Algonquin Gas Transmission, LLC

Algonquin Incremental Market Project

CONNECTICUT STORM WATER POLLUTION CONTROL PLAN ("SWPCP")

Prepared for:

Algonquin Gas Transmission, LLC
890 Winter Street, Suite 300
Waltham, MA 02451

Prepared by:

TRC Environmental Corporation
21 Griffin Road North
Windsor, Connecticut 06095

February 2015

For technical questions or questions related to certification, please contact Don Gonyea

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LIST OF ACRONYMS

AIM Project or Project	Algonquin Incremental Market Project
Algonquin	Algonquin Gas Transmission, LLC
APA	Aquifer Protection Area
CFR	Code of Federal Regulations
CT DEEP	Connecticut Department of Energy and the Environment
E&S	erosion and sedimentation
E&SCP	Erosion & Sediment Control Plan
EI	Environmental Inspector
FERC or Commission	Federal Energy Regulatory Commission
FGM	flexible growth medium
HDD	Horizontal Directional Drill
M&R	Metering and regulating
MLV	Mainline Valve
MP	milepost
ROW	Right-of-Way
SPCC	Spill Prevention Control and Countermeasures Plan
SWPCP	Storm Water Pollution Control Plan
TCE	Trichloroethene
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey

PROFESSIONAL ENGINEER CERTIFICATION

Stormwater Pollution Control Plan
Algonquin Incremental Market Project
February 2015

"I certify that I have thoroughly and completely reviewed the Stormwater Pollution Control Plan for the project or activity covered by this certification. I further certify, based on such review and on the standard of care for such projects, that the Stormwater Pollution Control Plan has been prepared in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, the Stormwater Quality Manual, as amended, and the conditions of the general permit, and that the controls required for such Plan are appropriate for the site. I further certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate, and complete to the best of my knowledge and belief. I also understand that knowingly making any false statement in this certification may subject me to sanction by the Department and/or be punishable as a criminal offense, including the possibility of fine and imprisonment, under section 53a-157b of the Connecticut General Statutes and any other applicable law."

Name: Carl Stopper, P.E.
Registered Professional Engineer, State of Connecticut

P.E. #: #13255

Signature: _____

Date: _____

CERTIFICATION OF REGISTRANT

Stormwater Pollution Control Plan
Algonquin Incremental Market Project
February 2015

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that a false statement made in this document or its attachments may be punishable as a criminal offense, in accordance with section 22a-6 of the Connecticut General Statutes, pursuant to section 53a-157b of the Connecticut General Statutes, and in accordance with any other applicable statute."

Company: Algonquin Gas Transmission, LLC

Name: Terrance W. Doyle
Manager, Environmental Construction Permitting

Signature: Terrance W Doyle

Date: 2/27/2015

CERTIFICATION OF PROFESSIONAL REPRESENTATIVE

Stormwater Pollution Control Plan
Algonquin Incremental Market Project
February 2015

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that a false statement made in this document or its attachments may be punishable as a criminal offense, in accordance with section 22a-6 of the Connecticut General Statutes, pursuant to section 53a-157b of the Connecticut General Statutes, and in accordance with any other applicable statute."

Company: TRC

Name: Mike Tyrrell
Principal, Energy Services

Signature:

Date: 2/27/2015

GENERAL PERMIT REGISTRATION FORM FOR THE:

Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, DEEP-WPED-GP-015 (rev 8/21/13)

Connecticut Department of
Energy & Environmental Protection
Bureau of Materials Management & Compliance Assurance
Water Permitting & Enforcement Division

General Permit Registration Form for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, effective 10/1/13 (non-electronic form)

Prior to completing this form, you **must** read the instructions for the subject general permit available at **DEEP-WPED-INST-015**.
This form must be filled out electronically before being printed.
You must submit the registration fee along with this form.

The status of your registration can be checked on the DEEP's ezFile Portal. Please note that DEEP will no longer mail certificates of registration.

CPPU USE ONLY

App #:_____

Doc #:_____

Check #:_____

Program: Stormwater

Part I: Registration Type

Select the appropriate boxes identifying the registration type and registration deadline.

Registration Type			Registration Timeline	
☐	**Re-registration** **Existing Permit No. GSN _____**		**On or before February 1, 2014*** *Note: Failure to renew a permit by this date will require submission of new registration. Re-registrants must only complete Parts I, II, III (except Question 8), IV - Question 1, VII and submit Attachment A.	
☒	**New Registration** (Refer to Section 2 of the permit for definitions of Locally Exempt and Locally Approvable Projects)	☐ **Locally Approvable Projects** **Size of soil disturbance:**	**New registration - Sixty (60) days prior to the initiation of the construction activity for:** Sites with a total soil disturbance area of 5 or more acres	
		☒ **Locally Exempt Projects** **Size of soil disturbance:**	☐	**New registration - Sixty (60) days prior to the initiation of the construction activity for:** Sites with a total disturbance area of one (1) to twenty (20) acres except those with discharges to impaired waters or tidal wetlands
			☒	**New registration - Ninety (90) days prior to the initiation of the construction activity for:** (i) Sites with a total soil disturbance area greater than twenty (20) acres, or (ii) Sites discharging to a tidal wetland (that is not fresh-tidal and is located within 500 feet), or (iii) Sites discharging to an impaired water listed in the "Impaired Waters Table for Construction Stormwater Discharges"

Part II: Fee Information

1. New Registrations
   a. Locally approvable projects (registration only):
      ☐ $625 [#1855]
   b. Locally exempt projects (registration and Plan):
      ☐ $3,000 total soil disturbance area ≥ one (1) and < twenty (20) acres. [#1856]
      ☐ $4,000 total soil disturbance ≥ twenty (20) acres and < fifty (50) acres. [#1857]
      ☒ $5,000 total soil disturbance ≥ fifty (50) acres. [#1858]
2. Re-Registrations
   ☐ $625 (sites previously registered prior to September 1, 2012) [#1853]
   ☐ $0 (sites previously registered between September 1, 2012 and the issuance date of this permit) [#1854]

The fees for municipalities shall be half of those indicated in subsections 1.a., 1.b., and 2 above pursuant to section 22a-6(b) of the Connecticut General Statutes. State and Federal agencies shall pay the full fees specified in this subsection. The registration will not be processed without the fee. The fee shall be non-refundable and shall be paid by certified check or money order payable to the Department of Energy and Environmental Protection.

Part III: Registrant Information

- If a registrant is a corporation, limited liability company, limited partnership, limited liability partnership, or a statutory trust, it must be registered with the Secretary of the State. If applicable, the registrant's name shall be stated **exactly** as it is registered with the Secretary of the State. This information can be accessed at **CONCORD.**
- If a registrant is an individual, provide the legal name (include suffix) in the following format: First Name; Middle Initial; Last Name; Suffix (Jr, Sr., II, III, etc.).

1. Registrant /Client Name: Algonquin Gas Transmission, LLC

   Registrant Type ⬇ Business Entity

   Secretary of the State business ID #:

   Mailing Address: Spectra Energy Partners, LP, 890 Winter Street, Suite 300

   City/Town: Waltham State: MA Zip Code: 02145

   Business Phone: (617) 560-1417 ext.:

   Example:(xxx) xxx-xxxx

   Contact Person: Terrance W. Doyle Title: Manager, Environmental Construction Permitting

   E-Mail: TWDoyle@spectraenergy.com

   Additional Phone Number (if applicable): ext.

