1203.65	1204.56	1206.68	0.064368	13.95	12.84	9.56	2.14
wetland	4	PF 3	266.45	1202.00	1204.28	1205.23	1207.33	0.046263	14.01	19.02	10.80	1.86
wetland	4	PF 4	356.93	1202.00	1204.87	1205.85	1207.86	0.035792	13.86	25.75	11.97	1.67
wetland	4	PF 5	447.75	1202.00	1205.45	1206.53	1208.31	0.028465	13.55	33.03	13.11	1.51
wetland	3	PF 1	87.95	1201.00	1203.11	1202.74	1203.49	0.006658	4.95	17.76	11.85	0.71
wetland	3	PF 2	176.33	1201.00	1203.96	1203.56	1204.53	0.007003	6.08	29.02	14.62	0.76
wetland	3	PF 3	266.45	1201.00	1204.56	1204.17	1205.31	0.007558	6.92	38.53	16.86	0.81
wetland	3	PF 4	356.93	1201.00	1204.32	1204.69	1205.98	0.018095	10.33	34.54	15.95	1.24
wetland	3	PF 5	447.75	1201.00	1204.60	1205.15	1206.63	0.020395	11.42	39.20	17.01	1.33
wetland	2	PF 1	87.95	1200.00	1202.29	1202.29	1202.97	0.015157	6.62	13.29	9.97	1.01
wetland	2	PF 2	176.33	1200.00	1203.16	1203.16	1204.02	0.013329	7.44	23.71	13.81	1.00
wetland	2	PF 3	266.45	1200.00	1203.79	1203.79	1204.79	0.012530	8.04	33.16	16.54	1.00
wetland	2	PF 4	356.93	1200.00	1204.28	1204.28	1205.41	0.012066	8.52	41.91	18.71	1.00
wetland	2	PF 5	447.75	1200.00	1204.70	1204.70	1205.94	0.011874	8.96	50.00	20.52	1.01
wetland	1	PF 1	87.95	1198.00	1200.78	1200.87	1201.59	0.017266	7.23	12.17	8.75	1.08
wetland	1	PF 2	176.33	1198.00	1201.65	1201.79	1202.75	0.016350	8.42	20.93	11.47	1.10
wetland	1	PF 3	266.45	1198.00	1202.33	1202.47	1203.60	0.015085	9.06	29.40	13.59	1.09
wetland	1	PF 4	356.93	1198.00	1202.90	1203.02	1204.29	0.013924	9.46	37.72	15.40	1.07
wetland	1	PF 5	447.75	1198.00	1203.43	1203.50	1204.88	0.012645	9.66	46.36	17.07	1.03
wetland	0	PF 1	87.95	1197.00	1198.64	1198.71	1199.24	0.016668	6.23	14.11	14.08	1.10
wetland	0	PF 2	176.33	1197.00	1199.09	1199.37	1200.17	0.022504	8.34	21.15	17.05	1.32
wetland	0	PF 3	266.45	1197.00	1199.42	1199.86	1200.93	0.026649	9.87	27.01	19.17	1.47
wetland	0	PF 4	356.93	1197.00	1199.67	1200.27	1201.58	0.029848	11.09	32.20	20.86	1.57
wetland	0	PF 5	447.75	1197.00	1199.89	1200.62	1202.19	0.032951	12.18	36.75	22.25	1.67



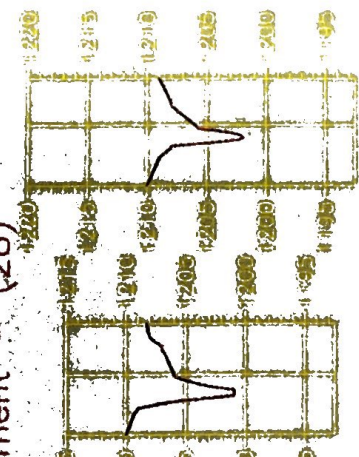
CROSS SECTION - 1/2

6 70 9

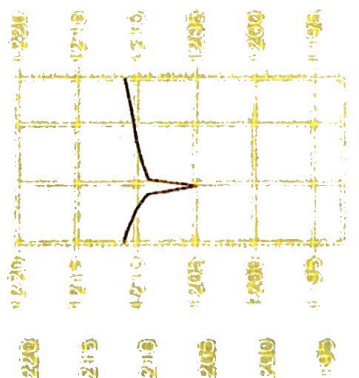
FILE
- (27)



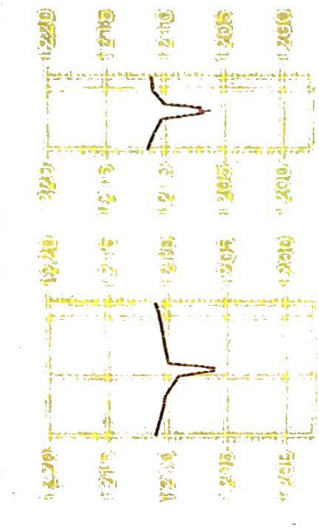
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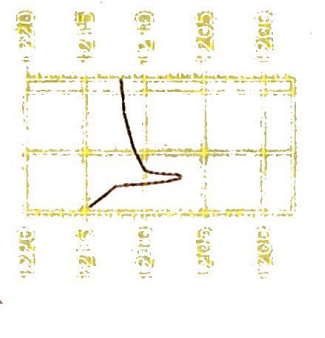
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PROFILE Alignment - (32)

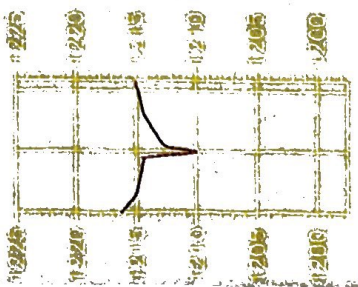


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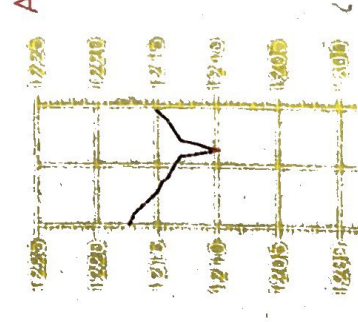


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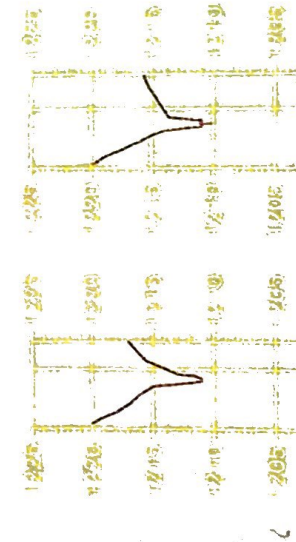
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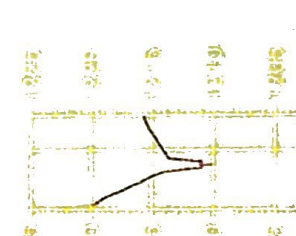
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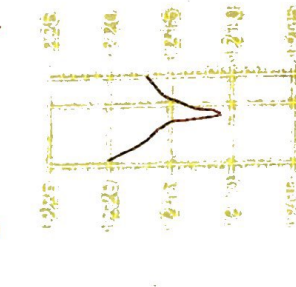
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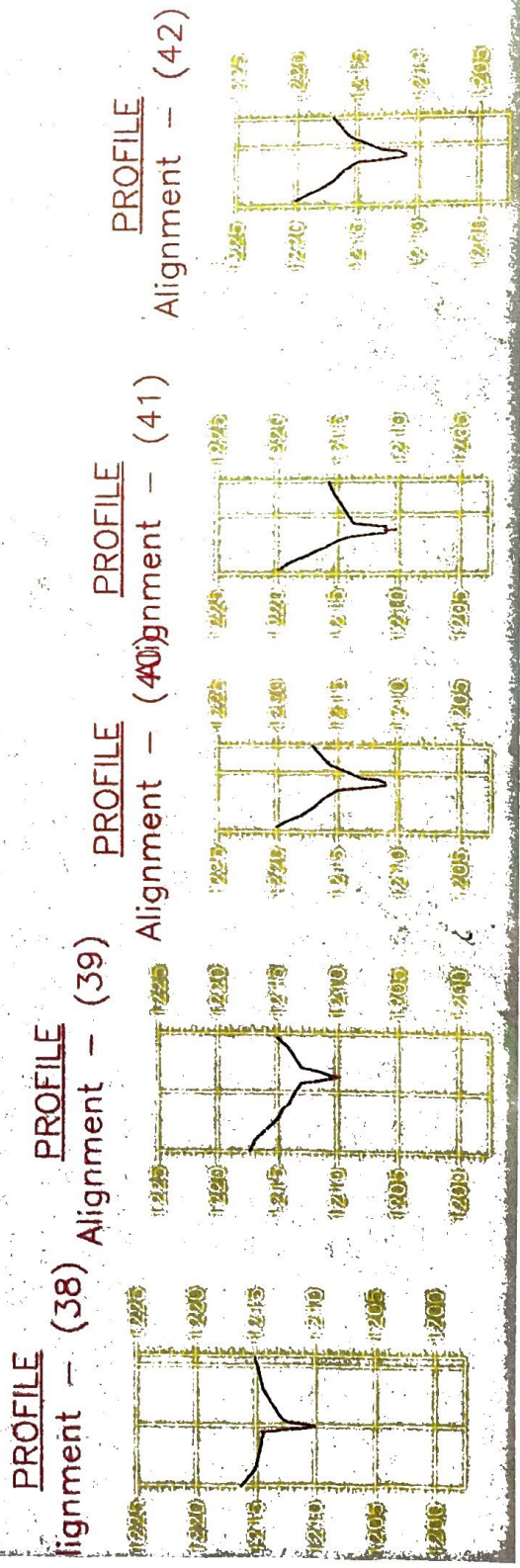
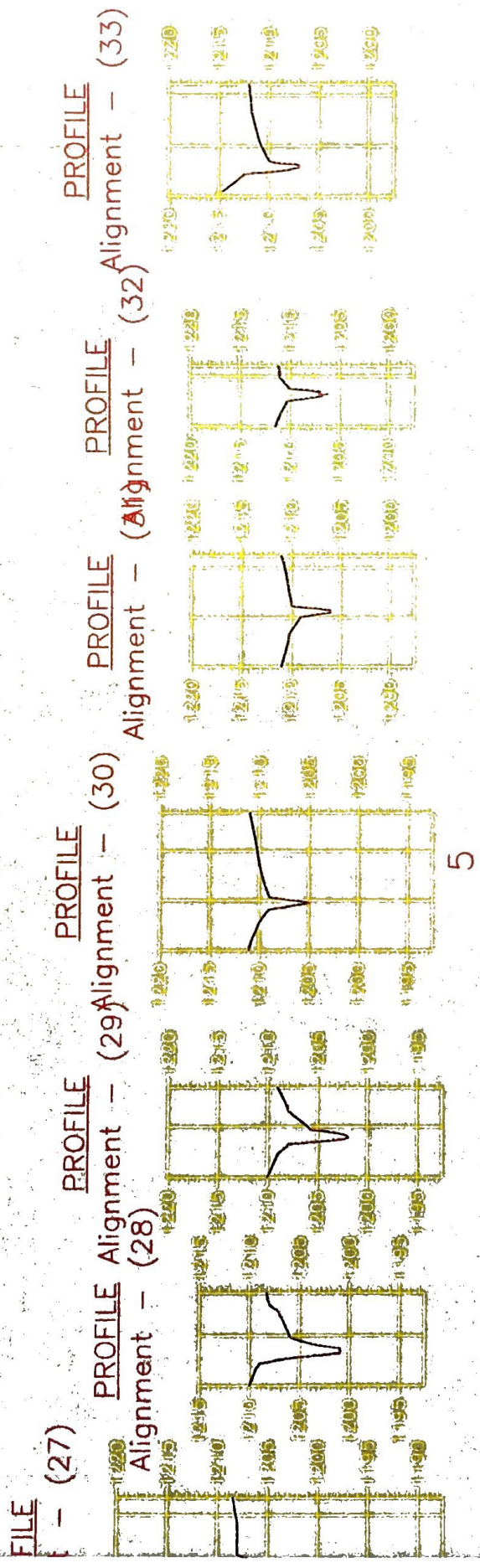


PROFILE Alignment - (41)



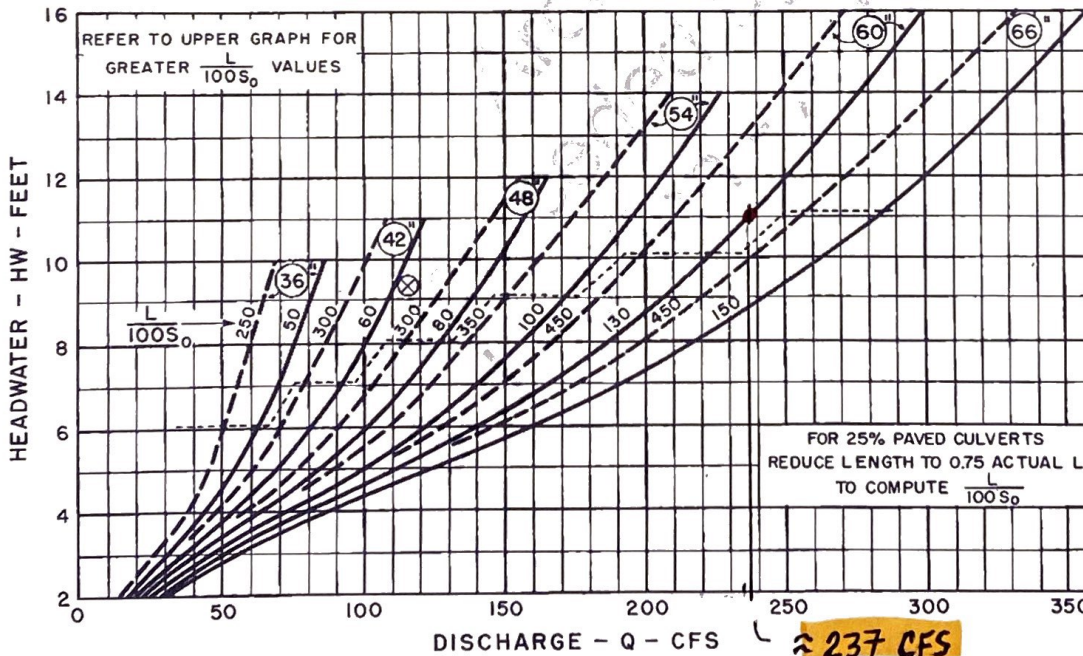
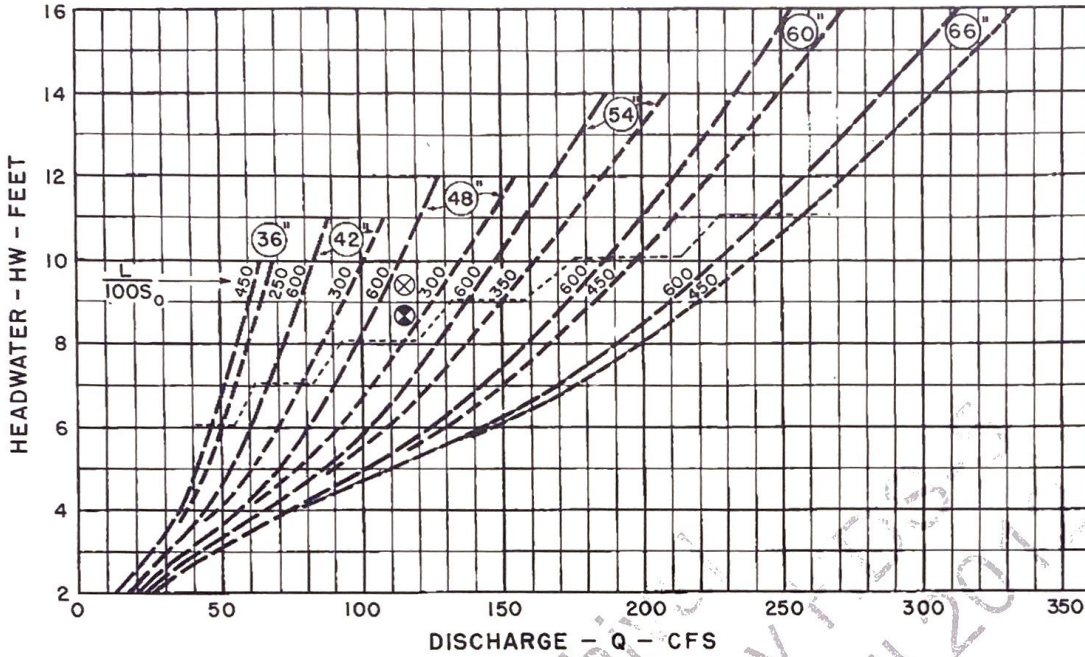
PROFILE Alignment - (42)





SECTION 3
FEMA FLOODMAP AT ADJACENT ROAD

CHART 20



EXAMPLE

- ⊗ GIVEN:
115 CFS; AHW = 9.4 FT.
L = 135 FT.; $S_0 = 0.0034$
- ⊗ SELECT 48" UNPAVED
HW = 8.6 FT.

CULVERT CAPACITY STANDARD
CIRCULAR CORR. METAL PIPE
PROJECTING ENTRANCE
36" TO 66" ○

ROAD = 1223.79'

L = 53.3'

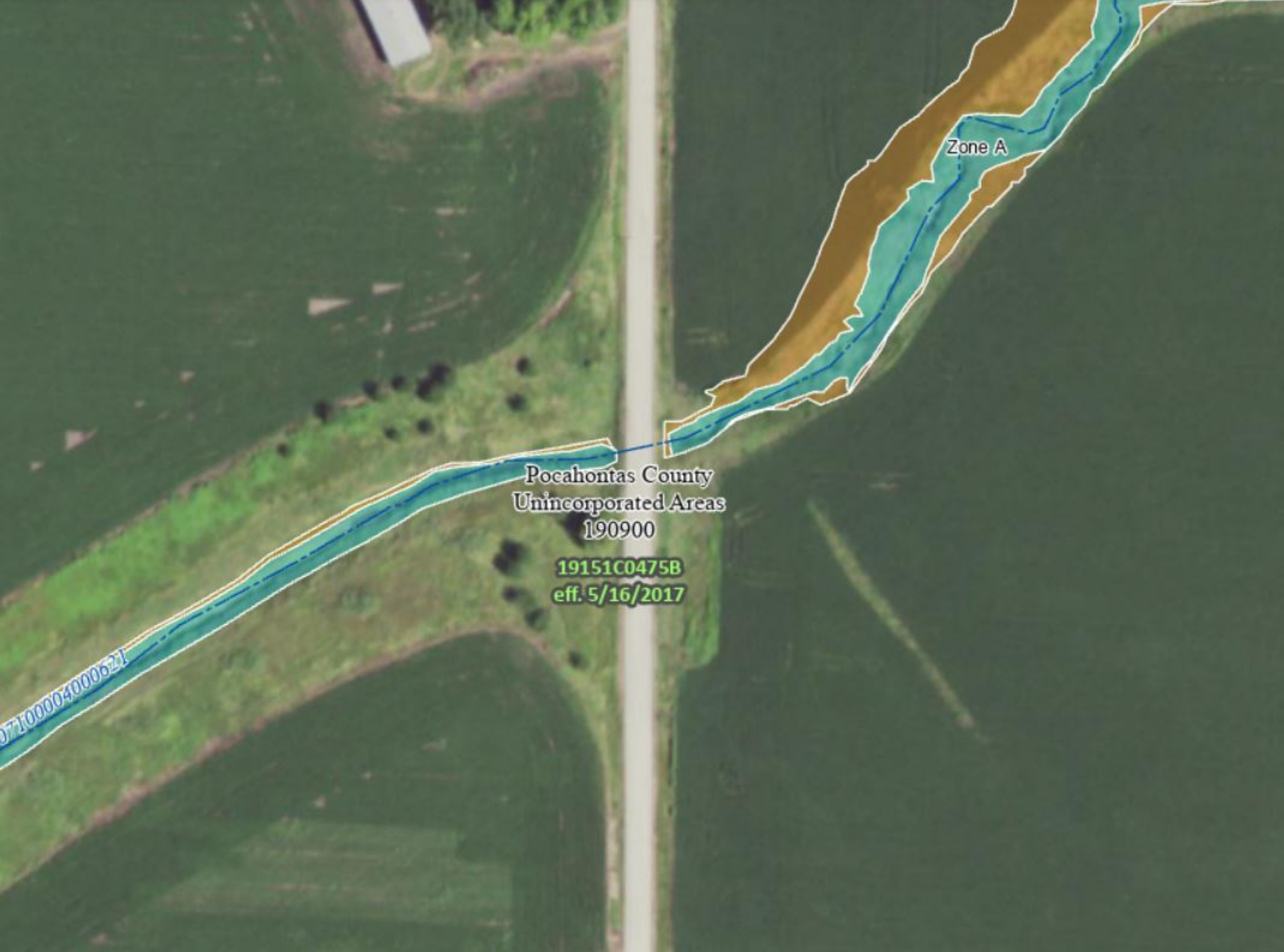
$$\frac{53.3'}{1} = 53.5$$

PIPE INV. = 1212.77'



$$\Delta = 11.02'$$

∴ REALISTICALLY NOT GETTING MORE THAN ~240 CFS IN DITCH / CREEK B/C FEMA MAP DOES NOT SHOW 100-YR EVENT OVER-TOPPING ROAD.



Zone A

Pocahontas County
Unincorporated Areas
190900

19151C0475B
eff. 5/16/2017

07100004000621

SECTION 4
NOAA RAINFALL DATA



NOAA Atlas 14, Volume 8, Version 2
Location name: Manson, Iowa, USA*
Latitude: 42.5779°, Longitude: -94.5555°
Elevation: 1207.52 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	0.390 (0.322-0.480)	0.458 (0.377-0.565)	0.576 (0.473-0.712)	0.681 (0.555-0.843)	0.834 (0.658-1.07)	0.959 (0.737-1.23)	1.09 (0.806-1.43)	1.23 (0.868-1.64)	1.43 (0.963-1.93)	1.58 (1.03-2.16)
10-min	0.571 (0.471-0.703)	0.671 (0.553-0.827)	0.844 (0.693-1.04)	0.997 (0.813-1.23)	1.22 (0.964-1.56)	1.40 (1.08-1.81)	1.60 (1.18-2.09)	1.80 (1.27-2.40)	2.09 (1.41-2.83)	2.32 (1.52-3.16)
15-min	0.696 (0.574-0.858)	0.818 (0.674-1.01)	1.03 (0.845-1.27)	1.22 (0.991-1.51)	1.49 (1.18-1.90)	1.71 (1.32-2.20)	1.95 (1.44-2.55)	2.20 (1.55-2.93)	2.55 (1.72-3.45)	2.83 (1.85-3.85)
30-min	0.993 (0.819-1.22)	1.17 (0.961-1.44)	1.47 (1.21-1.81)	1.74 (1.42-2.15)	2.14 (1.69-2.74)	2.47 (1.90-3.18)	2.81 (2.08-3.68)	3.18 (2.25-4.24)	3.71 (2.50-5.03)	4.12 (2.70-5.62)
60-min	1.28 (1.06-1.58)	1.50 (1.24-1.85)	1.90 (1.56-2.35)	2.27 (1.85-2.81)	2.83 (2.25-3.64)	3.30 (2.55-4.27)	3.81 (2.83-5.01)	4.37 (3.09-5.84)	5.16 (3.49-7.02)	5.81 (3.80-7.92)
2-hr	1.57 (1.31-1.92)	1.84 (1.53-2.25)	2.34 (1.94-2.86)	2.80 (2.31-3.43)	3.52 (2.83-4.51)	4.14 (3.23-5.32)	4.82 (3.61-6.29)	5.56 (3.97-7.38)	6.62 (4.53-8.95)	7.49 (4.95-10.1)
3-hr	1.74 (1.46-2.11)	2.03 (1.70-2.46)	2.58 (2.15-3.13)	3.11 (2.57-3.78)	3.94 (3.19-5.03)	4.66 (3.66-5.98)	5.46 (4.12-7.11)	6.35 (4.57-8.41)	7.63 (5.26-10.3)	8.69 (5.78-11.7)
6-hr	2.02 (1.71-2.42)	2.34 (1.98-2.81)	2.97 (2.50-3.56)	3.58 (2.99-4.32)	4.57 (3.75-5.80)	5.44 (4.32-6.92)	6.41 (4.89-8.29)	7.49 (5.45-9.87)	9.07 (6.32-12.2)	10.4 (6.98-13.9)
12-hr	2.31 (1.97-2.74)	2.66 (2.26-3.15)	3.33 (2.83-3.96)	4.00 (3.37-4.76)	5.07 (4.20-6.37)	6.02 (4.82-7.58)	7.07 (5.45-9.06)	8.25 (6.06-10.8)	9.97 (7.02-13.3)	11.4 (7.74-15.2)
24-hr	2.61 (2.25-3.06)	2.99 (2.57-3.50)	3.71 (3.18-4.36)	4.41 (3.76-5.20)	5.54 (4.62-6.86)	6.52 (5.27-8.12)	7.61 (5.92-9.65)	8.82 (6.55-11.4)	10.6 (7.53-14.0)	12.1 (8.27-15.9)
2-day	2.96 (2.57-3.42)	3.38 (2.93-3.91)	4.17 (3.61-4.84)	4.93 (4.23-5.74)	6.10 (5.13-7.46)	7.13 (5.81-8.76)	8.24 (6.46-10.3)	9.48 (7.10-12.1)	11.3 (8.08-14.7)	12.7 (8.82-16.7)
3-day	3.21 (2.81-3.69)	3.68 (3.21-4.23)	4.54 (3.94-5.23)	5.33 (4.61-6.17)	6.55 (5.52-7.92)	7.59 (6.21-9.25)	8.71 (6.86-10.8)	9.94 (7.48-12.6)	11.7 (8.44-15.2)	13.1 (9.16-17.2)
4-day	3.45 (3.02-3.94)	3.96 (3.47-4.53)	4.87 (4.25-5.58)	5.70 (4.94-6.56)	6.95 (5.87-8.34)	8.00 (6.57-9.69)	9.13 (7.21-11.3)	10.4 (7.82-13.1)	12.1 (8.75-15.6)	13.5 (9.45-17.6)
7-day	4.09 (3.62-4.64)	4.69 (4.14-5.32)	5.73 (5.04-6.51)	6.65 (5.81-7.58)	7.99 (6.77-9.44)	9.08 (7.49-10.9)	10.2 (8.13-12.5)	11.5 (8.70-14.3)	13.2 (9.58-16.9)	14.5 (10.3-18.8)
10-day	4.69 (4.16-5.27)	5.35 (4.75-6.03)	6.48 (5.73-7.31)	7.45 (6.55-8.45)	8.85 (7.53-10.4)	9.98 (8.27-11.8)	11.1 (8.89-13.5)	12.4 (9.44-15.4)	14.0 (10.3-17.9)	15.4 (10.9-19.8)
20-day	6.42 (5.75-7.13)	7.23 (6.48-8.04)	8.56 (7.64-9.55)	9.67 (8.58-10.8)	11.2 (9.59-12.9)	12.4 (10.3-14.5)	13.6 (10.9-16.2)	14.8 (11.4-18.1)	16.4 (12.1-20.7)	17.6 (12.7-22.6)
30-day	7.90 (7.13-8.72)	8.85 (7.98-9.78)	10.4 (9.32-11.5)	11.6 (10.4-12.9)	13.3 (11.4-15.1)	14.5 (12.2-16.8)	15.7 (12.7-18.6)	16.9 (13.1-20.6)	18.5 (13.7-23.1)	19.6 (14.2-25.0)
45-day	9.83 (8.92-10.8)	11.0 (9.96-12.1)	12.8 (11.6-14.1)	14.2 (12.8-15.7)	16.1 (13.8-18.1)	17.4 (14.7-19.9)	18.6 (15.2-21.9)	19.8 (15.4-23.9)	21.3 (15.9-26.4)	22.3 (16.2-28.3)
60-day	11.5 (10.5-12.6)	12.9 (11.7-14.0)	15.0 (13.6-16.4)	16.6 (14.9-18.2)	18.6 (16.1-20.8)	20.0 (16.9-22.8)	21.3 (17.4-24.9)	22.5 (17.5-27.0)	23.9 (17.9-29.4)	24.7 (18.1-31.3)

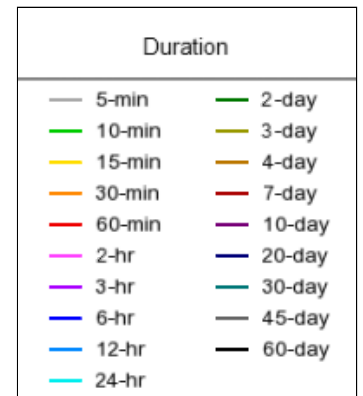
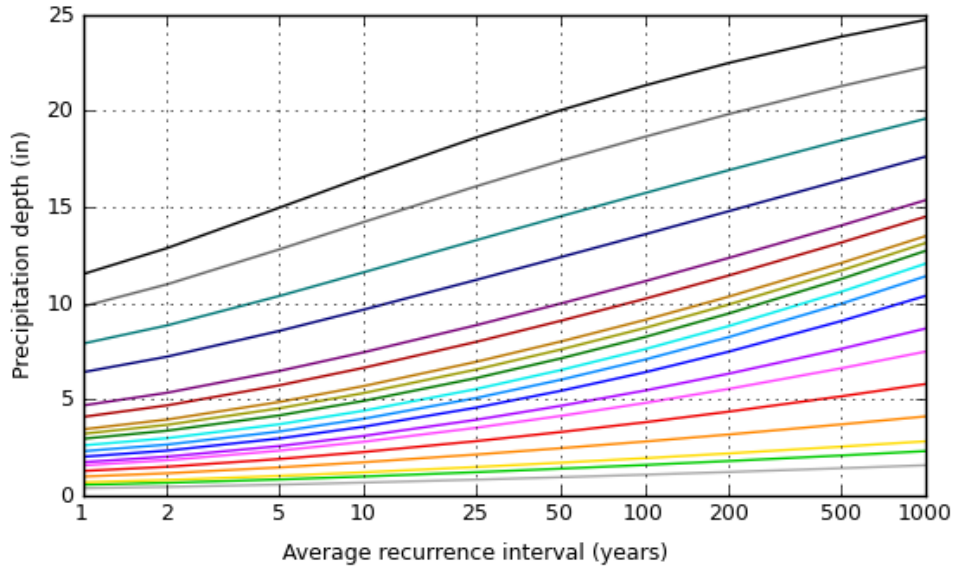
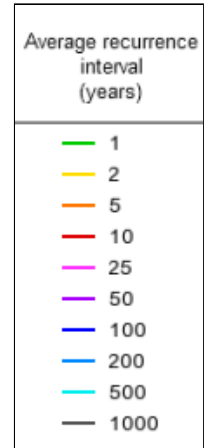
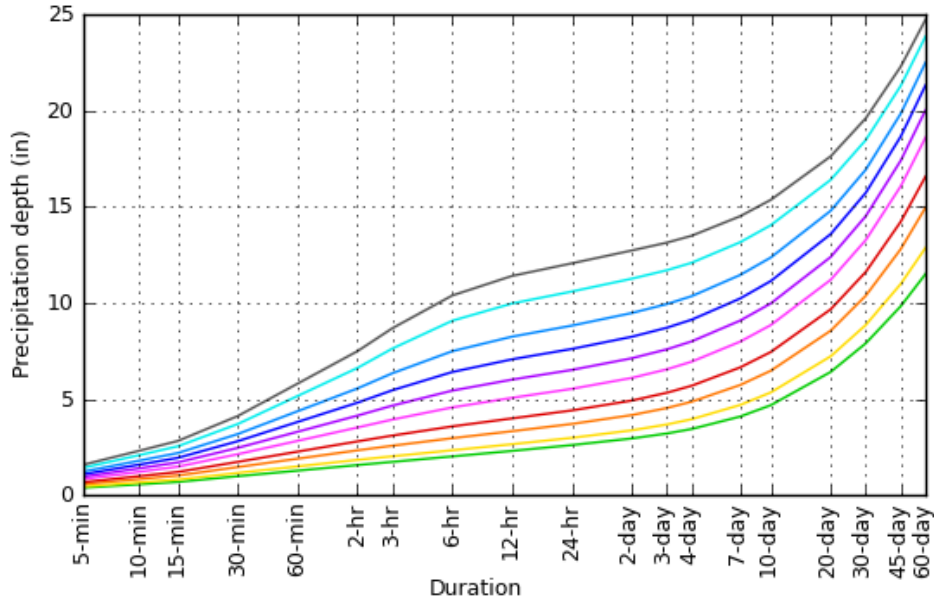
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average 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