2. List billing contact, if different than the registrant:

   Name:

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext.:

   Contact Person: Title:

Part III: Registrant Information (continued)

3. List primary contact for departmental correspondence and inquiries, if different than the registrant:

Name:

Mailing Address:

City/Town: State: Zip Code:

Business Phone: ext.:

Site Phone: Emergency Phone:

Contact Person: Title:

Association (e.g. developer, general or site contractor, etc.):

4. List owner of the property on which the activity will take place, if different from registrant:

Name:

Mailing Address:

City/Town: State: Zip Code:

Business Phone: ext.:

Contact Person:

5. List developer, if different from registrant or primary contact:

Name:

Mailing Address:

City/Town: State: Zip Code:

Business Phone: ext.:

Contact Person: Title:

6. List general contractor, if different from registrant or primary contact:

Name:

Mailing Address:

City/Town: State: Zip Code:

Business Phone: ext.:

Site Phone: Off Hours Phone:

Contact Person: Title:

7. List any engineer(s) or other consultant(s) employed or retained to assist in preparing the registration and/or Stormwater Pollution Control Plan. ☐ Please select if additional sheets are necessary, and label and attach them to this sheet.

Name: TRC

Mailing Address: 650 Suffolk Street

City/Town: Lowell State: MA Zip Code: 01854

Business Phone: (603) 801-4140 ext.:

Contact Person: Mike Tyrrell Title: Principal, Energy services

Service Provided: Environmental Consulting

8. List Reviewing Qualified Professional (for locally approvable projects only):

Name: Contact Person:

Mailing Address:

City/Town: State: Zip Code:

Business Phone: ext.:

Part IV: Site Information

1. Site Name: Algonquin Incremental Market Project
   Street Address or Description of Location: Algonquin's existing pipeline in Danbury, Cromwell, Rocky Hill, Lebanon, Franklin, Norwich, and Montville
   City/Town: Various - see above State: CT Zip Code:
   Brief Description of construction activity: Installation of new and replacement of existing multi-diameter-inch natural gas pipeline.
   Project Start Date: 5 / 2015 *(month/ yr)* Anticipated Completion Date: 11 / 2016 *(month/ yr)*
   Normal working hours: 7 AM to 6 PM

2. MINING: Is the activity on the site in question part of mining operations (i.e. sand and gravel)? ☐ Yes ☒ No

   If yes, mining is not authorized by this general permit. You must submit the Registration Form for the General Permit for the Discharge of Stormwater Associated with Industrial Activity.

3. COMBINED OR SANITARY SEWER: Does all of the stormwater from the proposed activity discharge to a combined or sanitary sewer (i.e. a sewage treatment plant)? ☐ Yes ☒ No

   If yes, this activity is not regulated by this permit. Contact the Water Permitting & Enforcement Division at 860-424-3018.

4. INDIAN LANDS: Is or will the facility be located on federally recognized Indian lands ☒ Yes ☐ No

5. COASTAL BOUNDARY: Is the activity which is the subject of this registration located within the coastal boundary as delineated on DEEP approved coastal boundary maps ☐ Yes ☒ No

   The coastal boundaries fall within the following towns: Branford, Bridgeport, Chester, Clinton, Darien, Deep River, East Haven, East Lyme, Essex, Fairfield, Greenwich, Groton (City and Town), Old Lyme, Guilford, Hamden, Ledyard, Lyme, Madison, Milford, Montville, New London, New Haven, North Haven, Norwalk, Norwich, Old Saybrook, Orange, Preston, Shelton, Stamford, Stonington (Borough and Town), Stratford, Waterford, West Haven, Westbrook and Westport.

   If "yes", and this registration is for a new authorization or a modification of an existing authorization where the physical footprint of the subject activity is modified, you must provide documentation the DEEP Office of Long Island Sound Programs or the local governing authority has issued a coastal site plan approval or determined the project is exempt from coastal site plan review. Provide this documentation with your registration as Attachment B. See guidance in Appendix D of the general permit. Information on the coastal boundary is available at the local town hall or at www.cteco.uconn.edu/map_catalog.asp. Additional DEEP Maps and Publications are available by contacting DEEP staff at 860-424-3555.

Part IV: Site Information (continued)

6. ENDANGERED OR THREATENED SPECIES:

In order to be eligible to register for this General Permit, each registrant must perform a self-assessment, obtain a limited one-year determination, or obtain a safe-harbor determination regarding threatened and endangered species. This may include the need to develop and implement a mitigation plan. While each alternative has different limitations, the alternatives are not mutually exclusive; a registrant may register for this General Permit using more than one alternative. See Appendix A of the General Permit. Each registrant must complete this section AND Attachment C to this Registration form and a registrant who does not or cannot do so is not eligible to register under this General Permit.

Each registrant must perform a review of the Department's Natural Diversity Database maps to determine if the site of the construction activity is located within or in proximity (within ¼ mile) to a shaded area.

a. Provide the date the NDDB maps were reviewed: 8/13/13 & 11/21/13 (Print a copy of the NDDB map you viewed since it must be submitted with this registration as part of Attacment C.)

b. For a registrant using a limited one-year determination or safe harbor determination to register for this General Permit, provide the Department's Wildlife Divison NDDB identification number for any such determination: 201302619 & 201305835 (The number is on the determination issued by the Department's Wildlife Divison).

c. verify that I have completed Attachment C to this Registration Form. ☒ Yes

For more information on threatened and endangered species requirements, refer to Appendix A and Section 3(b)(2) of this General Permit, visit the DEEP website at www.ct.gov/deep/nddbrequest or call the NDDB at 860-424-3011.

7. WILD AND SCENIC RIVERS: Is the proposed project within the watershed of a designated Wild and Scenic River? (See Appendix H for guidance) ☐ Yes ☒ No

8. AQUIFER PROTECTION AREAS: Is the site located within a mapped aquifer protection area www.ct.gov/deep/aquiferprotection as defined in section 22a-354h of the CT General Statutes? ☒ Yes ☐ No
(For additional guidance, please refer to Appendix C of the General Permit)

9. CT GUIDELINES FOR SOIL EROSION AND SEDIMENT CONTROL: Is the activity in accordance with CT Guidelines for Erosion and Sediment Control and local erosion & sediment control ordinances, where applicable? ☒ Yes ☐ No

10. HISTORIC AND/OR ARCHAEOLOGICAL RESOURCES:
Has the site of the proposed activity been reviewed (using the process outlined in Appendix G of this permit) for historic and/or archaeological resources? ☒ Yes ☐ No

a. The review indicates the proposed site does not have the potential for historic/ archaeological resources, OR ☐ Yes ☐ No

b. The review indicated historic and/ or archaeological resource potential exists and the proposed activity is being or has been reviewed by the Offices of Culture and Tourism, OR ☐ Yes ☐ No

c. The proposed activity has been reviewed and authorized under an Army Corps of Engineers Section 404 wetland permit. ☒ Yes ☐ No

11. CONSERVATION OR PRESERVATION RESTRICTION:
Is the property subject to a conservation or preservation restriction? ☐ Yes ☒ No

If Yes, proof of written notice of this registration to the holder of such restriction or a letter from the holder of such restriction verifying that this registration is in compliance with the terms of the restriction, must be submitted as Attachment D.