PDS-based depth-duration-frequency (DDF) curves

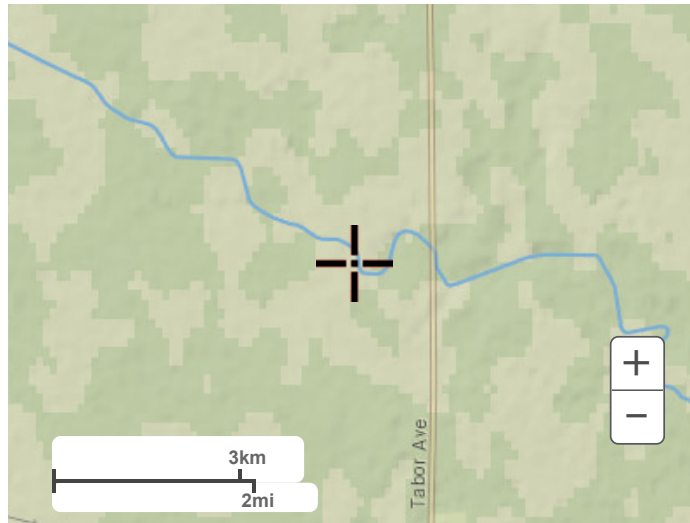
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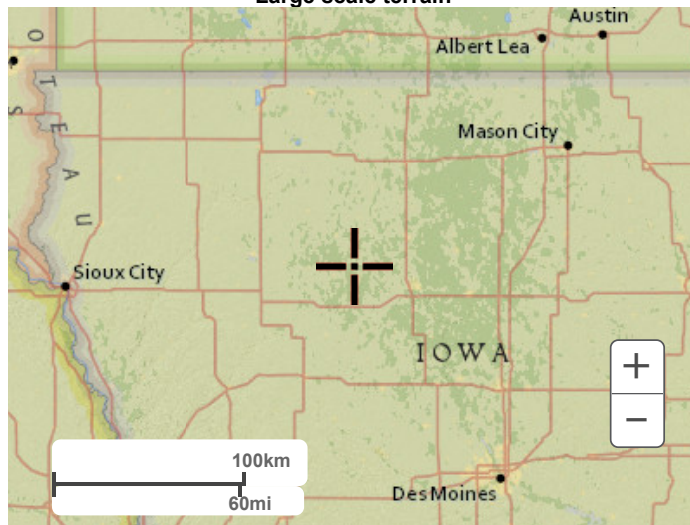
[Back to Top](#)

Maps & aerials

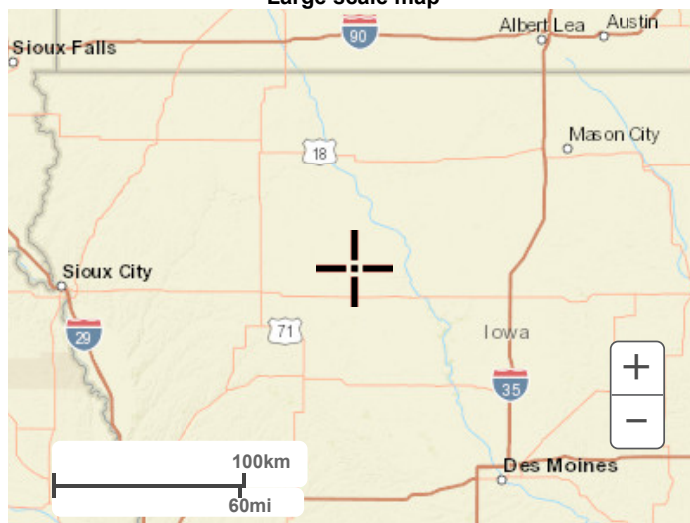
Small scale terrain



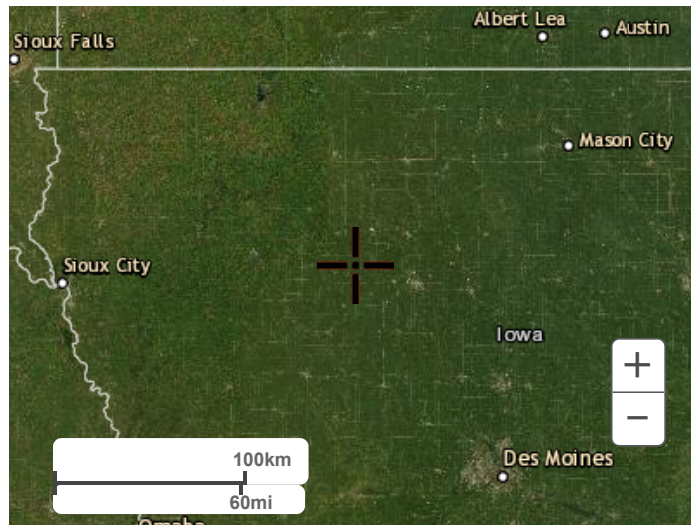
Large scale terrain



Large scale map



Large scale aerial



[Back to Top](#)

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[National Oceanic and Atmospheric Administration](#)
[National Weather Service](#)
[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

[Disclaimer](#)

SECTION 5
STREAMSTATS REPORT

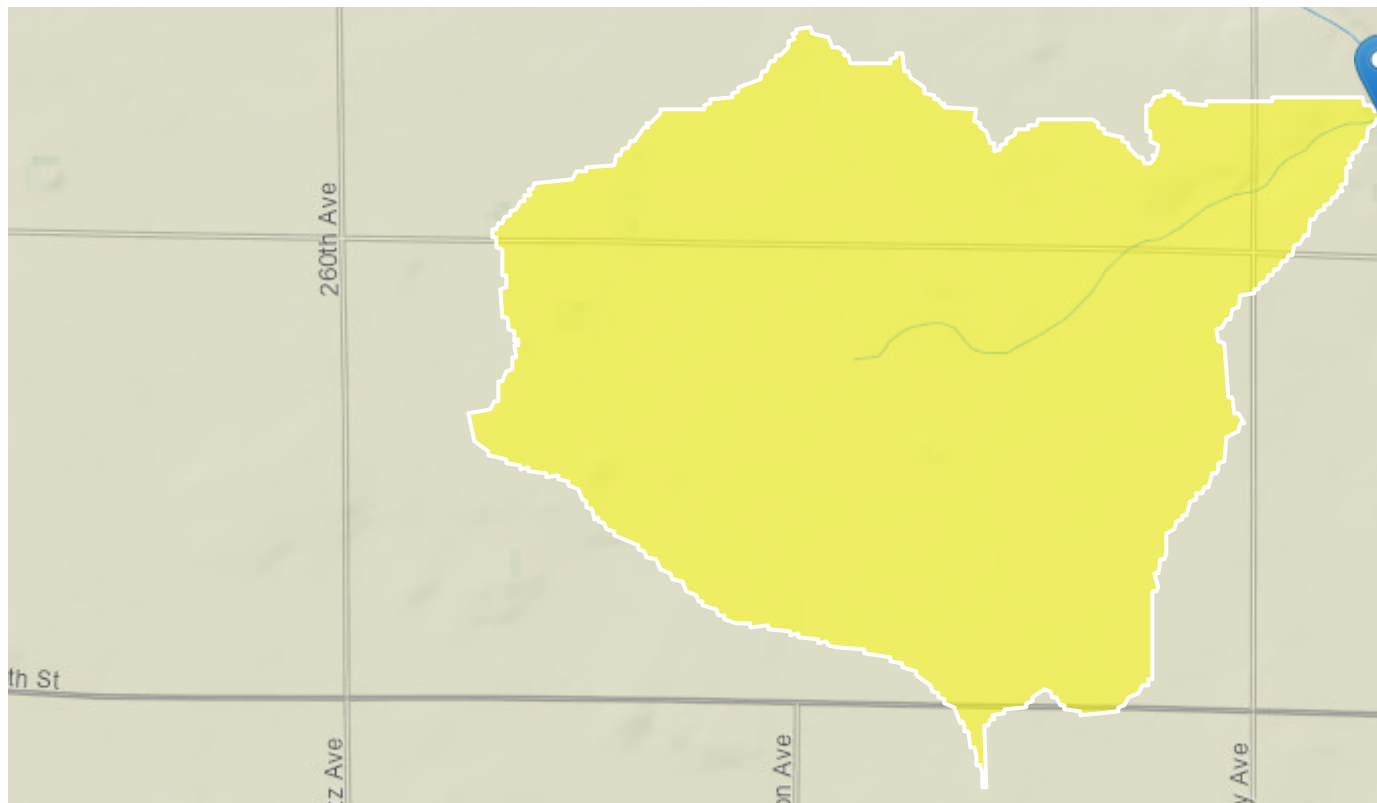
StreamStats Report - Pocahontas County - Moline Watershed

Region ID: IA

Workspace ID: IA20210209034456233000

Clicked Point (Latitude, Longitude): 42.57799, -94.55466

Time: 2021-02-08 21:45:17 -0600



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.84	square miles
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	4.33	inches
CCM	Constant of channel maintenance computed as drainage area divided by total stream length	1.28	square mile per mile
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	1.442	miles

Parameter Code	Parameter Description	Value	Unit
BFI	Proportion of mean annual flow that is from ground water (base flow)	0.56525	dimensionless
SSURGOA	Percentage of area of Hydrologic Soil Type A from SSURGO	0	percent
SSURGOC	Percentage of area of Hydrologic Soil Type C from SSURGO	0	percent
PRECIP	Mean Annual Precipitation	32.16	inches
RSD	Relative stream density first defined in SIR 2012_5171	0.89	dimensionless
HYSEP	Median percentage of baseflow to annual streamflow	56.48	percent
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.65	dimensionless
SSURGOB	Percentage of area of Hydrologic Soil Type B from SSURGO	100	percent
SSURGOD	Percentage of area of Hydrologic Soil Type D from SSURGO	0	percent
TAU_ANN_G	Tau, Average annual base-flow recession time constant as defined in SIR 2008-5065	22.79	days
BASLENAH	Basin length from outlet to basin divide determined using the method in the ArcHydro Toolset	1.76	miles
BSHAPE	Basin Shape Factor for Area	1.69	dimensionless
BSLDEM10M	Mean basin slope computed from 10 m DEM	0.76	percent
CSL100	Longest flow path slope in feet per miles, using DEM	18.5	feet per mi
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	11.3	feet per mi
DESMOIN	Area underlain by Des Moines Lobe	100	percent
DRNFREQ	Number of first order streams per square mile of drainage area	0.54	1st-order streams per square mile
FOSTREAM	Number of First Order Streams	1	dimensionless
HIGHREG	HIGHREG	1	dimensionless

Parameter Code	Parameter Description	Value	Unit
LC11CRPHAY	Percentage of cultivated crops and hay, classes 81 and 82, from NLCD 2011	83.5	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	4.11	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.64	percent
PRJULDEC10	Basin average mean precipitation for July to December from PRISM 1981-2010	2.81	inches
SSURGOKSAT	Saturated hydraulic conductivity in micrometers per second from NRCS SSURGO database	9.37	micrometers per second

Peak-Flow Statistics Parameters^[Peak Region 1 2013 5086]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.84	square miles	0.06	5464
I24H10Y	24 Hour 10 Year Precipitation	4.33	inches	3.58	4.5
CCM	Constant of Channel Maintenance	1.28	square mile per mile	0.11	3.87
STRMTOT	Stream Length Total	1.442	miles		

Peak-Flow Statistics Flow Report^[Peak Region 1 2013 5086]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	SEp
50_percent_AEP_flood	55.5	ft ³ /s	28.1	110	41.6
20_percent_AEP_flood	136	ft ³ /s	78.9	235	32.6
10_percent_AEP_flood	208	ft ³ /s	122	355	31.8
4_percent_AEP_flood	308	ft ³ /s	176	538	33.2
2_percent_AEP_flood	386	ft ³ /s	212	701	35.6
1_percent_AEP_flood	470	ft ³ /s	249	886	38
0_5_percent_AEP_flood	562	ft ³ /s	285	1110	41
0_2_percent_AEP_flood	664	ft ³ /s	316	1400	45.2

Peak-Flow Statistics Citations

Eash, D.A., Barnes, K.K., and Veilleux, A.G.,2013, Methods for estimating annual exceedance-probability discharges for streams in Iowa, based on data through water year 2010: U.S. Geological Survey Scientific Investigations Report 2013-5086, 63 p. with a (<http://pubs.usgs.gov/sir/2013/5086/>)

Low-Flow Statistics Parameters^[Low Flow Northwest annual 2012 5171]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.84	square miles	23.4	5464
BFI	Base Flow Index	0.56525	dimensionless	0.358	0.623
SSURGOA	SSURGO Percent Hydrologic Soil Type A	0	percent	0	7.87

Low-Flow Statistics Disclaimers^[Low Flow Northwest annual 2012 5171]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report^[Low Flow Northwest annual 2012 5171]

Statistic	Value	Unit
1 Day 10 Year Low Flow	0.000816	ft ³ /s
7 Day 10 Year Low Flow	0.00117	ft ³ /s
30 Day 10 Year Low Flow	0.00497	ft ³ /s
30 Day 5 Year Low Flow	0.0181	ft ³ /s

Low-Flow Statistics Citations

Eash, D.A., and Barnes, K.K.,2012, Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa: U.S. Geological Survey Scientific Investigations Report 2012-5171, 99 p. (<http://pubs.usgs.gov/sir/2012/5171/>)

Flow-Duration Statistics Parameters^[Statewide Flow Duration 2012 5232]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
----------------	----------------	-------	-------	-----------	-----------

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.84	square miles	15.5	7782
SSURGOC	SSURGO Percent Hydrologic Soil Type C	0	percent	0.09	83.5
PRECIP	Mean Annual Precipitation	32.16	inches	27.7	38
RSD	Relative Stream Density	0.89	dimensionless	0.22	0.49
HYSEP	Hydrograph separation percent	56.48	percent	20.3	78
STREAM_VARG	Streamflow Variability Index from Grid	0.65	dimensionless	0.21	0.76
SSURGOB	SSURGO Percent Hydrologic Soil Type B	100	percent	5.7	99.4
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	57

Flow-Duration Statistics Disclaimers^[Statewide Flow Duration 2012 5232]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report^[Statewide Flow Duration 2012 5232]

Statistic	Value	Unit
1 Percent Duration	9.73	ft ³ /s
5 Percent Duration	8.16	ft ³ /s
10 Percent Duration	5.72	ft ³ /s
15 Percent Duration	0.931	ft ³ /s
20 Percent Duration	0.779	ft ³ /s
30 Percent Duration	0.613	ft ³ /s
40 Percent Duration	0.463	ft ³ /s
50 Percent Duration	0.372	ft ³ /s
60 Percent Duration	0.278	ft ³ /s
70 Percent Duration	0.173	ft ³ /s
80 Percent Duration	0.0497	ft ³ /s
85 Percent Duration	0.0312	ft ³ /s
90 Percent Duration	0.0196	ft ³ /s

Statistic	Value	Unit
95 Percent Duration	0.0073	ft ³ /s
99 Percent Duration	0.00154	ft ³ /s

Flow-Duration Statistics Citations

Linhart, S.M., Nania, J.F., Sanders, C.L., Jr., and Archfield, S.A., 2012, Computing daily mean streamflow at ungaged locations in Iowa by using the Flow Anywhere and Flow Duration Curve Transfer statistical methods: U.S. Geological Survey Scientific Investigations Report 2012–5232, 50 p. (<http://pubs.usgs.gov/sir/2012/5232/>)

Seasonal Flow Statistics Parameters_[Low Flow Northwest Apr Jun 2016 5111]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.84	square miles	7.42	5460
SSURGOA	SSURGO Percent Hydrologic Soil Type A	0	percent	0.014	7.89
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	11.4

Seasonal Flow Statistics Parameters_[Low Flow Northwest Oct Dec 2016 5111]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.84	square miles	7.42	5460
SSURGOA	SSURGO Percent Hydrologic Soil Type A	0	percent	0.014	7.89
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	11.4

Seasonal Flow Statistics Disclaimers_[Low Flow Northwest Apr Jun 2016 5111]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report_[Low Flow Northwest Apr Jun 2016 5111]

Statistic	Value	Unit
Apr to Jun 1 Day 10 Year Low Flow	0.00199	ft^3/s
Apr to Jun 7 Day 10 Year Low Flow	0.00284	ft^3/s
Apr to Jun 30 Day 10 Year Low Flow	0.00841	ft^3/s

Seasonal Flow Statistics Disclaimers[Low Flow Northwest Oct Dec 2016 5111]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report[Low Flow Northwest Oct Dec 2016 5111]

Statistic	Value	Unit
1 Day 10 Year lowflow Oct to Dec	0.0000435	ft^3/s
7 Day 10 Year lowflow Oct to Dec	0.0000728	ft^3/s
Oct_to_Dec_30_Day_10_Year_Low_Flow	0.000286	ft^3/s

Seasonal Flow Statistics Flow Report[Area-Averaged]

Statistic	Value	Unit
Apr to Jun 1 Day 10 Year Low Flow	0.00199	ft^3/s
Apr to Jun 7 Day 10 Year Low Flow	0.00284	ft^3/s
Apr to Jun 30 Day 10 Year Low Flow	0.00841	ft^3/s
1 Day 10 Year lowflow Oct to Dec	0.0000435	ft^3/s
7 Day 10 Year lowflow Oct to Dec	0.0000728	ft^3/s
Oct_to_Dec_30_Day_10_Year_Low_Flow	0.000286	ft^3/s

Seasonal Flow Statistics Citations

Eash, D.A., Barnes, K.K., and O’Shea, P.S.,2016, Methods for estimating selected spring and fall low-flow frequency statistics for ungaged stream sites in Iowa, based on data through June 2014: U.S. Geological Survey Scientific Investigations Report 2016–5111, 32 p. (<http://dx.doi.org/10.3133/sir20165111>)

General Flow Statistics Parameters[Low Flow Northwest annual 2012 5171]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.84	square miles	23.4	5464

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
TAU_ANN_G	Tau Annual from Grid	22.79	days	21.2	35.8
RSD	Relative Stream Density	0.89	dimensionless	0.189	0.511

General Flow Statistics Disclaimers^[Low Flow Northwest annual 2012 5171]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

General Flow Statistics Flow Report^[Low Flow Northwest annual 2012 5171]

Statistic	Value	Unit
Harmonic Mean Streamflow	0.172	ft ³ /s

General Flow Statistics Citations

Eash, D.A., and Barnes, K.K., 2012, Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa: U.S. Geological Survey Scientific Investigations Report 2012-5171, 99 p. (<http://pubs.usgs.gov/sir/2012/5171/>)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

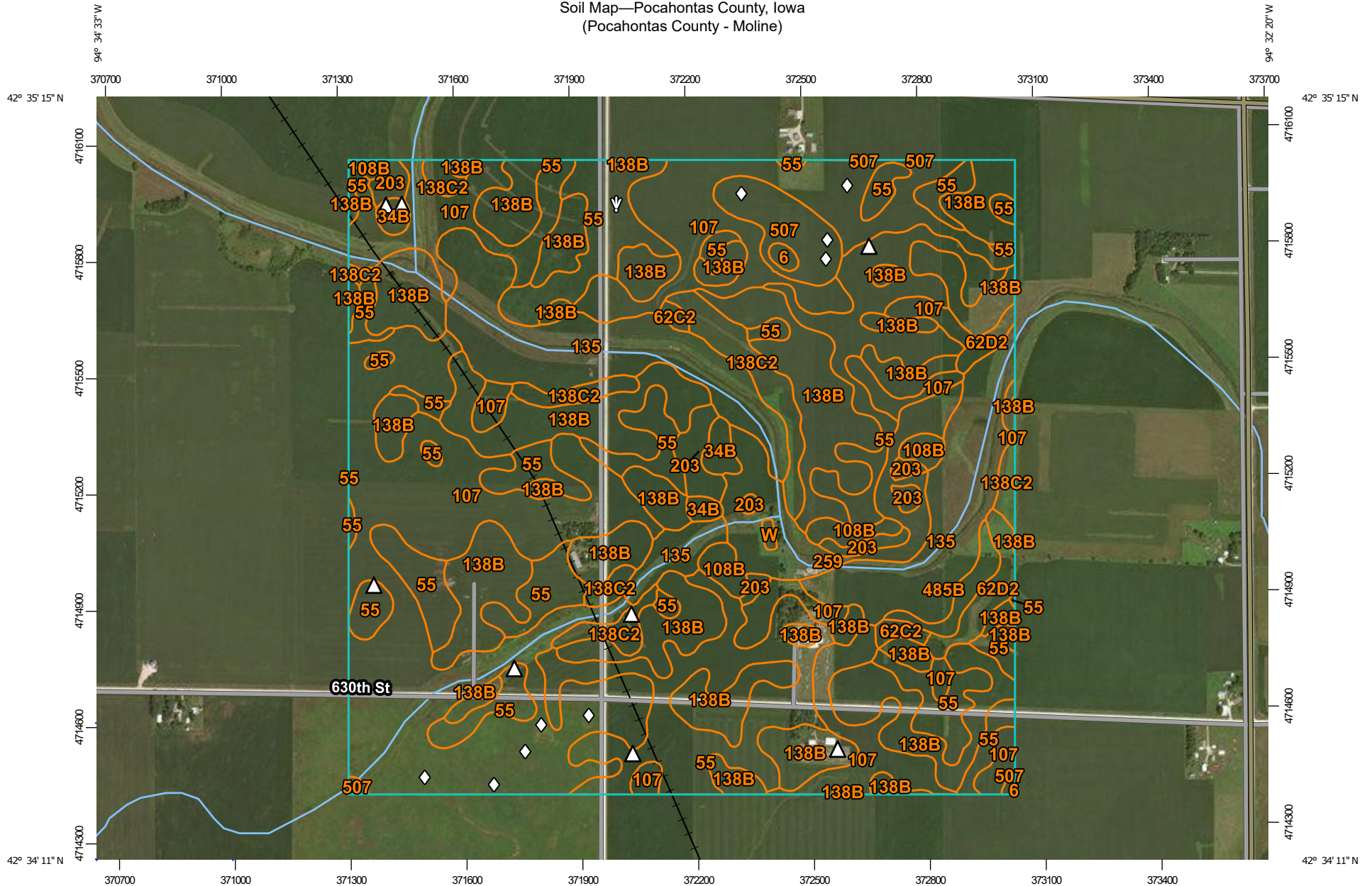
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Application Version: 4.4.0

SECTION 6
NRCS SOIL DATA

Soil Map—Pocahontas County, Iowa
(Pocahontas County - Moline)



Map Scale: 1:13,900 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84


Soil Map—Pocahontas County, Iowa
(Pocahontas County - Moline)


MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)




















Soils






 Soil Map Unit Polygons

 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features






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

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features


Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Pocahontas County, Iowa
Survey Area Data: Version 27, Jun 10, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 12, 2014—Sep 26, 2016

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6	Okoboji silty clay loam, 0 to 1 percent slopes	1.0	0.1%
34B	Estherville sandy loam, 2 to 6 percent slopes	5.4	0.8%
55	Nicollet clay loam, 1 to 3 percent slopes	144.3	20.6%
62C2	Storden loam, 6 to 10 percent slopes, moderately eroded	2.6	0.4%
62D2	Storden loam, 10 to 16 percent slopes, moderately eroded	8.3	1.2%
107	Webster clay loam, 0 to 2 percent slopes	207.8	29.6%
108B	Wadena loam, 2 to 6 percent slopes	8.2	1.2%
135	Coland clay loam, 0 to 2 percent slopes, occasionally flooded	78.6	11.2%
138B	Clarion loam, 2 to 6 percent slopes	169.0	24.1%
138C2	Clarion loam, 6 to 10 percent slopes, moderately eroded	23.9	3.4%
203	Cylinder loam, 0 to 2 percent slopes	11.5	1.6%
259	Biscay clay loam, 0 to 2 percent slopes	23.3	3.3%
485B	Spillville loam, 2 to 5 percent slopes	4.3	0.6%
507	Canisteo clay loam, 0 to 2 percent slopes	12.5	1.8%
W	Water	0.6	0.1%
Totals for Area of Interest		701.1	100.0%

SECTION 7
10-INCH TILE & AGRIDRAIN CALCULATIONS

POCAHONTAS - MOLINE

AGRIDRAIN CALCS.

1/1
4/30/2021

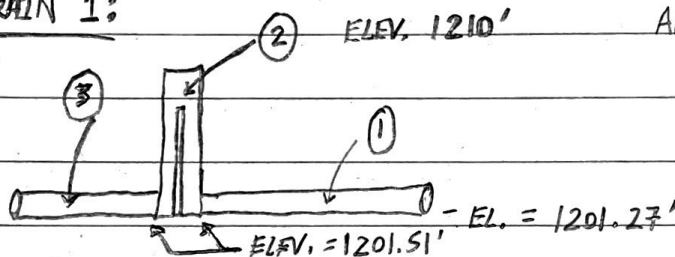
A.A.S.

AREA DRAINED \approx 30 ACRES

USE $0.65 \text{ ft}^3/\text{s}$ (NEH, 650-14.72)

TOTAL LENGTH OF PIPE, $L_T = 1,687 \text{ ft}$.

AGRI-DRAIN 1:



AGRIDRAIN HT. = $1210 - 1201.27$

= $8.73'$

= USE 10' TALL A.D.

① Culvert 10"

TRY 10" AGRIDRAIN:

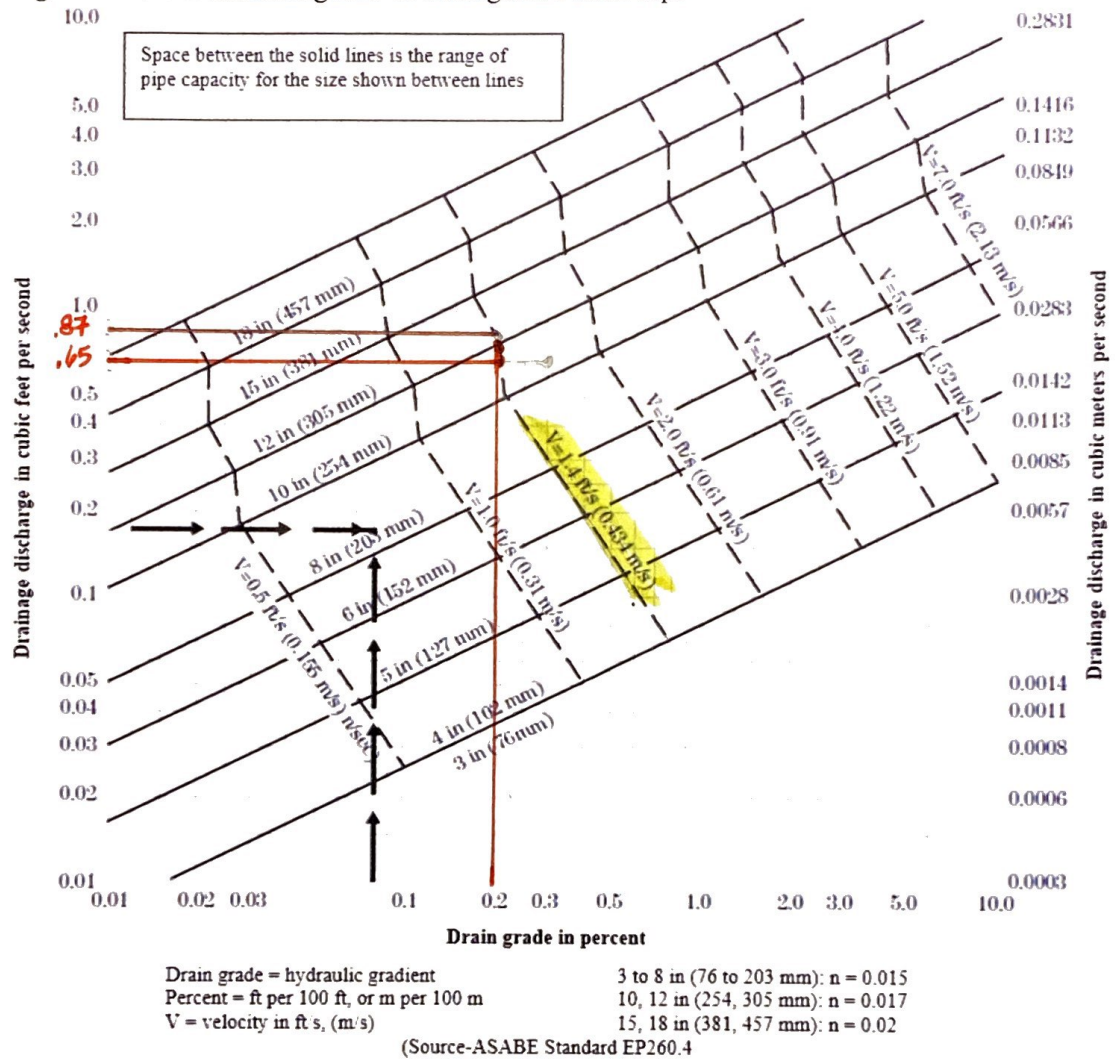
WIDTH = 14"

DEPTH = 16"

PEAK ELEV. $1210.31'$ @ 9.75 HRS. (W/ STOP LOGS AT 1210') OK

PEAK ELEV. $1202.16'$ @ 9.85 HRS. (W/ OUT STOPLOGS) OK

Figure 14-43: Determining Size of Corrugated Plastic Pipe



10" @ .2% SLOPE SHOULD WORK

Moline - Agridrain 1

Prepared by HydroCAD Demo

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Rainfall file not specified

Printed 4/30/2021

Page 2

Summary for Pond 5P: Agridrain 1 w/out Stoplogs (TILE SYSTEM)

[57] Hint: Peaked at 1,202.16' (Flood elevation advised)

[62] Hint: Exceeded Reach 4R OUTLET depth by 0.21' @ 9.85 hrs

Inflow = 0.65 cfs @ 10.80 hrs, Volume= 0.785 af
 Outflow = 0.65 cfs @ 10.80 hrs, Volume= 0.785 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.65 cfs @ 10.80 hrs, Volume= 0.785 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 1,202.16' @ 9.85 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,201.51'	10.0" Round Culvert to Creek L= 80.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,201.51' / 1,201.27' S= 0.0030 ' / Cc= 0.900 n= 0.017, Flow Area= 0.55 sf
#2	Device 1	1,201.51'	13.0" W x 120.0" H Vert. Agridrain w/out Stoplogs C= 0.600 Limited to weir flow at low heads
#3	Device 2	1,201.51'	10.0" Vert. Pipe in to Agridrain C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.65 cfs @ 10.80 hrs HW=1,202.16' (Free Discharge)

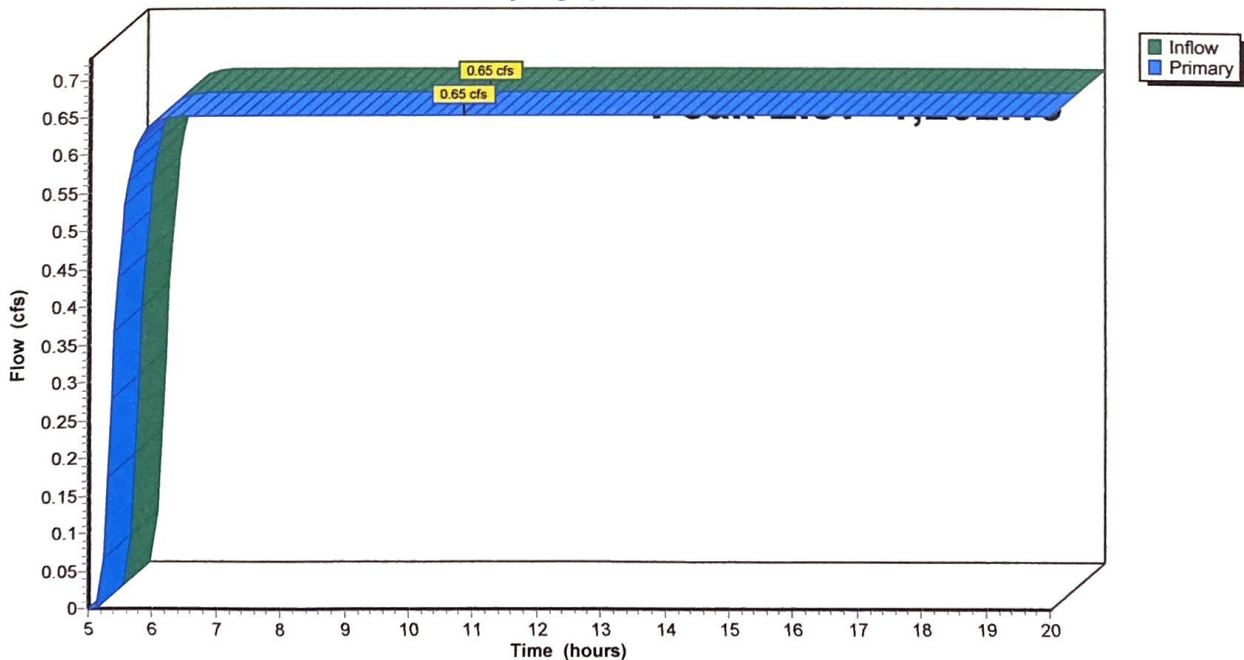
1=Culvert to Creek (Barrel Controls 0.65 cfs @ 1.96 fps)