Part V: Stormwater Discharge Information

Table 1

Outfall #	a) Type	b) Pipe Material	c) Pipe Size	d) Note: To find lat/long, go to: CT ECO. A decimal format is required here. Directions on how to use CT ECO to find lat./long. and conversions can be found in Part V, Section d of the DEEP-WPED-INST-015 .		e) What method was used to obtain your latitude/longitude information?
				Longitude	Latitude	
	Select One:	Select One:	Select One:	- .	.	Select One:
	Select One:	Select One:	Select One:	- .	.	Select One:
	Select One:	Select One:	Select One:	- .	.	Select One:
	Select One:	Select One:	Select One:	- .	.	Select One:
	Select One:	Select One:	Select One:	- .	.	Select One:

Table 2

Outfall #	a) For temporary and permanent outfalls, provide a start date. For temporary discharges, also provide a date the discharge will cease.	b) For the drainage area associated with each outfall: Effective Impervious Area Before Construction	c) For the drainage area associated with each outfall: Effective Impervious Area After Construction	d) To what system or receiving water does your stormwater runoff discharge? either "storm sewer" or "wetlands/waterbody" (If you select "storm sewer" proceed to Part VI of the form. If you select "wetlands/waterbody" proceed to next question)	e) For each outfall, does it discharge to any of the following towns: *Branford, Kent, Manchester, Meriden, North Branford, Norwalk, or Wilton?* (If no, proceed to Part VI of the form. If yes, proceed to next question.)	f) For each outfall, does it discharge to a "freshwater" or "salt water" ? (If you select "freshwater" proceed to Table 3. If you selected "salt water", proceed to Part VI of the form.)
	- mm/dd-mm/dd	sq feet	sq feet	Select one:	☐ Yes ☐ No	Select one:
	- mm/dd-mm/dd	sq feet	sq feet	Select one:	☐ Yes ☐ No	Select one:
	- mm/dd-mm/dd	sq feet	sq feet	Select one:	☐ Yes ☐ No	Select one:
	- mm/dd-mm/dd	sq feet	sq feet	Select one:	☐ Yes ☐ No	Select one:
	- mm/dd-mm/dd	sq feet	sq feet	Select one:	☐ Yes ☐ No	Select one:
		total sq feet	**total sq feet**			

Part V: Stormwater Discharge Information (continued)

Table 3 Provide the following information about the receiving water(s)/wetland(s) that receive stormwater runoff from your site:			
Outfall #	a) What is your 305b ID # (water body ID #)? (Section 3.b, of the DEEP-WPED-INST-015, explains how to find this information)	b) Is your receiving water identified as a impaired water in the "Impaired Waters Table for Construction Stormwater Discharges"? If yes, proceed to next question. If no, proceed to Part VI: Pollution Control Plan.	c) Has any Total Maximum Daily Load (TMDL) been approved for the impaired water?
		☐ Y ☐ N	☐ Y ☐ N
		☐ Y ☐ N	☐ Y ☐ N
		☐ Y ☐ N	☐ Y ☐ N
		☐ Y ☐ N	☐ Y ☐ N
		☐ Y ☐ N	☐ Y ☐ N

Part V: Stormwater Discharge Information (continued)

Impaired waters: If you answered "yes" to Table 3, question b.,**verify** that the project's Pollution Control Plan (Plan) addresses the control measures below in Question 1 or 2, as appropriate.

1. **If the impaired water does not have a TMDL,** confirm compliance by selecting 1.a. or 1.b. below:
   a. No more than 3 acres is disturbed at any time; ☐ Yes

   OR

   b. Stormwater runoff from a 2 yr, 24 rain event is **retained.** ☐ Yes

2. **If the impaired water has a TMDL,** confirm compliance by selecting 2.a. and 2.b. below and either question 2.c.1. or 2.c.2. below:
   a. The Plan documents there is sufficient remaining Waste Load Allocations (WLA)in the TMDL for the proposed discharge, ☐ Yes

   AND

   b. Control measures shall be implemented to assure the WLA will not be exceeded, ☐ Yes

   AND

   c. 1. Stormwater discharges will be monitored for the indicator pollutant identified in theTMDL, ☐ Yes

   OR

   2. The Plan documents specific requirements for stormwater discharges specified in the TMDL. ☐ Yes

Part VI: Pollution Control Plan (select one of the following four categories)

☐ I am registering a Locally Exempt project and submitting the required electronic Plan (in Adobe™ PDF or similar publically available format) pursuant to Section 3(*c*)(2)(E) of this permit.

- ☐ Plan is attached to this registration form
- ☐ Plan is available at the following Internet Address (URL):

☐ I am registering a Locally Approvable project and have chosen not to submit the Plan with this registration pursuant to Section 3(*c*)(1) of this permit.

☐ I am registering a Locally Approvable project and have chosen to make my Plan electronically available pursuant to Section 4(*c*)(2)(N) of this permit.

- ☐ Plan is attached to this registration form
- ☐ Plan is available at the following Internet Address (URL):

☒ I am registering a Locally Exempt project and do not have the capability to submit the Plan electronically. Therefore, I am submitting a paper copy with this registration as Attachment E.

Part VII: Registrant Certification

The registrant *and* the individual(s) responsible for actually preparing the registration must sign this part. A registration will be considered incomplete unless all required signatures are provided.

For New Registrants:

" I hereby certify that I am making this certification in connection with a registration under such general permit, [INSERT NAME OF REGISTRANT BELOW] submitted to the commissioner by Algonquin Gas Transmission, LLC for [INSERT ADDRESS OF PROJECT OR ACTIVITY BELOW] an activity located at Algonquin Incremental Market Project-Linear and that all terms and conditions of the general permit are being met for all discharges which have been initiated and such activity is eligible for authorization under such permit. I further certify that a system is in place to ensure that all terms and conditions of this general permit will continue to be met for all discharges authorized by this general permit at the site. I certify that the registration filed pursuant to this general permit is on complete and accurate forms as prescribed by the commissioner without alteration of their text. I certify that I have personally examined and am familiar with the information that provides the basis for this certification, including but not limited to all information described in Section 3(*b*) (8)(A) of such general permit, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate and complete to the best of my knowledge and belief. I certify that I have made an affirmative determination in accordance with Section 3(*b*)(8)(B) of this general permit. I understand that the registration filed in connection with such general permit is submitted in accordance with and shall comply with the requirements of Section 22a-430b of Connecticut General Statutes. I also understand that knowingly making any false statement made in the submitted information and in this certification may be punishable as a criminal offense, including the possibility of fine and imprisonment, under Section 53a-157b of the Connecticut General Statutes and any other applicable law."

For Re-registrants:

" I hereby certify that I am making this certification in connection with a registration under the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, submitted to the commissioner [INSERT NAME OF REGISTRANT BELOW] by _____ for an activity located at [INSERT ADDRESS OF PROJECT OR ACTIVITY BELOW] _____ and that all terms and conditions of the general permit are being met for all discharges which have been initiated and such activity is eligible for authorization under such permit. I further certify that all designs and plans for such activity meet the current terms and conditions of the general permit in accordance with Section 5(b)(5)(C) of such general permit and that a system is in place to ensure that all terms and conditions of this general permit will continue to be met for all discharges authorized by this general permit at the site. I certify that the registration filed pursuant to this general permit is on complete and accurate forms as prescribed by the commissioner without alteration of their text. I certify that I have personally examined and am familiar with the information that provides the basis for this certification, including but not limited to all information described in Section 3(*b*)(8)(A) of such general permit, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate and complete to the best of my knowledge and belief. I also understand that knowingly making any false statement made in the submitted information and in this certification may be punishable as a criminal offense, including the possibility of fine and imprisonment, under Section 53a-157b of the Connecticut General Statutes and any other applicable law."

Terrance W Doyle	2/23/2015
Signature of Registrant	Date
Terrance W. Doyle	Manager, Environmental Construction Permitting
Name of Registrant (print or type)	Title (if applicable)
	2/23/2015
Signature of Preparer (if different than above)	Date
Mike Tyrrell	Principal, Energy Services
Name of Preparer (print or type)	Title (if applicable)

Part VIII: Professional Engineer (or Landscape Architect, where appropriate) Design Certification (for publically approvable and exempt projects)

The following certification must be signed by a Professional Engineer or Landscape Architect where appropriate.