2=Agridrain w/out Stoplogs (Passes 0.65 cfs of 1.82 cfs potential flow)

3=Pipe in to Agridrain (Passes 0.65 cfs of 1.25 cfs potential flow)

Pond 5P: Agridrain 1 w/out Stoplogs

Hydrograph



Moline - Agridrain 1

Prepared by HydroCAD Demo

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Page 1

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	5P	1,201.51	1,201.27	80.0	0.0030	0.017	0.0	10.0	0.0

Moline - Agridrain 1

Prepared by HydroCAD Demo

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Rainfall file not specified

Printed 4/30/2021

Page 2

Summary for Pond 2P: Agridrain 1 (TILE SYSTEM)

W/STOPLOGS AT 1210'

[57] Hint: Peaked at 1,210.31' (Flood elevation advised)

[62] Hint: Exceeded Reach 3R OUTLET depth by 8.36' @ 9.75 hrs

Inflow = 0.65 cfs @ 10.80 hrs, Volume= 0.785 af
 Outflow = 0.65 cfs @ 10.80 hrs, Volume= 0.785 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.65 cfs @ 10.80 hrs, Volume= 0.785 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 1,210.31' @ 9.75 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,201.51'	10.0" Round Culvert to Creek L= 80.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,201.51' / 1,201.27' S= 0.0030 ' S= 0.0030 ' Cc= 0.900 n= 0.017, Flow Area= 0.55 sf
#2	Device 1	1,210.00'	1.2' long Agridrain Stop Logs 2 End Contraction(s)
#3	Device 2	1,201.51'	10.0" Vert. Pipe in to Agridrain C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.65 cfs @ 10.80 hrs HW=1,210.31' (Free Discharge)

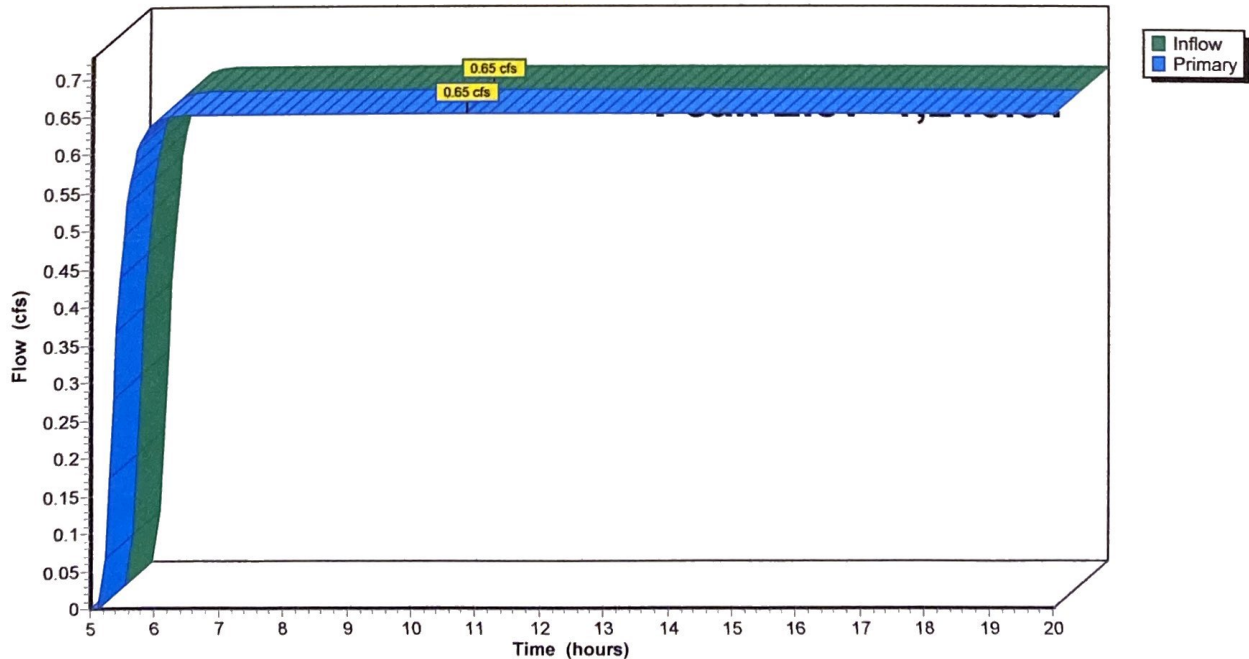
1=Culvert to Creek (Passes 0.65 cfs of 4.62 cfs potential flow)

2=Agridrain Stop Logs (Weir Controls 0.65 cfs @ 1.83 fps)

3=Pipe in to Agridrain (Passes 0.65 cfs of 1.47 cfs potential flow)

Pond 2P: Agridrain 1

Hydrograph



Moline - Agridrain 1

Prepared by HydroCAD Demo

Printed 4/30/2021

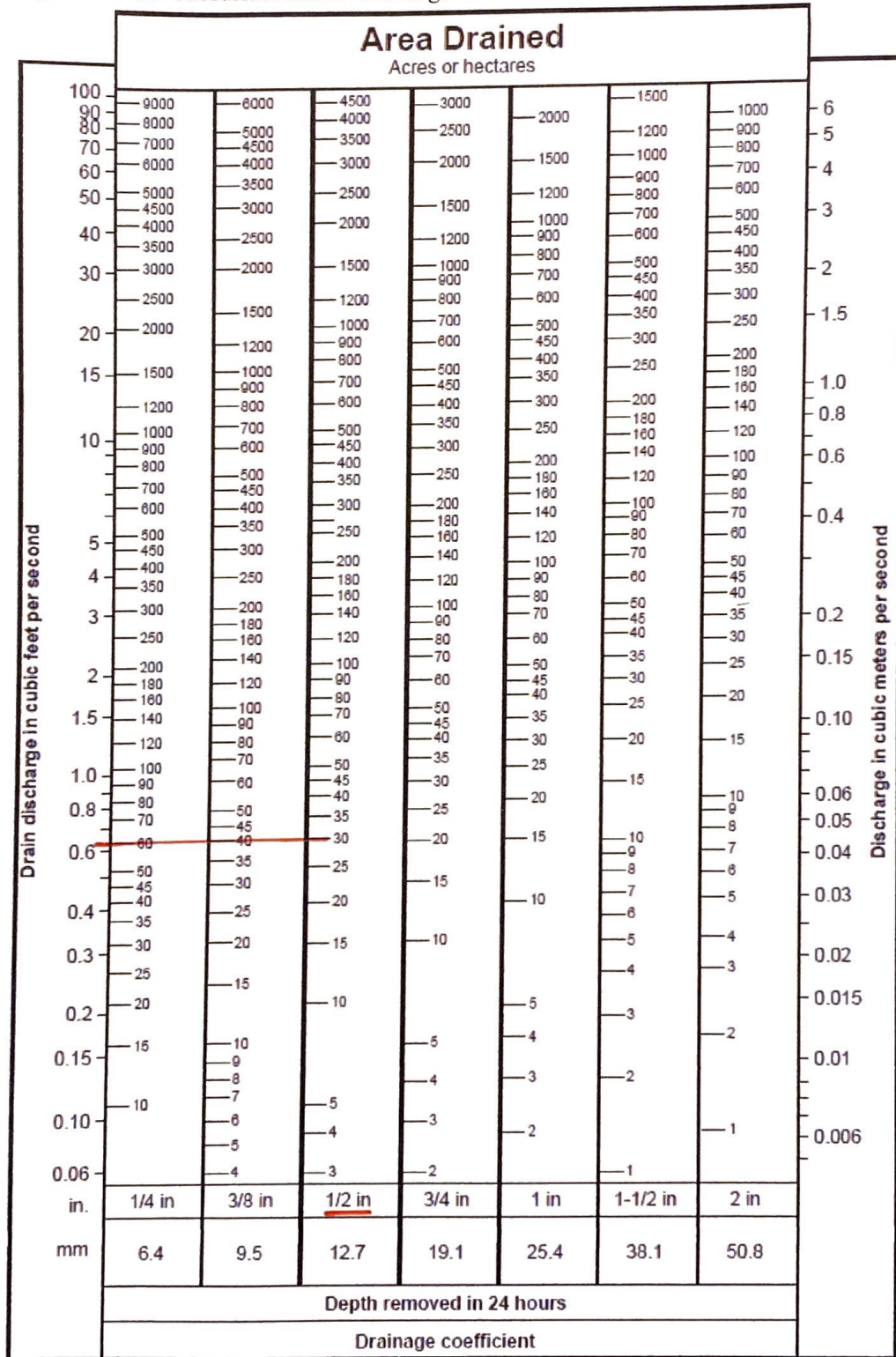
HydroCAD® 10.10-5a s/n 01206 © 2020 HydroCAD Software Solutions LLC

Page 1

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	2P	1,201.51	1,201.27	80.0	0.0030	0.017	0.0	10.0	0.0

Figure 14-42: Subsurface Drain Discharge



Note: Use acres with ft³/s and hectares with m³/s
(Source-ASAE Standard EP260.4)

POCAHONTAS - MOLINE



PROPOSE TILE AREA = 1,249,273.62 A.²
= 28.7 acres

USE 30 ACRES

SECTION 8
5-INCH LATERAL TILE CALCULATIONS

POCAHONTAS - MOULINE

1/2
4/25/21
A.A.S.

DETERMINE SIZE & SLOPE - MIN. & MAX. 5" CPP TILE

Manning's Eq:

CPP 3-8", n = .015 (NEH)

CPP 10", n = .017

$$V = \frac{1.486}{n} r^{2/3} \cdot s^{1/2}$$

V = velocity (1.4 ft/s)

r = hydraulic radius

s = head loss ft/ft. (slope)

Pipe Flowing Full, $r = \frac{D}{4}$

$$s = \left[\frac{V}{\frac{1.486}{n} \cdot r^{2/3}} \right]^2$$

$$r_5 = \frac{.42'}{4} = 0.1042'$$

Assume 8" PIPE (.67' ϕ)

$$r_8 = \frac{.67'}{4} = .1675' \quad r_{10} = .2083'$$

$$s = \left[\frac{1.4 \text{ ft/s}}{\frac{1.486}{.015} \cdot (.1675)^{2/3}} \right]^2$$

$$10" \Rightarrow s = \left[\frac{1.4 \text{ ft/s}}{\frac{1.486}{.017} \cdot (.2083)^{2/3}} \right]^2$$

$$s = 0.002162957 \text{ ft/ft} \\ (.2\% \text{ SLOPE})$$

$$s = 0.002077 \quad 10" \text{ O.K.}$$

CHECK SLOPE FOR 6 ft/s (5" SLOPING IN TO 10")

NOMOGRAPH SHOWS 10" PIPE

RECHECK MANNING'S W/ 10"

$$s = \left[\frac{6 \text{ ft/s}}{\frac{1.486}{.015} \cdot (.1042)^{2/3}} \right]^2$$

$$s = .074809561 \text{ ft/ft}$$

MIN. SLOPE 5" TILE:

$$S = \left[\frac{1.4 \text{ ft/s}}{\frac{1.486}{.015} \times (.1042')^{2/3}} \right]^2$$

S = 0.004072965 ft/ft

MAX. SLOPE 5" TILE:

$$S = \left[\frac{6.0 \text{ ft/s}}{\frac{1.486}{.015} \times (.1042')^{2/3}} \right]^2$$

S = .074809561 ft/ft

$\frac{1.72'}{.0748 \text{ ft/ft}} = 22.99 \text{ ft.}$

$\frac{.72'}{.0748 \text{ ft/ft}} = 9.624 \text{ ft.}$

$\frac{1.15'}{.0748 \text{ ft/ft}} = 15.37 \text{ ft.}$

$\frac{.59'}{.0748 \text{ ft/ft}} = 7.5 \text{ ft.}$

SECTION 9
LATERAL EFFECT CALCULATIONS

POCAHONTAS - MOULINE
LATERAL EFFECT DISTANCE

1/2
 4/24/2021
 A.I.S.

$$L_e = \frac{1}{2} S$$

$$S' = \sqrt{\frac{9(K)(t)(a)}{f' [\ln(m_0(2a+m)) - \ln(m(2a+m_0))]}}$$

SOILS:

203 - Cylinder loam, 0-2% slopes

259 - Biscay clay loam, 0-2% slopes

34B - Esterville sandy loam, 2-6% slopes

K_{SAT}:
 2.44 in/hr
 (WEB SOIL SURVEY)

t = 14 days

D = 10 (NEH, CH. 19); d = 5.21'

a = 4.79

(10 - 5.21' = 4.79)

Avg. Tile Depth (B) = 5.21'

$$f' = f + \left(\frac{s}{m_0 - m} \right)$$

f - drainable porosity

s - water trapped on surface by soil roughness

m - ht. water table above center of drain after time = 4.21'

m₀ - "

" at time zero = 5.21'

Draindown Depth - 12 in.

s = 0.1 in. (NEH, CH. 19) 19-69

f = 0.20 (Soil Survey Pocahontas Cty. pg. 123)

$$f' = 0.20 + \frac{0.1}{12}$$

m₀ = 5.21'

m = 4.21'

$$\frac{2.44 \text{ in.}}{\text{hr.}} \times \frac{1 \text{ ft.}}{12 \text{ in.}} \times \frac{24 \text{ hr.}}{1 \text{ day}}$$

K = 4.88 ft./day

$$f' = 0.2083 \text{ ft./ft.}$$

$$S' = \sqrt{\frac{9(4.88)(14)(4.79)}{0.2083 [\ln(5.21'(2 \times 4.79 + 4.21')) - \ln(4.21'(2 \times 4.79 + 5.21'))]}}$$

2945.28
 2945.28
 ,029809735
 4.131413924

$$S' = 314.3'$$

$$\frac{a}{s'} = \frac{4.79'}{314.3'} = .015 < .3$$

$$d_e = \frac{a}{1 + \left(\frac{a}{s'}\right) \left[\left(\frac{8}{\pi}\right) \ln \left(\frac{a}{r_e}\right) - 3.4 \right]}$$

$$r_e (5'' \text{ tile}) = 0.034'$$

$$d_e = \frac{4.79'}{1 + \left(\frac{4.79'}{314.3'}\right) \left[\left(\frac{8}{\pi}\right) \ln \left(\frac{4.79'}{0.034'}\right) - 3.4 \right]} = \frac{4.79'}{1.140206759}$$

9.199787971

$$d_e = 4.2'$$

$$S = \sqrt{\frac{9 (4.88') (14) (4.2')}{.2083 \left[\ln (5.21' (2 \times 4.2 + 4.21')) - \ln (4.21' (2 \times 4.2 + 5.21')) \right]}} = \frac{2582.496}{.028495969}$$

4.785070006 4.048267464

$$S = 301.04'$$

$$\frac{314.3' - 301.04'}{301.04'} \times 100 = 4.4\% \quad \underline{\text{OK}}$$

USE 300'

Saturated Hydraulic Conductivity (Ksat), Standard Classes

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
34B	Estherville sandy loam, 2 to 6 percent slopes	74.1744	1.8	5.3%
55	Nicollet clay loam, 1 to 3 percent slopes	6.1807	5.5	16.1%
107	Webster clay loam, 0 to 2 percent slopes	5.5260	2.7	7.9%
135	Coland clay loam, 0 to 2 percent slopes, occasionally flooded	5.9696	3.9	11.3%
138B	Clarion loam, 2 to 6 percent slopes	8.8557	14.5	42.3%
138C2	Clarion loam, 6 to 10 percent slopes, moderately eroded	9.1700	1.8	5.1%
203	Cylinder loam, 0 to 2 percent slopes	59.2941	4.1	11.8%
Totals for Area of Interest			34.3	100.0%

$$\begin{aligned}
 & (74.1744 \times .053) + (6.1807 \times .161) + (5.5260 \times .079) + (5.9696 \times .113) \\
 & + (8.8557 \times .423) + (9.17 \times .051) + (59.2941 \times .118)
 \end{aligned}$$

9.7834158

$$\begin{aligned}
 K_{SAT, WT.} &= 17.25 \text{ mm/s} \\
 &= 2.44 \text{ in./hr.} \\
 &= 4.08 \text{ ft./day}
 \end{aligned}$$

2.44 in.

★ AREA OF INTEREST CHOSEN AT APPROX. LOCATION OF WHERE REMAINING PATTERN TILE SYSTEM WILL BE. USED A DEPTH RANGE OF 0-10'

SECTION 10
SEDIMENT ACCUMULATION CALCULATIONS

DU PROJECT NO.: IA-340-3
 IDALS PROJECT NO.: POC903130C
 DESIGNED BY: A.S.
 DATE:

SEDIMENT ACCUMULATION

CONTRIBUTING DRAINAGE AREA ¹ :	1177.6 ACRES	1.840	SQMI
STORAGE VOLUME AT NWL ¹ :		9.57	AC-FT
TRAP EFFICIENCY ² :		90	PERCENT
AVG. ANNUAL SHEET AND RILL EROSION ³ :		5.0	TONS/AC/YR
AREA OF DEPRESSIONS NOT SUBJECT TO SEDIMENT DELIVERY ¹ :		0	ACRES
AREA SUBJECT TO SHEET AND RILL EROSION ¹ :		1,178	ACRES
AVG. ANNUAL SHEET AND RILL EROSION:		5,888	TONS/YR
DELIVERY RATIO ² :		6.0	PERCENT
SHEET AND RILL EROSION DELIVERED TO SITE:		353	TONS/YR
ADJUSTMENT FOR LRA 103 ⁴ :		1.3	FACTOR
ADJUSTED SHEET AND RILL EROSION DELIVERED:		459	TONS/YR
LENGTH OF GULLY EROSION ¹ :		1,700	FT
AVG. ANNUAL GULLY EROSION RATE ² :		0.25	FT ³ /FT
IN-PLACE DENSITY OF GULLY MATERIAL ² :		90	LB/FT ³
AVG. ANNUAL GULLY EROSION (100% DELIVERED):		19	TON/YR
TOTAL SEDIMENT DELIVERED:		478	TON/YR
WEIGHT OF SEDIMENT RETAINED IN WETLAND AT 90 PERCENT TRAPPED:		431	TON/YR
SEDIMENT ACCUMULATION DURING 150 YEAR PERIOD:		64,583	TONS
ESTIMATE 80 PERCENT OF DELIVERED SEDIMENT WILL BE SUBMERGED ⁵ :		51,666	TONS
VOLUME OF SUBMERGED SEDIMENT ⁵ AT 1,307 TON/AC-FT ² :		39.53	AC-FT
NORMAL POOL VOLUME 9.570 AC-FT	WETLAND STORAGE EXCEEDED		
ESTIMATE 20 PERCENT OF DELIVERED SEDIMENT WILL BE AERATED ⁵ :		12,917	TONS
VOLUME OF AERATED SEDIMENT ⁵ AT 1,742 TON/AC-FT ² :		7.41	AC-FT
WETLAND SEDIMENTATION ACCUMULATION DESIGN STORAGE LIFE:		36	YEARS

REFERENCES:

- ¹ DETERMINED BY ENGINEER.
- ² NRCS, FIELD OFFICE TECHNICAL GUIDE, IOWA, "EROSION AND SEDIMENT DELIVERY", MARCH 1998.
- ³ NATIONAL ACADEMICS PRESS, "SOIL CONSERVATION", CHAPTER 1, PG. 8.
- ⁴ NATIONAL ACADEMICS PRESS, "SOIL CONSERVATION", CHAPTER 3, PG. 51.
- ⁵ NATIONAL ENGINEERING HANDBOOK, CHAPTER 8, SEDIMENT-STORAGE DESIGN CRITERIA.

SECTION 11
CTS GEOTECHNICAL REPORT



Certified Testing Services, Inc.

GEOTECHNICAL ENGINEERING REPORT

**Moline C101 Site
Project US-IA-340-3
Pocahontas County, IA**

Prepared For:
Ducks Unlimited
Grimes, Iowa

CTS Project No. G6970



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa.

Signature: *Matthew R. Dailey* 4-7-2023

Name: Matthew R. Dailey, P.E. (date)

License Number: 19700

My license renewal date is December 31, 2023.

Pages or sheets covered by this seal:

This bound report contains 26 pages, including this page.
CTS File Number G6970



Certified Testing Services, Inc.

419 W. 6th Street • P.O. Box 1193 • Sioux City, Iowa 51102 • Phone (712) 252-5132

April 7, 2023

Attn: Mr. Andrew Schippers, P.E.
Regional Engineer
Ducks Unlimited
Great Lakes Atlantic Regional Office
3300 SE Glenstone Drive, Unit 1
Grimes, Iowa 50111

RE: Geotechnical Engineering Report
Moline C101 Site
Project US-IA-340-3
Pocahontas County, Iowa
CTS Job No. G6970

Dear Mr. Schippers:

Certified Testing Services, Inc. is pleased to transmit our Geotechnical Engineering Report for the referenced project. This report includes the results of field and laboratory testing and groundwater information.

We appreciate the opportunity to perform this Geotechnical Study and look forward to continued participation during the construction phases of this project. If you have any questions pertaining to this report or if we may be of further service, please contact our office.

Respectfully submitted,
CERTIFIED TESTING SERVICES, INC.



James A. Bertsch, P.E. IA 12121
Senior Geotechnical Engineer



Matthew R. Dailey, P.E. IA 19700
Geotechnical Department Manager

JAB/MRD/jb

GEOTECHNICAL ENGINEERING REPORT

**MOLINE C101 SITE
PROJECT US-IA-340-3
POCAHONTAS COUNTY, IOWA**

CTS PROJECT NO. G6970

PREPARED FOR

**ATTN: MR. ANDREW SCHIPPERS, P.E.
REGIONAL ENGINEER
DUCKS UNLIMITED
GREAT LAKES ATLANTIC REGIONAL OFFICE
3300 SE GLENSTONE DRIVE, UNIT 1
GRIMES, IOWA 50111**

APRIL 7, 2023

TABLE OF CONTENTS

	Page No.
PROJECT INFORMATION	1
Project Authorization	1
Project Description.....	1
Purpose and Scope of Services	1
 SITE AND SUBSURFACE CONDITIONS	 1
Site Location and Description.....	1
Subsurface Conditions	2
Water Level Measurements.....	3
 EVALUATION AND RECOMMENDATIONS	 3
Laboratory Data	3
 REPORT LIMITATIONS	 3
 Appendix	
Boring Location Plan	
Boring Logs	
Boring Profiles	
Laboratory Test Data	
Soil Classification Chart and General Notes	

PROJECT INFORMATION

Project Authorization

Certified Testing Services, Inc. has completed a subsurface exploration for the Moline C101 Site Project. Our work was authorized through Ducks Unlimited's Consultant Agreement dated March 7, 2023. This work was performed in general accordance with CTS Proposal Number 6307 dated March 2, 2023.

Project Description

Mr. Andrew Schippers, P.E., Regional Engineer for Great Lakes Atlantic Regional Office of Ducks Unlimited, presented project information through emails on February 27 and 28, 2023. The email on February 27, 2023, included Drawing GLARO-340-3-C101 that was titled, "Pocahontas – Moline C101 Site Plan", showing the location of the borings and boring depth information.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site in order to provide laboratory soil data for the materials encountered at the boring locations. Our scope of services included performing Borings B1, B3, B4, and B6 to depths of depths of 25 feet below the existing grade and Borings B2 and B5 to depths of 20 feet below the existing grade in the wetland area at locations chosen by Ducks Unlimited personnel. The original scope of work also included select laboratory testing that included unit weight at the existing moisture content, in-situ moisture content, and unconfined compressive strength on each clay samples, and a #200 wash on each granular material to determine percent sand and percent material passing the #200 sieve and one hydrometer on a granular material per boring; however, it should be noted that due to minimum sample recovery of the poorly graded sand encountered between the depths of 9 feet and 10.5 feet in Boring B3 could not be tested in the laboratory. The scope of work also included the preparation of this geotechnical report. This report briefly outlines the testing procedures, describes the site and subsurface conditions, and presents soils design parameters requested by Mr. Schippers. The scope of services does not include an environmental assessment of the site.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The site for the proposed wetland is located northeast of the intersection of 280th Avenue and 630th Street in Pocahontas County, Iowa.. The site is bordered by South Branch Lizard Creek to the north and east, 280th Street to the west and agricultural field to the south. At the time of drilling, the site surface consisted of a harvested agricultural field. The site was soft at the time of our site visit and the drill rig did experience some difficulty moving around the site.

Subsurface Conditions

The site subsurface conditions were explored with six soil test borings sampled to depths ranging from 20 feet to 25 feet below the existing ground surface at locations chosen by Ducks Unlimited personnel. The boring depths were also chosen by Ducks Unlimited personnel. CTS located the borings in the field using a handheld GPS device. The following table presents the approximate GPS coordinates and elevations for the boring locations and the approximate locations of the borings are also presented on the “Boring Location Plan” included in the Appendix, which is a modified copy of drawing titled, “Pocahontas – Moline C101 Site Plan”. Boring B2 was used as a benchmark and an elevation of 1207.2 feet was interpolated from the information provided on the drawing titled, “Pocahontas – Moline C101 Site Plan”.

BORING NUMBER	BORING LOCATION	BORING ELEVATIONS
B1	42.58039° N; -94.55560° W	1210.6'
B2	42.57978° N; -94.55571° W	1207.2'
B3	42.57959° N; -94.55497° W	1209.3'
B4	42.57887° N; -94.55486° W	1207.7'
B5	42.57867° N; -94.55528° W	1207.8'
B6	42.57828° N; -94.55485° W	1205.1'

The borings were advanced utilizing hollow stem auger drilling methods and soil samples were routinely obtained during the drilling process. Select soil samples were later tested in the laboratory to determine the material’s engineering properties. Soil sampling and laboratory testing were accomplished generally in accordance with ASTM procedures. The borings were backfilled with on-site material after performing our work; however, it should be noted that some settlement of the backfill material may occur and it is the client’s responsibility to backfill the borings once we have left the site.

The subsurface conditions below the surface material generally consisted of lean clay with sand fill, lean clay with sand alluvium, sandy lean clay with gravel alluvium, poorly graded sand with clay glacial sand, lean clay glacial outwash, sandy lean clay glacial outwash, lean clay with sand glacial outwash, lean clay with sand weathered glacial till, and lean clay with sand glacial till. It should be noted that the sand material encountered below the water table was not tested for natural moisture content in the laboratory.

The boring logs included in the Appendix should be reviewed for specific information at the individual boring locations. The boring logs include soil/rock descriptions, stratifications, penetration resistances, and locations of the samples and laboratory test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected at locations other than the boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during

field operations is also shown on the boring logs. Samples that were not altered by laboratory testing will be retained for 30 days from the date of this report and then will be discarded.

Water Level Measurements

Free water was encountered in Borings B3 and B4 at depths ranging from 9 feet to 10.5 feet below the existing grade at the time of drilling. It should be noted that with the relatively impervious materials encountered at the site that a long monitoring time would be required to determine the static water level. Water levels should be expected to fluctuate with changes in climatic conditions. The water level measurements presented in this report are the levels that were measured at the time of our field activities and are presented in the following table, as well as the estimated seasonal high water level.

Boring Number	Elevation of Water at Time of Drilling	Seasonal High Water Level*
B1	N/A	1201.6 Feet
B2	N/A	1206.2 Feet
B3	1200.3 Feet	1200.3 Feet
B4	1197.2 Feet	1197.2 Feet
B5	N/A	1197.8 Feet
B5	N/A	1200.1.3 Feet

* Based on discoloration of soils and groundwater level encountered

EVALUATIONS AND RECOMMENDATIONS

Laboratory Data

The laboratory data that includes the unit weight at the existing moisture content, in-situ moisture content, and unconfined compressive strength of the clay materials is presented in the "Laboratory Data" section of the Appendix. It should be noted that sand was only encountered in Boring B3 and based on minimal sample recovery of the sand, the sand was not tested in the laboratory.

REPORT LIMITATIONS

The laboratory data submitted is for the subsurface information obtained by CTS. Deviations from the subsurface conditions noted in this report will likely be encountered during construction.

This report has been prepared for the exclusive use of Ducks Unlimited and their consultants for the specific application to the proposed Moline C101 Wetland Project US-IA-340-3 in Pocahontas County, Iowa.

APPENDIX

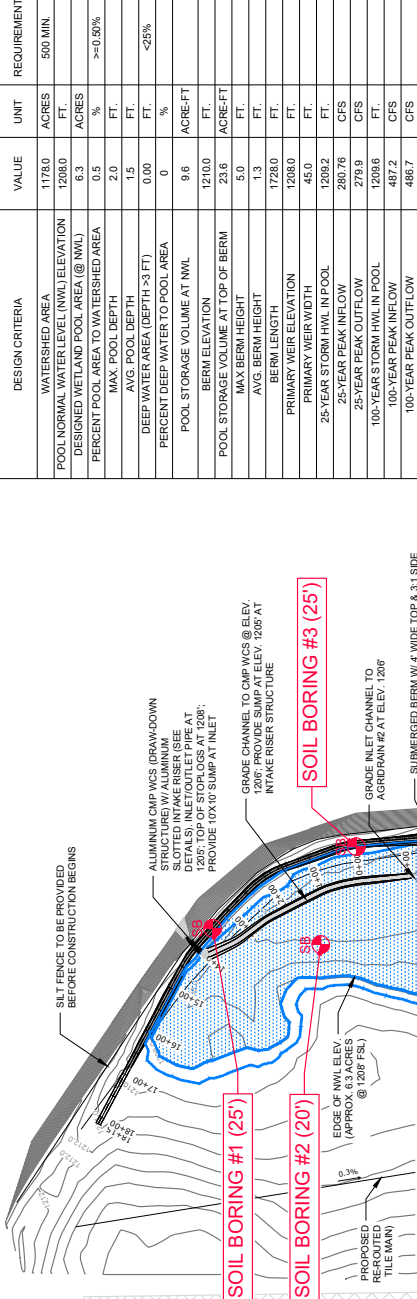
BORING LOCATION PLAN

SOIL BORING SCOPE 2-23-23

NOTE: CONTRACTOR SHALL PROVIDE ADDITIONAL GRADING, AS NECESSARY, TO PREVENT PONDING WATER AGAINST BACKSIDE OF BERM. THIS SHALL BE CONSIDERED INCIDENTAL TO BERM CONSTRUCTION.

NOTE: SILT FENCE TO BE PROVIDED STARTING AT EXISTING 1209' CONTOUR BEFORE CONSTRUCTION BEGINS.

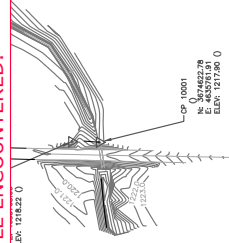
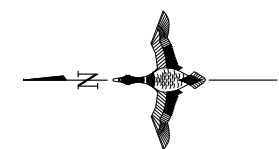
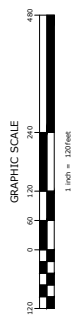
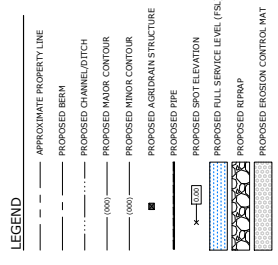
EXCESS SPILL MATERIAL SHALL BE PLACED AT THIS LOCATION AT 6' DEPTH



- NOTES:**
1. SAMPLES SHALL BE TAKEN EVERY 5'.
 2. FOR CLAY SAMPLES, USE 3"Ø SHELBY TUBES.
 3. FOR SANDY SOILS, USE SPLIT SPOON.
 4. FOR PREDOMINATELY COHESIVE/CLAY MATERIALS, PROVIDE DENSITY, MOISTURE CONTENT, AND UNCONFINED COMPRESSIVE STRENGTH ON EACH SAMPLE.
 5. FOR PREDOMINATELY SANDY MATERIALS, PROVIDE % FINES FOR EACH SAND SAMPLE (% PASSING #200) AND ONE FULL GRADATION PER BORING. ALSO INCLUDE N (BLOW COUNTS) FOR EACH SAND SAMPLE ENCOUNTERED.