"I hereby certify that I am a choose qualification licensed in the State of Connecticut. I am making this certification in connection with a registration under such general permit, submitted to the commissioner by

[INSERT NAME OF REGISTRANT BELOW]

Algonquin Gas Transmission, LLC for an activity located at

[INSERT ADDRESS OF PROJECT OR ACTIVITY BELOW]

Algonquin Incremental Market Project-Linear.

I certify that I have thoroughly and completely reviewed the Stormwater Pollution Control Plan for the project or activity covered by this certification. I further certify, based on such review and on the standard of care for such projects, that the Stormwater Pollution Control Plan has been prepared in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, the Stormwater Quality Manual, as amended, and the conditions of the general permit, and that the controls required for such Plan are appropriate for the site. I further certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate, and complete to the best of my knowledge and belief. I also understand that knowingly making any false statement in this certification may subject me to sanction by the Department and/or be punishable as a criminal offense, including the possibility of fine and imprisonment, under section 53a-157b of the Connecticut General Statutes and any other applicable law."

	2/27/2015
Signature of Design Professional	Date
Carl Stopper	Licensed P.E.
Name of Professional (print or type)	Title
21 Griffin Road North	Windsor
Mailing Address	City/Town
CT 06095	(860) 298-6231
State Zip Code	Business Phone
	#13255
	License #
Affix P.E/L.A Stamp Here	

Part IX: Reviewing Qualified Professional Certification

The following certification must be signed by a) a Conservation District reviewer OR, b) a qualified soil erosion and sediment control and/or professional engineer

☐ **Review certification by Conservation District:**

1.) District: list of districts

Date of Affirmative Determination:

" I am making this certification in connection with a registration under General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, submitted to the commissioner

[INSERT NAME OF REGISTRANT BELOW]

by _____ for an activity located at

[INSERT ADDRESS OF PROJECT OR ACTIVITY BELOW]

_____.

I have personally examined and am familiar with the information that provides the basis for this certification, and I affirm, based on the review described in Section 3(*b*)(11)(C) of this general permit and on the standard of care for such projects, that the Stormwater Pollution Control Plan is adequate to assure that the activity authorized under this general permit will comply with the terms and conditions of such general permit and that all stormwater management systems: (i) have been designed to control pollution to the maximum extent achievable using measures that are technologically available and economically practicable and that conform to those in the Guidelines and the Stormwater Quality Manual; (ii) will function properly as designed; (iii) are adequate to ensure compliance with the terms and conditions of this general permit; and (iv) will protect the waters of the state from pollution."

_____

Signature of District Professional and Date

_____

Name of District Professional and License Number (if applicable)

Or

☒ **Review certification by Qualified Professional**

Company: xxxx

Name: xxxxx

License # : #xxxxx

Level of independency of professional:

Required for all projects disturbing over 1 acre:

1. I verify I am not an employee of the registrant. ☐ Yes
2. I verify I have no ownership interest of any kind in the project for which the registration is being submitted. ☐ Yes

Required for projects with 15 or more acres of site disturbance (in addition to questions 1&2):

3. I verify I did not engage in any activities associated with the preparation, planning, designing or engineering of the soil erosion and sediment control plan or stormwater management systems plan for this registrant. ☒ Yes
4. I verify I am not under the same employ as any person associated with the preparation, planning, designing or engineering of the soil erosion and sediment control plan or stormwater management systems plan for this registrant. ☒ Yes

Part IX: Reviewing Qualified Professional Certification (continued)

"I hereby certify that I am a qualified professional engineer or qualified soil erosion and sediment control professional, or both, as defined in the General Permit for Discharge of Stormwater and Dewatering Wastewaters from Construction Activities and as further specified in Sections 3(*b*)(11)(A) and (B) of such general permit. I am making this certification in connection with a registration under such general permit,

[INSERT NAME OF REGISTRANT BELOW]

submitted to the commissioner by Algonquin Gas Transmission, LLC

[INSERT ADDRESS OF PROJECT OR ACTIVITY BELOW]

for an activity located at Algonquin Incremental Market Project-Linear.

I have personally examined and am familiar with the information that provides the basis for this certification, including but not limited to all information described in Section 3(*b*)(11)(C) of such general permit, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate and complete to the best of my knowledge and belief. I further certify that I have made the affirmative determination in accordance with Sections 3(*b*)(11)(D)(i) and (ii) of this general permit. I understand that this certification is part of a registration submitted in accordance with Section 22a-430b of Connecticut General Statutes and is subject to the requirements and responsibilities for a qualified professional in such statute. I also understand that knowingly making any false statement in this certification may be punishable as a criminal offense, including the possibility of fine and imprisonment, under Section 53a-157b of the Connecticut General Statutes and any other applicable law."

_____

Signature of Reviewing Qualified Professional Date: 2/20/2015

Carl Stopper, P.E.

Name of Reviewing Qualified Professional License No.: #13255

Affix P.E./L.A. Stamp Here

Part X: Supporting Documents

Select the applicable box below for each attachment being submitted with this registration form. When submitting any supporting documents, please label the documents as indicated below (e.g., Attachment A, etc.) and be sure to include the registrant's name as indicated on this certification form.

- [X] **Attachment A:** Select here as verification that an 8 ½" X 11" copy of the relevant portion of a USGS Quadrangle Map with a scale of 1:24,000, showing the exact location of the facility has been submitted with this registration. Indicate the quadrangle name on the map, and be sure to include the registrant's name. (To obtain a copy of the relevant USGS Quadrangle Map, call your town hall or DEEP Maps and Publications Sales at 860-424-3555)
- [ ] **Attachment B:** Documentation related to *Coastal Consistency Review,* if applicable.
- [X] **Attachment C:** Threatened and Endangered Species Form and any additional information (such as a copy of a NDDB map)
- [ ] **Attachment D:** Conservation or Preservation Restriction Information, if applicable.
- [X] **Attachment E:** Where applicable, non-electronic Pollution Control Plan.

Note: Please submit the fee along with a completed, printed and signed Registration Form and all additional supporting documents to:

CENTRAL PERMIT PROCESSING UNIT
DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION
79 ELM STREET
HARTFORD, CT 06106-5127

INSERT COPY OF CHECK FOR $5,000

ATTACHMENT A OF GENERAL PERMIT REGISTRATION FORM

USGS Quadrangle Maps

[Provided in Appendix A of Attachment E – Stormwater Pollution Control Plan]

ATTACHMENT C: THREATENED AND ENDANGERED SPECIES

Information about compliance with the requirements of Section 3(b)(2) of this general permit, regarding threatened and endangered species, is in Appendix A of the general permit. Choose one or more (if applicable) of the following in order to be eligible to register for this General Permit. A registrant who does not or cannot do so is not eligible to register under this General Permit.

☐ Self Assessment using the NDDB maps – Select this only if:

a. The site of the construction activity is not entirely, partially or within a ¼ mile of a shaded area depicted on the Department's Natural Diversity Database maps and this determination was made not more than six months before the date of submitting this registration;

AND

b. The entity registering for this General Permit has no reasonably available verifiable scientific, or other credible information that the construction activity could reasonably be expected to have an adverse impact upon a federal or state species listed as threatened or endangered.

Attach a copy of the NDDB map used to conduct the self assessment used to register for this general permit.

Note: Both a and b as used in this section, must be true in order for a Registrant to register for this General Permit using the self-assessment option. If neither is true, a Registrant cannot use the self-assessment option to comply with Section 3(b)(2) and Appendix A of the General Permit.

☐ Limited One-Year Determination – Select this only if:

a. The entity registering for this General Permit has obtained a limited one-year determination from the Department's Wildlife Division regarding threatened and endangered species: i) within a year of the date of submitting this registration; or ii) more than 1 year before submitting this registration, but such determination has been extended by the Department within one year of the date of submitting this registration;

AND

b. The Registrant has provided to the Department's Wildlife Division any reasonably available verifiable scientific, or other credible information that the construction activity could reasonably be expected to have an adverse impact upon a federal or state species listed as threatened or endangered.

Provide the date the limited one-year determination was issued by the Department's Wildlife Division _____;

or

Provide the date that the most recent extension to a limited one year determination was issued by the Department's Wildlife Division _____.

Note: Both a and b as used in this section, must be true in order for a Registrant to register for this General Permit using the Limited One-Year Determination option. If a Limited One-Year Determination or extension to any such determination was issued by the Department's Wildlife Division more than one year before the submission of this registration, a Registrant cannot use any such determination or extension to comply with Section 3(b)(2) and Appendix A of the General Permit.

ATTACHMENT C: THREATENED AND ENDANGERED SPECIES (continued)

☐ **Select here if the Limited One-Year Determination issued by the Department includes a Mitigation Plan.**

Provide the date the Mitigation Plan was approved: _____

Governmental Entity Approving the Plan: _____

As of the date this Registration is submitted,

Has the Mitigation Plan been fully implemented? ☐ Yes ☐ No

Date commenced: _____ Date completed:_____

Is the Mitigation Plan partially implemented? ☐ Yes ☐ No

If yes, what actions have been taken?_____

And which actions are yet to be implemented and what is the timeframe for completion of such actions:_____

Is the Mitigation Plan yet to be implemented? ☐ Yes ☐ No

If yes, specify the timeframe for implementation: _____ to _____

And summarize actions to be implemented: _____

☒ Safe Harbor Determination - Select this only if:

a. The entity registering for this General Permit has obtained a Safe Harbor Determination from the Department's Wildlife Division regarding threatened and endangered species: i) within 3 years of the date of submitting this registration; or ii) more than 3 years before submitting this registration, but within one-year of a one-year extension issued by the Department's Wildlife Division to a safe harbor determination;

NDDB reviewed the AIM Project on 8/13/13 and 11/21/13. Additional consultations with NDDB conducted in 2014. Specific mitigation/conservation measures are identified in the draft CT DEEP 401 Water Quality Certificate (WQC) for the AIM Project and further described in Algonquin's 401 WQC Application. The final 401 WQC is anticipated in March 2015.

AND

b. The entity registering for this General Permit has provided to the Department's Wildlife Division any reasonably available verifiable scientific, or other credible information that the construction activity could reasonably be expected to have an adverse impact upon a federal or state species listed as threatened or endangered.

Provide the date the Department's Wildlife Division issued a Safe Harbor Determination: _____

If applicable, provide the date that any one-year extension to a Safe Harbor Determination was issued by the Department's Wildlife Division: _____.

Note: Both a and b as used in this section, must be true in order for a Registrant to register for this General Permit using the Safe Harbor Determination option. If a Safe Harbor Determination was issued by the Department's Wildlife Division more than three years before the submission of this registration, and has not been extended, a Registrant cannot use any such safe harbor to comply with section 3(b)(2) and Appendix A of this General Permit. If a Safe Harbor Determination was granted and extended for one-year, more than four years before the submission of this registration, a Registrant cannot use any such Safe Harbor Determination to comply with Section 3(b)(2) and Appendix A of the general permit.

ATTACHMENT C: THREATENED AND ENDANGERED SPECIES (continued)

☒ **Select here if the safe harbor noted above includes a Mitigation Plan.**

Provide the date the Mitigation Plan was approved: Mitigation plan was included in the AIM Project CTDEEP 401 WQC application and measures are identified in the draft 401 WQC.

Governmental Entity Approving the Plan: _____

As of the date this Registration is submitted,

Has the Mitigation Plan been fully implemented? ☐ Yes ☒ No

Date commenced: _____ Date completed: _____

Is the Mitigation Plan partially implemented? ☐ Yes ☒ No

If yes, what actions have been taken? _____

And which actions are yet to be implemented and what is the timeframe for completion of such actions: Conservation measures will be implemented during Project construction (May 2015 - Nov. 2016)

Is the Mitigation Plan yet to be implemented? ☒ Yes ☐ No

If yes, specify the timeframe for implementation: May 2015 to November 2016

And summarize actions to be implemented: _____

Specific mitigation measures are identified in the draft CT DEEP 401 Water Quality Certificate (WQC) for the AIM Project and in Algonquin's 401 WQC Application.

Connecticut Department of

ENERGY &
ENVIRONMENTAL
PROTECTION

November 21, 2013

Richard C Paquette, Jr.
TRC Environmental Corporation
6 Ashley Drive, 1st. Fl.
Scarborough, ME 04074
rpaquette@trcsolutions.com

Project: Algonquin Incremental Market (AIM) Project, Update to NDDB Determination 201302619 with Modifications to Waterbury M&R Station and Construction of New Norwich Oakland Heights M& R Station
NDDB Determination No.: 201305835

Dear Richard C Paquette, Jr.,

I have reviewed Natural Diversity Data Base maps and files regarding the area delineated on the map provided for the proposed Algonquin Incremental Market (AIM) Project, Update to NDDB Determination 201302619 with Modifications to Waterbury M&R Station and Construction of New Norwich Oakland Heights M& R Station, Connecticut. I have determined that the proposed activities will not impact any extant populations of Federal or State Endangered, Threatened or Special Concern Species that occur in the vicinity of this property. This determination is good for one year. Please re-submit an NDDB Request for Review if the scope of work changes or if work has not begun on this project by November 21, 2014.

Natural Diversity Data Base information includes all information regarding critical biological resources available to us at the time of the request. This information is a compilation of data collected over the years by the Department of Energy and Environmental Protection's Natural History Survey and cooperating units of DEEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the Data Base should not be substitutes for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available. The result of this review does not preclude the possibility that listed species may be encountered on site and that additional action may be necessary to remain in compliance with certain state permits.

Please contact me if you have further questions at (860) 424-3592, or dawn.mckay@ct.gov . Thank you for consulting the Natural Diversity Data Base.

Sincerely,

Dawn M. McKay

Dawn M. McKay
Environmental Analyst 3

Connecticut Department of

ENERGY &
ENVIRONMENTAL
PROTECTION

August 13, 2013

Richard C. Paquette, Jr
TRC
400 Southborough Drive
South Portland, ME 04106
rpaquette@trcsolutions.com

Project: Algonquin Incremental Market Project with 18 Miles of Linear Pipeline, Modification of 19 Existing Compressor and Meter Stations in Danbury, Cromwell, Rocky Hill, Glastonbury, Lebanon, Franklin, Norwich, Oxford, Berlin, Pomfret, Plainville, North Haven, Vernon, Chaplin, Southbury, Farmington, Montville, Guilford, Windham, Middletown and Putnam
NDDB Determination No.: 201302619

Dear Richard,

I have reviewed Natural Diversity Data Base maps and files regarding the area delineated on the map provided for the proposed Algonquin Incremental Market Project with 18 Miles of Linear Pipeline, Modification of 19 Existing Compressor and Meter Stations in Danbury, Cromwell, Rocky Hill, Glastonbury, Lebanon, Franklin, Norwich, Oxford, Berlin, Pomfret, Plainville, North Haven, Vernon, Chaplin, Southbury, Farmington, Montville, Guilford, Windham, Middletown and Putnam, Connecticut. I have determined that the proposed activities will not impact any extant populations of Federal or State Endangered, Threatened or Special Concern Species that occur in the vicinity of these 13 particular facilities:

1. Chaplin Compressor Station
2. Bristol M&R Station
3. Farmington M&R Station
4. Glastonbury M&R Station
5. Greenville M&R Station
6. Guilford M&R Station
7. Kensington M&R Station
8. Montville M&R Station
9. Putnam M&R Station
10. Salem Pike M&R Station
11. Southbury M&R Station
12. Willimantic M&R Station
13. E-1 System (12” Pipeline E-1 System Loop for 2.4 miles in Montville-County New London)

There are several facilities that have extant records for State Special Concern *Terrapene carolina carolina* (eastern box turtle) in the R-O-W. Eastern box turtles may be impacted by your pipeline work at the following facilities:

1. Oxford Compressor Station
2. Middletown M&R Station
3. North Haven M&R Station
4. Vernon M&R Station

I recommend that work be done during the dormant period for these turtles (October through March). If this is not possible and you intend to work when box turtles are active (March through September) then I recommend the following protection protocols be implemented:

- Silt fencing should be installed around the work area prior to construction;
- After silt fencing is installed and prior to construction, a sweep of the work area should be conducted to look for turtles;
- Workers should be apprised of the possible presence of turtles, and provided a description of the species (http://www.ct.gov/dep/cwp/view.asp?a=2723&q=473472&depNav_GID=1655);
- Any turtles that are discovered should be moved, unharmed, to an area immediately outside of the fenced area, and position in the same direction that it was walking;
- No vehicles or heavy machinery should be parked in any turtle habitat;
- Work conducted during early morning and evening hours should occur with special care not to harm basking or foraging individuals; and
- All silt fencing should be removed after work is completed and soils are stable so that reptile and amphibian movement between uplands and wetlands is not restricted.

At the West Danbury M&R Station we have State Special Concern *Ambystoma Jeffersonianum* (Jefferson salamander "complex"). You can lessen the impacts on these salamanders by working during their dormant period which is between August and January. However, if you are working while they are active February through the end of April it is best to avoid any wetland areas where they may be breeding.

The following five project facilities have multiple Federal or State listed species. Once the details and proposed activities of your project are more narrowly defined (time of year, construction timeline) you should contact our program for a more detailed review by our program biologists. These five facility areas include:

1. Cromwell Compressor Station (Shunpike Road)
2. Pomfret M&R Station (Wrights Crossing Road)
3. 26-inch Mainline (pipeline Southeast to MLV 19 lift and replacement)
4. 30-inch L3OB (pipeline Cromwell Loop Extension in Cromwell)
5. E-1-6" System (pipeline E-1 system lift and replacement in Lebanon, Franklin and Norwich)

I have attached a list of species for each of these five sites so you may address any mitigation or protection as part of your project planning. This determination (and the associated list) is good for one year. Please re-submit an NDDB Request for Review if the scope of work changes or if work has not begun on this project by August 13, 2014.

Natural Diversity Data Base information includes all information regarding critical biological resources available to us at the time of the request. This information is a compilation of data collected over the

years by the Department of Energy and Environmental Protection's Natural History Survey and cooperating units of DEEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the Data Base should not be substitutes for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available. The result of this review does not preclude the possibility that listed species may be encountered on site and that additional action may be necessary to remain in compliance with certain state permits.

Please contact me if you have further questions at (860) 424-3592, or dawn.mckay@ct.gov . Thank you for consulting the Natural Diversity Data Base.

Sincerely,

Dawn M. McKay

Dawn M. McKay
Environmental Analyst 3

Species List for Request Number R201302619 Compre

8/2/2013

Scientific Name	Common Name	State Protection Status
Animals		
Scaphinotus viduus	Ground beetle	SC
Terrapene carolina carolina	Eastern box turtle	SC
Plants		
Carex collinsii	Collins sedge	SC*
Linnaea borealis ssp. americana	Twinflower	E
Lygodium palmatum	Climbing fern	SC
Maianthemum trifolium	Three-leaved false Solomon's-seal	T
Paspalum laeve	Field paspalum	E
Platanthera ciliaris	Yellow-fringed orchid	T

E = Endangered, T = Threatened, SC = Special Concern, SC* = Special Concern, Presumed Extirpated

Species List for Request Number R201302619 Pomfret

8/2/2013

Scientific Name	Common Name	State Protection Status
Animals		
Botaurus lentiginosus	American bittern	E
Falco sparverius	American kestrel	T
Lasiurus borealis	Red bat	SC
Passerculus sandwichensis	Savannah sparrow	SC
Podilymbus podiceps	Pied-billed grebe	E

E = Endangered, T = Threatened, SC = Special Concern, SC* = Special Concern, Presumed Extirpated

Species List for Request Number R201302619 26-inch

8/13/2013

Scientific Name	Common Name	State Protection Status
Animals		
Ambystoma jeffersonianum	Jefferson salamander "complex"	SC
Glyptemys muhlenbergii	Bog turtle	E
Plants		
Schoenoplectus acutus	Hard-stemmed bulrush	T

E = Endangered, T = Threatened, SC = Special Concern, SC* = Special Concern, Presumed Extirpated

Species List for Request Number R201302619 30-inch

8/13/2013

Scientific Name	Common Name	State Protection Status
Animals		
Cicindela formosa generosa	Pine barrens tiger beetle	SC
Puma concolor couguar	Eastern cougar	SC*
Scaphinotus viduus	Ground beetle	SC
Terrapene carolina carolina	Eastern box turtle	SC
Plants		
Carex collinsii	Collins sedge	SC*
Linnaea borealis ssp. americana	Twinflower	E
Lygodium palmatum	Climbing fern	SC
Maianthemum trifolium	Three-leaved false Solomon's-seal	T
Paspalum laeve	Field paspalum	E
Platanthera ciliaris	Yellow-fringed orchid	T

E = Endangered, T = Threatened, SC = Special Concern, SC* = Special Concern, Presumed Extirpated

Species List for Request Number R201302619 E-1-6" S

8/13/2013

Scientific Name	Common Name	State Protection Status
Animals		
Heterodon platirhinos	Eastern hognose snake	SC
Plants		
Podostemum ceratophyllum	Threadfoot	SC

E = Endangered, T = Threatened, SC = Special Concern, SC* = Special Concern, Presumed Extirpated

ATTACHMENT E OF GENERAL PERMIT REGISTRATION FORM

Stormwater Pollution Control Plan

Algonquin Gas Transmission, LLC

Algonquin Incremental Market Project

CONNECTICUT STORM WATER POLLUTION CONTROL PLAN ("SWPCP")

Prepared for:

Algonquin Gas Transmission, LLC
890 Winter Street, Suite 300
Waltham, MA 02451

Prepared by:

TRC Environmental Corporation
21 Griffin Road North
Windsor, Connecticut 06095

February 2015

For technical questions or questions related to certification, please contact Don Gonyea

1.0 INTRODUCTION

1.1 Background

Algonquin Gas Transmission, LLC ("Algonquin"), an indirect, wholly-owned subsidiary of Spectra Energy Partners, LP, is seeking authorization from the Federal Energy Regulatory Commission ("FERC" or "Commission") pursuant to Section 7(c) of the Natural Gas Act to construct, install, own, operate, and maintain the Algonquin Incremental Market Project ("AIM Project" or "Project") which will involve expansion of its existing pipeline systems located in New York, Connecticut, Rhode Island and Massachusetts. The AIM Project will create 342,000 dekatherms per day of firm pipeline capacity to deliver natural gas to the Northeast markets to meet immediate and future supply and load growth requirements. Specifically, the Project will create the additional capacity from the Ramapo, New York receipt point on Algonquin's systems to various Algonquin city gate delivery points in Connecticut and Massachusetts.