DESIGN CRITERIA	VALUE	UNIT	REQUIREMENT
WATERSHED AREA	1178.0	ACRES	500 MIN
POOL NORMAL WATER LEVEL (NWL) ELEVATION	1208.0	FT.	
DESIGNED WETLAND POOL AREA (@ NWL)	6.3	ACRES	
PERCENT POOL AREA TO WATERSHED AREA	0.5	%	≥0.50%
MAX POOL DEPTH	2.0	FT.	
AVG POOL DEPTH	1.5	FT.	
DEEP WATER AREA (DEPTH ≥3 FT)	0.00	FT.	<25%
PERCENT DEEP WATER TO POOL AREA	0	%	
POOL STORAGE VOLUME AT NWL	9.6	ACRE-FT	
BERM ELEVATION	1210.0	FT.	
POOL STORAGE VOLUME AT TOP OF BERM	23.6	ACRE-FT	
MAX BERM HEIGHT	5.0	FT.	
AVG BERM HEIGHT	1.3	FT.	
BERM LENGTH	1728.0	FT.	
PRIMARY WEIR ELEVATION	1208.0	FT.	
25-YEAR STORM HWL IN POOL	1208.2	FT.	
25-YEAR PEAK INFLOW	2807.6	CFS	
100-YEAR STORM HWL IN POOL	1206.6	FT.	
100-YEAR PEAK INFLOW	487.2	CFS	
100-YEAR PEAK OUTFLOW	486.7	CFS	

WETLAND POOL CHARACTERISTICS	WETLAND POOL DEPTH	ELEV.	INCREMENTAL AREA (ACRE)	CUMULATIVE VOLUME (ACRE-FT)
	0.0	1206.0	0.558	-
	1.0	1207.0	5.850	3.49
	2.0	1208.0	6.304	9.57
	3.0	1209.0	6.712	16.72
	4.0	1210.0	8.599	23.61



BORING LOGS

LOG OF EXPLORATORY BORING



Job Number: G6970
Project: Moline C101 Site
Date Started: 3/28/23
Date Completed: 3/28/23

Boring No.: B-1
Boring Location: Pocahontas Co., IA
Drill Type: Hollow Stem
Ground Elev.: 1210.6

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 36-Inch Frost Depth FILL, Lean Clay with Sand, Dark Brown and Light Brownish Gray, Wet to Moist (Gravel Layer)			19	109	100	4.50	4.60				
5						22	89	66	4.50	1.10				
10			LEAN CLAY WITH SAND, Dark Brownish Gray to Light Gray, Very Moist, Alluvium	CL	4-3-5 N= 8	14								
			SANDY LEAN CLAY WITH GRAVEL, Light Gray, Very Moist, Stiff, Alluvium	CL										
15			LEAN CLAY WITH SAND, Dark Gray, Very Moist, Glacial Till	CL		18	112	97	1.50	1.60				
20						18	111	97	2.50	1.90				
25			END OF BORING AT 25 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING			17	112	95	4.50	3.10				

LOG OF BORING_G6970.GPJ_CERTIFIED TESTING.GDT_4/6/23

LOG OF EXPLORATORY BORING



Job Number: G6970
Project: Moline C101 Site
Date Started: 3/29/23
Date Completed: 3/29/23

Boring No.: B-2
Boring Location: Pocahontas Co., IA
Drill Type: Hollow Stem
Ground Elev.: 1207.2

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
		Shelby Tube Modified California Standard Split Spoon Grab Sample Water Level ATD Cave-In Level												
0			12-Inch Root and Disturbed Zone, 36-Inch Frost Depth											
0			SANDY LEAN CLAY, Dark Gray Brown, Moist, Glacial Outwash	CL		14	113	79	4.50	2.10				
5			(Sand Lense)											
5			LEAN CLAY WITH SAND, Medium Gray, Very Moist, Stiff, Weathered Glacial Till (Gravel)	CL	3-5-5 N= 10	17								
10			LEAN CLAY WITH SAND, Medium Gray, Very Moist, Glacial Till	CL		18	112	97	1.25	1.40				
15						18	111	98	1.25	1.60				
20						17	115	98	2.25	2.00				
20			END OF BORING AT 20 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING



Job Number: G6970
Project: Moline C101 Site
Date Started: 3/28/23
Date Completed: 3/28/23

Boring No.: B-3
Boring Location: Pocahontas Co., IA
Drill Type: Hollow Stem
Ground Elev.: 1209.3

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 36-Inch Frost Depth FILL, Lean Clay with Sand, Dark Brown and Light Brownish Gray, Moist			12	115	73	4.50	1.60				
5						16	109	83	4.50	6.70				
10			POORLY GRADED SAND WITH CLAY, Grayish Yellow Brown, Wet, Glacial Sand LEAN CLAY WITH SAND, Medium Gray, Wet, Glacial Outwash (Sand Lense)	SP-SC CL	4-4-5 N= 9	22								
15			LEAN CLAY WITH SAND, Medium Gray, Very Moist, Weathered Glacial Till	CL	1-4-5 N= 9	19								
20						18	112	99	1.50	1.60				
25			END OF BORING AT 25 FEET FREE WATER WAS ENCOUNTERED AT 9 FEET AT TIME OF DRILLING			18	113	100	2.50	1.60				

LOG OF BORING G6970.GPJ CERTIFIED TESTING.GDT 4/6/23

LOG OF EXPLORATORY BORING



Job Number: G6970
Project: Moline C101 Site
Date Started: 3/29/23
Date Completed: 3/29/23

Boring No.: B-4
Boring Location: Pocahontas Co., IA
Drill Type: Hollow Stem
Ground Elev.: 1207.7

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
		Shelby Tube Modified California Standard Split Spoon Grab Sample Water Level ATD Cave-In Level												
			12-Inch Root and Disturbed Zone, 36-Inch Frost Depth FILL, Lean Clay with Sand, Dark Brown, Very Moist			17	110	91	4.50	2.80				
5			LEAN CLAY WITH SAND, Black, Moist to Wet, Glacial Outwash (Gravel)	CL		18	98	67	3.75	4.00				
10			(Medium Gray)		5-4-4 N= 8	19								
					3-4-5 N= 9									
15			LEAN CLAY WITH SAND, Medium Gray, Very Moist, Glacial Till	CL		15	116	94	2.75	2.40				
20						17	113	94	2.00	1.70				
25			END OF BORING AT 25 FEET FREE WATER WAS ENCOUNTERED AT 10.5 FEET AT TIME OF DRILLING			19	111	99	0.75	1.30				

LOG OF BORING G6970.GPJ CERTIFIED TESTING.GDT 4/6/23

LOG OF EXPLORATORY BORING



Job Number: G6970
Project: Moline C101 Site
Date Started: 3/29/23
Date Completed: 3/29/23

Boring No.: B-5
Boring Location: Pocahontas Co., IA
Drill Type: Hollow Stem
Ground Elev.: 1207.8

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
		Shelby Tube Modified California Standard Split Spoon Grab Sample Water Level ATD Cave-In Level												
			12-Inch Root and Disturbed Zone, 36-Inch Frost Depth FILL, Lean Clay with Sand, Brownish Gray and Dark Brown, Moist			15	113	86	4.50	3.50				
5			LEAN CLAY, Black, Moist, Glacial Outwash	CL		24	82	63	2.00	1.00				
10			LEAN CLAY WITH SAND, Brownish Gray, Very Moist, Oxidized, Weathered Glacial Till	CL		21	107	100	1.75	1.80				
15			(Dark Gray)			18	111	97	2.00	1.70				
20			LEAN CLAY WITH SAND, Medium Gray, Very Moist, Glacial Till	CL		16	115	95	3.25	3.50				
			END OF BORING AT 20 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING



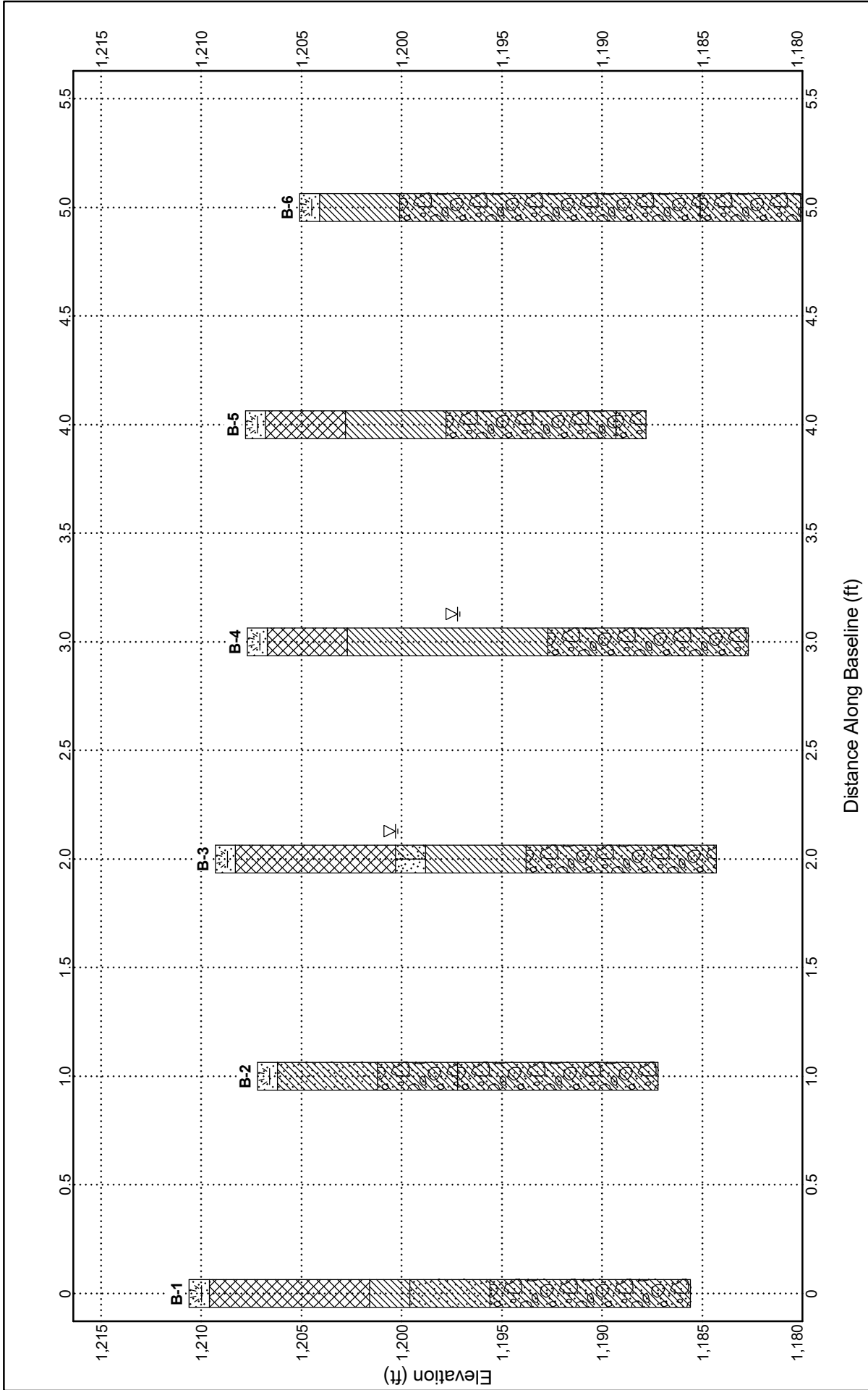
Job Number: G6970
Project: Moline C101 Site
Date Started: 3/29/23
Date Completed: 3/29/23

Boring No.: B-6
Boring Location: Pocahontas Co., IA
Drill Type: Hollow Stem
Ground Elev.: 1205.1

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 36-Inch Frost Depth LEAN CLAY, Black, Very Moist, Glacial Outwash	CL		22	96	81	4.50	2.10				
5			LEAN CLAY WITH SAND, Medium Gray and Brownish Gray, Very Moist, Oxidized, Weathered Glacial Till	CL		22	104	97	2.50	1.30				
10			(Dark Gray)			18	110	96	1.75	1.50				
15			(Gravel)			19	110	97	3.50	1.60				
20			LEAN CLAY WITH SAND, Medium Gray, Very Moist, Glacial Till	CL		13	122	94	4.25	6.50				
25			END OF BORING AT 25 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING			12	123	88	4.50	5.90				

LOG OF BORING G6970.GPJ CERTIFIED TESTING.GDT 4/16/23

BORING PROFILES



Certified Testing Services, Inc.
419 W. 6th Street, PO Box 1193
Sioux City, Iowa 51102
Telephone: 712-252-5132
Fax: 712-252-0110

Moline C101 Site
Pocahontas Co., IA

LABORATORY TEST DATA

BORING B-1

Material	Moisture Content (%)	Moist Unit Weight (PCF)	Unconfined Compressive Strength (TSF)	Standard Penetration Test (BPF)
Lean Clay Fill (0' to 5')	19.4	130.5	4.6	-
Lean Clay Fill (5' to 9')	21.7	108.3	1.1	-
Sandy Lean Clay (9' to 15')	14.2	-	-	8
Glacial Till (15' to 20')	17.8	131.6	1.6	-
Glacial Till (20' to 23.5')	18.1	131.6	1.9	-
Glacial Till (23.5' to 25')	17.3	128.7	3.1	-

BORING B-2

Material	Moisture Content (%)	Moist Unit Weight (PCF)	Unconfined Compressive Strength (TSF)	Standard Penetration Test (BPF)
Sandy Lean Clay (0' to 6')	13.8	128.1	2.1	-
Weathered Glacial Till (6' to 10')	17.4	-	-	10
Glacial Till (10' to 15')	17.6	131.5	1.4	-
Glacial Till (15' to 18.5')	18.4	131.7	1.6	-
Glacial Till (18.5' to 20')	16.7	133.7	2.0	-

BORING B-3

Material	Moisture Content (%)	Moist Unit Weight (PCF)	Unconfined Compressive Strength (TSF)	Standard Penetration Test (BPF)
Lean Clay Fill (0' to 5')	12.2	128.7	1.6	-
Lean Clay Fill (5' to 9')	16.3	127.2	6.7	-
Sand (9' to 10.5')	-	-	-	-
Glacial Outwash (10.5' to 15.5')	22.2	-	-	9
Glacial Till (15.5' to 20')	19.1	-	-	9
Glacial Till (20' to 23.5')	18.2	132.0	1.6	
Glacial Till (23.5' to 25')	17.8	132.9	1.6	-

BORING B-4

Material	Moisture Content (%)	Moist Unit Weight (PCF)	Unconfined Compressive Strength (TSF)	Standard Penetration Test (BPF)
Lean Clay Fill (0' to 5')	17.1	129.3	2.8	-
Glacial Outwash (5' to 10')	17.5	115.5	4.0	-
Glacial Outwash (10' to 15')	18.9	-	-	8
Glacial Till (15' to 20')	15.1	134.1	2.4	
Glacial Till (20' to 23.5')	17.0	131.7	1.7	
Glacial Till (23.5' to 25')	18.9	131.5	1.3	-

BORING B-5

Material	Moisture Content (%)	Moist Unit Weight (PCF)	Unconfined Compressive Strength (TSF)	Standard Penetration Test (BPF)
Lean Clay Fill (0' to 5')	15.0	128.7	3.5	-
Glacial Outwash (5' to 10')	23.9	102.2	1.0	-
Weathered Glacial Till (10' to 15')	20.8	128.8	1.8	-
Weathered Glacial Till (15' to 18.5')	18.1	131.4	1.7	-
Glacial Till (18.5' to 20')	15.9	133.4	3.5	-

BORING B-6

Material	Moisture Content (%)	Moist Unit Weight (PCF)	Unconfined Compressive Strength (TSF)	Standard Penetration Test (BPF)
Glacial Outwash (0' to 5')	22.0	117.1	2.1	-
Weathered Glacial Till (5' to 10')	21.9	126.7	1.3	-
Weathered Glacial Till (10' to 15')	18.3	130.0	1.5	-
Weathered Glacial Till (15' to 20')	18.6	130.9	1.6	-
Glacial Till (20' to 23.5')	12.7	137.9	6.5	-
Glacial Till (23.5' to 25')	11.8	137.0	5.9	-

SOIL CLASSIFICATION CHART AND GENERAL NOTES

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
<p>COARSE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p>GRAVEL AND GRAVELLY SOILS</p>	<p>CLEAN GRAVELS</p> <p>(LITTLE OR NO FINES)</p>		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	<p>SAND AND SANDY SOILS</p>	<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		SM	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES	
	<p>FINE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT LESS THAN 50</p>		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT GREATER THAN 50</p>			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
<p>HIGHLY ORGANIC SOILS</p>				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GENERAL NOTES

SAMPLING SYMBOLS:

	STANDARD PENETRATION TEST – 1 3/8" I.D., 2" O.D.
	SHELBY THIN-WALLED TUBE – 3" O.D. UNDISTURBED SAMPLE
	GRAB SAMPLE
	ROCK CORE
	AUGER SAMPLE
	NO RECOVERY

WATER LEVEL MEASUREMENT SYMBOLS:

	WATER LEVEL AT TIME OF DRILLING
	WATER LEVEL AFTER 7 DAYS

CONSISTENCY OF FINE-GRAINED SOILS	
UNCONFINED COMPRESSIVE STRENGTH, QU, PSF	CONSISTENCY
< 500	VERY SOFT
500 - 1,000	SOFT
1,001 - 2,000	MEDIUM
2,001 - 4,000	STIFF
4,001 - 8,000	VERY STIFF
8,001 - 16,000	HARD
> 16,000	VERY HARD

RELATIVE DENSITY OF COARSE GRAINED SOILS	
N-BLOWS/FT.	RELATIVE DENSITY
0 - 3	VERY LOOSE
4 - 9	LOOSE
10 - 29	MEDIUM DENSE
30 - 49	DENSE
50 - 80	VERY DENSE
80 +	EXTREMELY DENSE

RELATIVE PROPORTIONS OF SAND AND GRAVEL	
DESCRIPTIVE TERM(S) (OF COMPONENTS ALSO PRESENT IN SAMPLE)	PERCENT OF DRY WEIGHT
WITH	15 - 29
MODIFIER	> 30

GRAIN SIZE TERMINOLOGY	
MAJOR COMPONENT OF SAMPLE	SIZE RANGE
BOULDERS	OVER 12 IN. (300MM)
COBBLES	12 IN. TO 3 IN. (300 MM TO 75 MM)
GRAVEL	3 IN. TO #4 SIEVE (75MM TO 4.75MM)
SAND	#4 TO #200 SIEVE (4.75MM TO 0.075 MM)
SILT OR CLAY	PASSING #200 SIEVE (0.075MM)

RELATIVE PROPORTIONS OF FINES	
DESCRIPTIVE TERM(S) (OF COMPONENTS ALSO PRESENT IN SAMPLE)	PERCENT OF DRY WEIGHT
WITH	15 - 29
MODIFIER	> 30



SECTION 12
IDALS RIPRAP TOE RECOMMENDATION

Moline Wetland Stability Analysis
Pocahontas County, Iowa
September 29, 2023
Completed by: Michael L. Bourland, P.E., Iowa No. 12804

Background

The Iowa Department of Agriculture and Land Stewardship has been working for over 20 years to design and construct nutrient removal wetlands. The number of wetlands required to reach the targeted goal set by the Environmental Protection Agency is thousands. Creative alternatives for siting wetlands has been pursued to increase the number of potential wetland, especially as IDALS has encountered numerous permitting challenges.