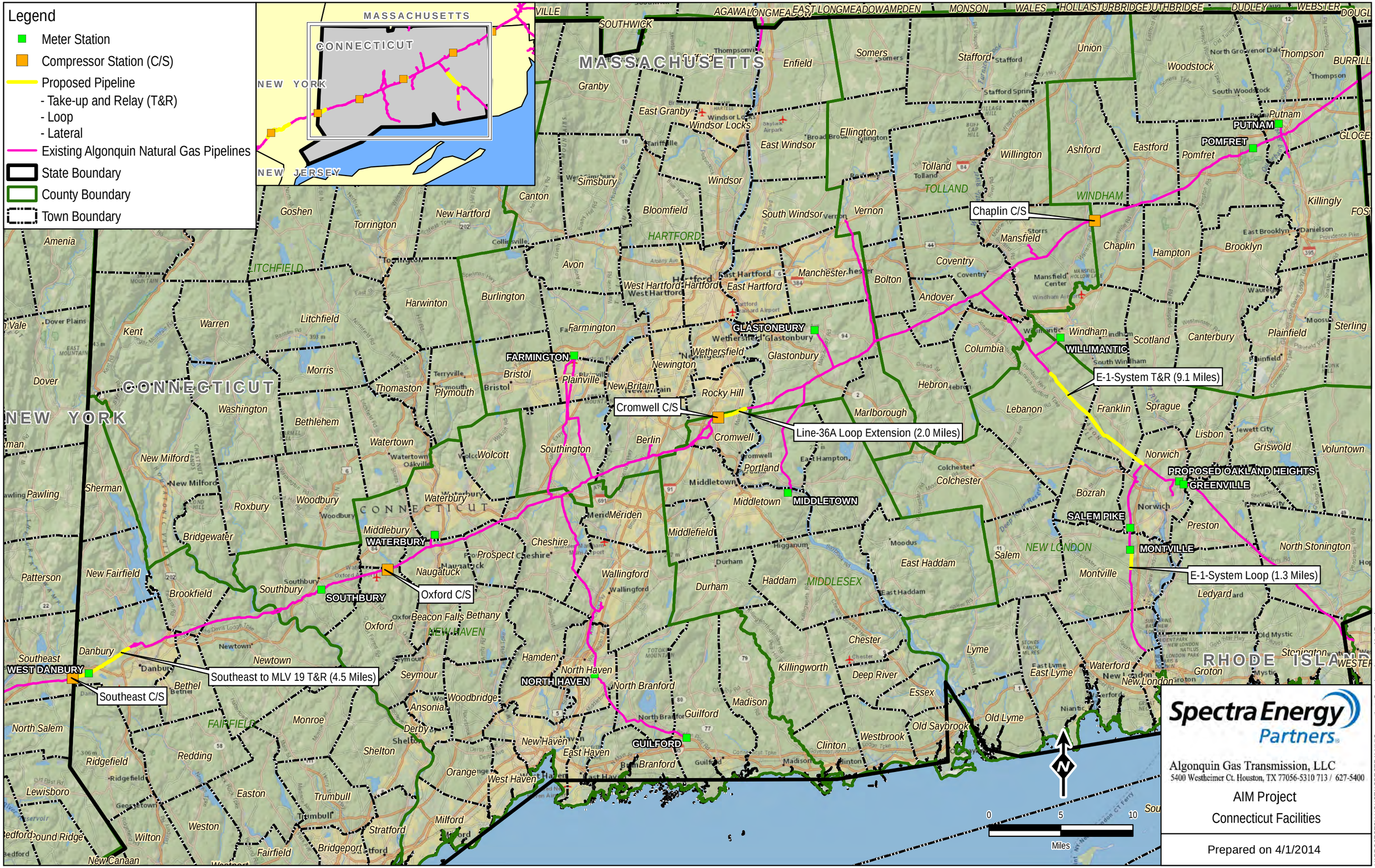
This document presents the *Storm Water Pollution Control Plan* ("SWPCP") for Algonquin's AIM Project pipeline and aboveground facilities located in Fairfield County, Middlesex County, Hartford County, Windham County, New Haven, County, and New London, County, Connecticut (refer to Figure 1-1 for an Overview Map). The AIM Project facilities that involve ground disturbing activities in Connecticut include:

- Installation of one new compressor unit at the existing Cromwell Compressor Station;
- Installation of one new compressor unit and restage two existing compressor units at the Chaplin Compressor Station;
- Take-up and Relay[1] of 4.4 miles of existing 26-inch diameter Mainline with 42-inch diameter pipe in Danbury;
- Extension of the existing Line 36A Loop[2] with 2.0 miles of new 36-inch diameter pipeline in Cromwell and Rocky Hill;
- Take-up and Relay of 9.1 miles of existing 6-inch diameter E-1 System Lateral with 16-inch diameter pipe in Lebanon, Franklin, and Norwich;
- Installation of 1.3 miles of new 12-inch diameter E-1 System Lateral Loop in Montville;
- Construction of one new metering and regulator ("M&R") Station (Oakland Heights M&R Station) located in the Norwich;
- Removal of one existing M&R Station (Greenville M&R Station) located in the Norwich; and
- Modifications to 13 existing M&R stations at various locations.

A more detailed description of the Project facilities is provided in Section 2.0. United States Geological Survey ("USGS") maps depicting the Project facilities are provided in Appendix A. Detailed Project alignment sheets depicting limits of work and erosion controls are provided in Appendix B. This SWPCP identifies the Best Management Practices to be implemented during and following construction activities to minimize impacts to the environment (i.e., soil erosion and sediment control measures, landscaping and site restoration, storm water controls, etc.).

[1] Take-up and relay refers to a construction method by which an existing pipeline is removed and replaced with a new pipeline in the same location and ditch.

[2] A pipeline loop is a segment of pipe constructed parallel to an existing pipeline to increase capacity.


Legend
Meter Station
Compressor Station (C/S)
Proposed Pipeline
- Take-up and Relay (T&R)
- Loop
- Lateral
Existing Algonquin Natural Gas Pipelines
State Boundary
County Boundary
Town Boundary
MASSACHUSETTS
CONNECTICUT
NEW YORK
NEW JERSEY
RHODE ISLAND
Chaplin C/S
E-1-System T&R (9.1 Miles)
Cromwell C/S
Line-36A Loop Extension (2.0 Miles)
Oxford C/S
E-1-System Loop (1.3 Miles)
Southeast to MLV 19 T&R (4.5 Miles)
Southeast C/S
WEST DANBURY
SOUTHBURY
WATERBURY
FARMINGTON
GLASTONBURY
MIDDLETOWN
WILLIMANTIC
PUTNAM
POMFRET
PROPOSED OAKLAND HEIGHTS
GREENVILLE
SALEM PIKE
MONTVILLE
GUILFORD
Spectra Energy Partners
Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400
AIM Project
Connecticut Facilities
Prepared on 4/1/2014
0 5 10
Miles
Data Sources: ESRI, CT GIS, SPECTRA, TRC
V:\PROJECTS\AUGUSTA\SPECTRA\AIM\Connecticut_Overview_1page_11x17.mxd

1.2 Project Permits and Approvals

1.2.1 Federal Requirements

The AIM Project will be constructed in compliance with applicable federal regulations and guidelines, and the specific requirements of the following:

- 18 Code of Federal Regulations ("CFR") Part 380 – FERC's Regulations Implementing the National Environmental Policy Act (including § 380.15 - Siting and Maintenance Requirements);
- 49 CFR Part 192 – Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards; and
- The Federal Energy Regulatory Commission *Upland Erosion Control, Revegetation, and Maintenance Plan* (May 2013 Version) and *Wetland and Waterbody Construction and Mitigation Procedures* (May 2013 Version).