This site was initially found as a possible site by Iowa State University researchers. The overall concept includes directing water flowing from a small unnamed tributary that flows into Lizard Creek (also part of Pocahontas DD #22) into a newly created wetland west of and adjacent to Lizard Creek. At this time, the area of the wetland is used for row crops and includes subsurface drainage.

The wetland project has been designed by Ducks Unlimited. We have completed the permitting process through the Iowa Department of Natural Resources for completing this project in the floodplain. We have also recently received the Corps of Engineers permit after completing and submitting a revised and updated archeology report.

We have been working with the Assistant to Pocahontas County Engineer about receiving approval as the trustees of the drainage district. The initial concerns related to using the existing material placed along the drainage ditch as the embankment for the wetland. After it was noted that the existing embankment will be mostly removed and reconstructed, another concern was raised relating to the stability of the banks of Lizard Creek. The existing creek banks are steep and have some indications of sloughing.

To address this concern, soil borings, surveyed cross sections, and a stability analyses were completed. The geotechnical report with the soil borings are attached as an appendix to this report, along with the surveyed cross sections.

Gathered Information

An engineer with IDALS obtained cross sections of Lizard Creek at 6 different locations using GPS equipment. Some of the soil boring locations were also able to be surveyed at this time. The raw data and plotted cross sections are provided as an appendix to this report. It should be noted that during this site visit, several areas with surface sloughing was observed on both sides of the drainage ditch as shown on the attached photographs. Several of the cross-sections were taken at these locations. The existing slopes at the surveyed locations are generally around 2 horizontal to 1 vertical. We understand that Pocahontas County has experienced back stability issues with slopes that have similar steepness.

Six soil borings were completed by Certified Testing Services, Inc. The geotechnical report is attached to this report. In general, the boring encountered existing fill closer to Lizard Creek that was placed when the creek was modified as part of the drainage district work. The fill was underlain mostly by clay materials with various amounts of organic and sand material. One boring noted a sand layer. The clay materials were underlain by a stiff glacial clay till layer. A summary of the material properties used in the analysis is provided in the analysis section below.

Soil profiles were created for each of the surveyed cross sections using existing conditions. These soil profiles and cross sections were modified for the proposed grading based on the final topography for the site and that the new fill will be placed using NRCS Method 3 compaction (90% Standard Proctor).

Analysis

Slope stability analyses of the developed cross sections provided were completed using Galena Slope Stability Analysis System, Version 7.20.2.01. The factor of safety analysis utilized the Simple Bishop method with a circular failure surface since the predominant materials are cohesive clay soils.

The main factors that influencing the results were the soil parameters and phreatic surface. The unit weight for each soil type was obtained from averaging the laboratory tests of the soil boings. Clay soils have both cohesion and internal angle of friction. The assumed internal friction angle values were used based on values presented in literature for undisturbed clay soils. The laboratory results provided unconfined compressive strengths that can be used to estimate cohesion. Various analyses were performed with different soil strength values and the values presented in the table below were used for the final analysis results included with this report. These conservative soil parameters were used since limited information is available. The assumed phreatic surfaces used in the analyses for the existing conditions are shown on the cross sections and generally followed the slope of natural soils. The analyses for after construction conservatively assumed an increased elevation of the phreatic surface at with the wetland water elevation. These water levels are also shown on the cross-sections of the final analysis.

	Total Unit Wt (pcf)	Cohesion (psf)	Friction Angle (°)
Soil 1 Fill	130	150	15
Soil 2 - Sand	130	0	22
Soil 3 - Clay	130	150	16
Soil 4 - Dark Gray Lean Clay	126	150	16
Soil 5 - Lean Clay with Sand	133.5	2000	15
Soil 6 - New Fill	135	1000	18

Results

The final results of the analysis for the existing and proposed conditions completed for each cross section is attached as an appendix to this report. In general, a factor of safety of 1.3 is considered to be acceptable and stable. The factor of safety determined for existing conditions ranged from 1.34 to 1.56 based on the developed cross sections and assumed soil parameters and water levels. The factor of safety determined for the proposed final conditions, assuming the wetland is constructed and the water level is increased, ranged from 1.06 to 1.31. The proposed conditions factor of safety below 1.3 were at Sections 1 and 2. These sections had experienced previous failures as is evidenced by the cross-sections. Note that the proposed factor of safety for Section 6 actually increased because the failure surface would extend through newly placed and compacted fill with better soil properties.

Factor of Safety		
	Existing	Proposed
Section 1	1.56	1.14
Section 2	1.42	1.06
Section 3	1.61	1.40
Section 4	1.81	1.58
Section 5	1.37	1.31
Section 6	1.34	1.46

Conclusion

This analysis indicates that if an increased water level occurs from the wetland where the new embankment is offset west of the Lizard Creek, the factor of safety would be below an acceptable level in the areas of Section 1 and 2 where sloughing has occurred in the past. The factor of safety can be increased by flattening the slope, lowering the water level, and/or increasing the soil strength. Flattening the slope is not a viable option because excess material would need to be hauled off site outside of the flood plain and would also result in a reduced wetland surface area. Therefore, lowering the water level and increasing the strength of materials is the only option that can be considered.

Additional analyses were completed for Sections 1 and 2 proposed conditions that included a riprap toe being placed along the west side of the drainage ditch, Lizard Creek. Riprap placed as shown on the attached cross sections would provide for a slight decrease in the phreatic surface and replace the existing clay with material with a much higher angle of friction. The analysis determined the modified proposed factor of safety with the riprap in place to be 1.40 at Section 1 and 1.31 at Section 2. The proposed cross section is provided as an appendix to this report.

Construction will require the placement of this riprap to be completed sequentially with the use of a long-reach excavator. In general, the section of riprap to be placed will extend 2 feet below and 2 feet out from the existing toe of slope. The riprap will then extend back 6 feet from the toe into the slope and then sloped back west as needed to be stable long enough to place the riprap. The outside face of the riprap will be flush with the adjacent existing slope. This work will need to be completed during low flow conditions. We will require that the riprap be underlain with a clean 1-inch gravel layer of at least 6 inches in thickness since it will not be possible to use filter fabric. We will also require that the work be completed sequentially in sections no longer than 10 feet at a time along the length of Lizard Creek for an anticipated total length of 200 feet. The spoil material obtained from riprap placement will be used as part of construction where possible or placed outside of the flood plain.



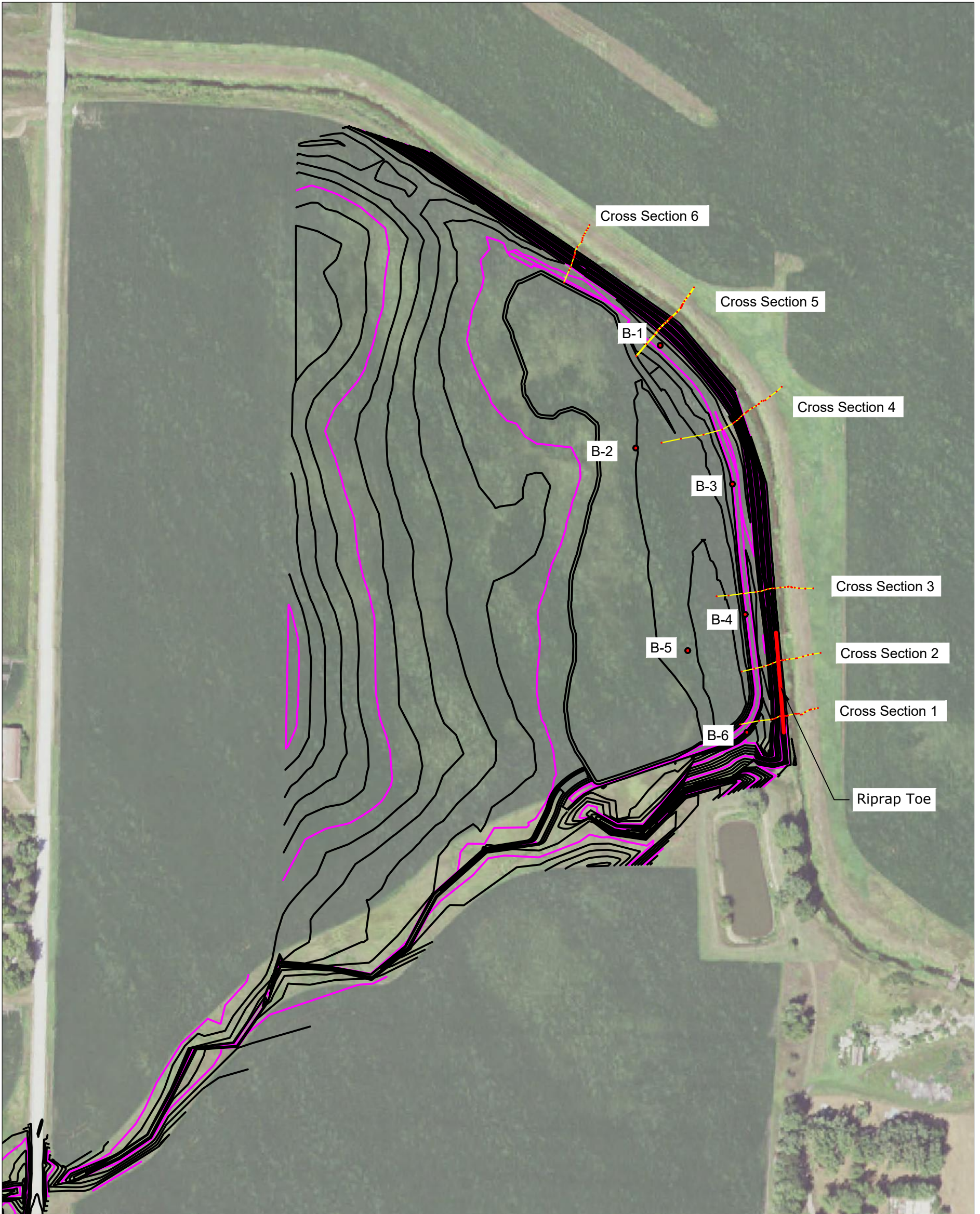
Photo looking south (Moline wetland site to right)



Photo looking south (Moline wetland to right)
Previously failed area near Sections 1 and 2 shown



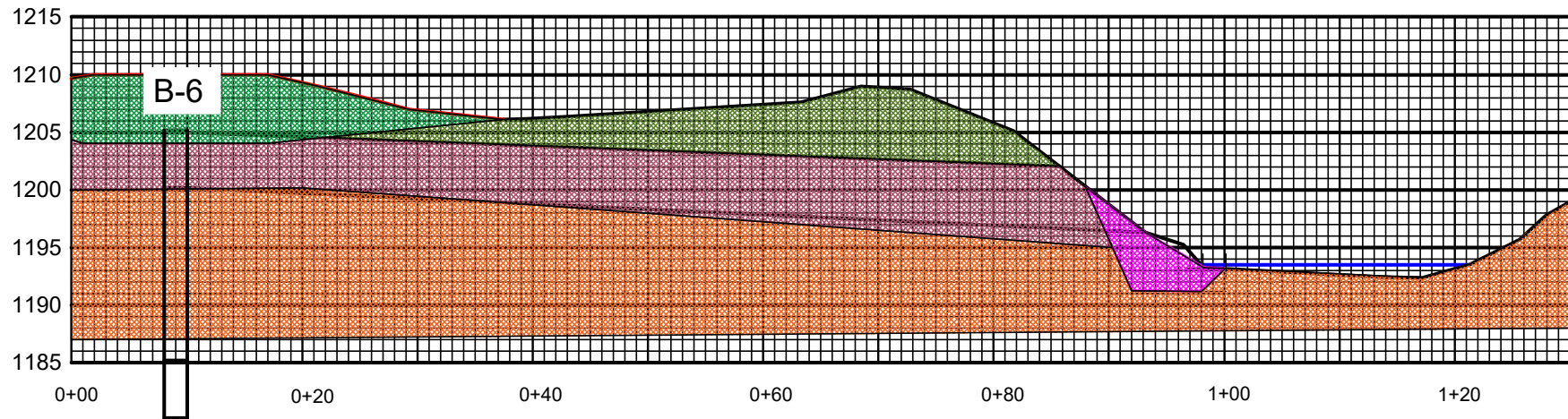
Channel outlet area into Lizard Creek (looking west)



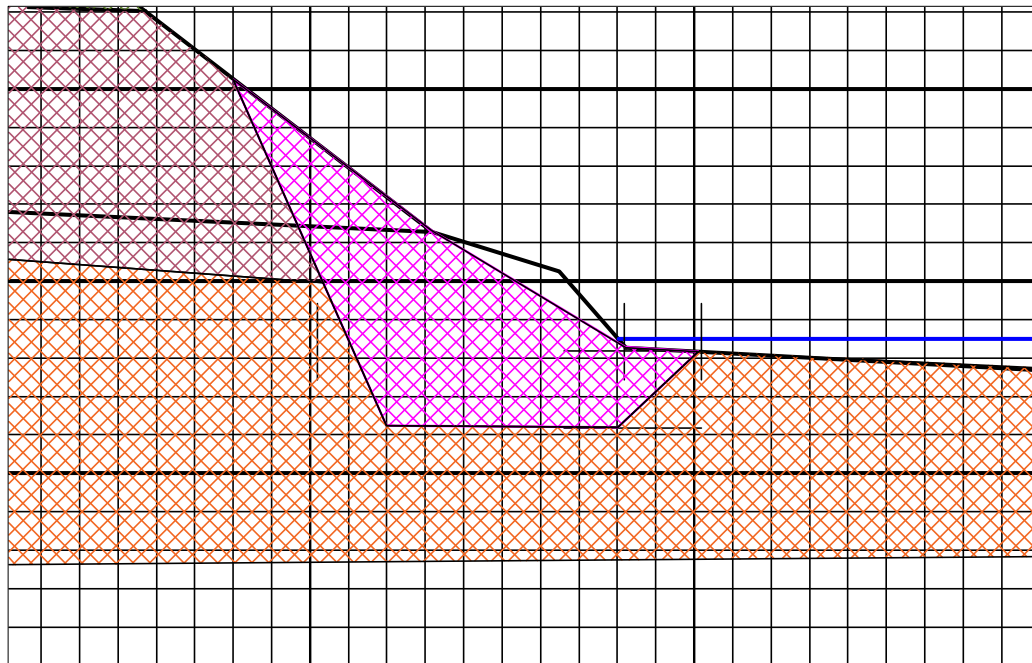
Slope Stability Analysis Site Plan
Moline Nutrient Reduction Wetland
Poc903130C - Pocahontas County, Iowa



Scale 1" = 200'
for 11 x 17



Cross Section 1



**Riprap Toe Details
for Stable Slopes**

**Moline Wetland
Poc903130C**

Each square = 1 square foot