A list of required permits for the AIM Project is provided below in Table 1-1.

TABLE 1-1

AIM Project Permit Summary for Connecticut Facilities

Agency	Permits and Consultations	Date Submitted / *Anticipated Submittal Date*	Date Received *Anticipated Receipt Date*
FEDERAL			
Federal Energy Regulatory Commission (FERC) o Office of Energy Projects (OEP)	*Required Permit:* o Certificate of Public Convenience and Necessity o National Environmental Policy Act (NEPA) – Environmental Impact Statement Review o Pipeline abandonment under Section 7(b) of the Natural Gas Act	Filed Formal FERC Application – February 28, 2014	*FEIS issued January 2015* *Receive FERC Certificate – February/March 2015*
U.S. Army Corps of Engineers (USACE) o New England District – Regulatory Division	*Required Permit:* o Sec. 10 Rivers and Harbors Act o Sec. 404 Clean Water Act (CWA)	Filed NY - March 21, 2014	*1st Quarter 2015*
U.S. Environmental Protection Agency (USEPA) o Region 1	*Consultations:* o Wetland review during USACE Section 404 permit process o Consultation during NEPA review and oversight of air permits o SPCC Plan o SIP Conformity	No USEPA approval required. Consultation through the USACE permitting process.	N/A
National Marine Fisheries Service (NOAA Fisheries) o Office of Protected Resources	*Consultations:* o Federal Endangered Species Act o Magnuson-Stevens Fishery Conservation and Management Act	*Consultation complete*	N/A
U.S. Fish and Wildlife Service (USFWS) o New England Field Office	*Consultations:* o Federal Endangered Species Act o Migratory Bird Treaty Act o Fish and Wildlife Coordination Act	*Consultation complete, waiting on final concurrence letter*	N/A
STATE OF CONNECTICUT			
Connecticut Department of Energy and Environmental Protection o Bureau of Water Protection and Land Reuse	*Required Permits:* o 401 Water Quality Certification o Inland Wetlands and Watercourses o General Permit for the Discharge of Hydrostatic Pressure Testing Wastewater	Filed 401 and Hydro Test Registration on March 28, 2014	*Hydrotest discharge permits issued*

TABLE 1-1

AIM Project Permit Summary for Connecticut Facilities

Agency	Permits and Consultations	Date Submitted / *Anticipated Submittal Date*	Date Received *Anticipated Receipt Date*
	o General Permit for the Discharge of Stormwater and dewatering wastewaters from Construction Activities	To be completed with submittal of this SWPCP	*401 WQC expected February 2015*
Connecticut Department of Energy and Environmental Protection o Bureau of Natural Resources ▪ Wildlife Division - Natural Diversity Data Base ▪ Inland Fisheries	*Consultation:* o State-listed threatened and endangered species consultations o Inland fisheries	*Complete*	N/A
Connecticut Department of Energy and Environmental Protection o Bureau of Air Management	*Required Permits:* o Air Permits for modifications to compressor stations	Filed Cromwell on February 4, 2014 Filed Chaplin on January 31, 2014	*Permits issued January/February 2015*
Connecticut Department of Energy and Environmental Protection o Connecticut Siting Council	*Consultation:* o Review and certification of energy facilities through the FERC process	*N/A*	November 7, 2013, the Connecticut Siting Council issued its decision on Petition No. 1072, finding that Federal agencies have exclusive jurisdiction over the AIM Project
Connecticut Department of Economic and Community Development **Offices of Culture and Tourism** **Connecticut State Historic Preservation Office** o Connecticut Office of the State Archaeologist	*Consultation:* o Review and consultation under Section 106 of the National Historic Preservation Act	*Ongoing consultation*	*1st Quarter 2015*
Connecticut Indian Affairs Council	*Consultation:* o Review and consultation under Section 106 of the National Historic Preservation Act	*Ongoing consultation*	*1st Quarter 2015*
Connecticut Commission on Culture and Tourism	*Consultation:* o Review and consultation under Section 106 of the National Historic Preservation Act	*Ongoing consultation*	*1st Quarter 2015*
Municipal Inland Wetlands and Watercourse Agencies	*Consultation:* o Inland Wetlands and Watercourses	*Consultation Only* On April 14, 2014, Algonquin provided a copy of the 401 WQC Application to each IWWA.	N/A
NATIVE AMERICAN TRIBES			
Federally Recognized o Wampanoag Tribe of Gay Head (Aquinnah) o Mashpee Wampanoag Indian Tribe o Narragansett Indian Tribe	*Consultations:* o Section 106, National Historic Preservation Act (16 USC § 470f)	*Ongoing consultation*	*1st Quarter 2015*

TABLE 1-1 **AIM Project Permit Summary for Connecticut Facilities**			
Agency	**Permits and Consultations**	**Date Submitted / *Anticipated Submittal Date***	**Date Received *Anticipated Receipt Date***
o Mohegan Indian Tribe o Mashantucket Pequot Tribal Nation o Delaware Nation of Oklahoma o Delaware Tribe of Indians o St. Regis Mohawk Tribe o Stockbridge-Munsee Community Band of Mohican Indians			
Non-Federally Recognized o Ramapough Lenape Indian Nation o Golden Hill Tribe of the Paugussett Indian Nation o Schaghticoke Tribal Nation o Eastern Pequot Tribal Nation	*Consultations:* o Section 106, National Historic Preservation Act (16 USC § 470f)	*Ongoing consultation*	*1st Quarter 2015*

1.2.2 General Permit for Discharge of Storm Water and Dewatering Wastewaters from Construction Activities

This SWPCP was prepared in accordance with the requirements of the State of Connecticut Department of Energy and the Environment ("CTDEEP") *General Permit for Discharge of Storm Water and Dewatering Wastewaters from Construction Activities*[3] ("General Permit"). The General Permit covers discharges that are associated with construction activity, including activities that result in the disturbance of one acre or more of total land area.

Construction activities (including other land-disturbing activities) that disturb one acre or more are regulated under the National Pollutant Discharge Elimination System stormwater program. Under the authority of the Clean Water Act, the CTDEEP General Permit requires construction projects to obtain coverage under the General Permit, and as a requirement of coverage under the permit, prepare and implement a SWPCP.

This SWPCP was developed to minimize pollution caused by soil erosion and sedimentation during and after construction and stormwater pollution caused by use of the Project site after construction is completed.

During construction, the construction contractor(s) will implement all elements of the erosion and sedimentation control measures as defined in the Contract Documents and in this SWPCP. After construction, Algonquin will maintain the applicable erosion and sedimentation controls and stormwater pollution prevention measures. Throughout the construction process, Environmental Inspectors ("EIs") will periodically inspect erosion control measures and conduct stormwater monitoring as applicable. A copy of the Inspection Report Form and Stormwater Monitoring Reports are provided in Appendix C.

Algonquin understands this construction project will not be considered complete until all disturbed areas have been satisfactorily stabilized, all erosion has been repaired, and all temporary erosion control measures have been removed. The general contractor and subcontractor(s) will be required to sign the certification statement provided in Appendix E of this Plan.

[3] General Permit was issued on August 21, 2013 and made effective on October 1, 2013.

1.2.3 Algonquin Erosion and Sedimentation Control Plan

Algonquin's AIM Project, Erosion and Sediment Control Plan ("E&SCP") is provided in Appendix D of this SWPCP. The E&SCP is designed to provide specifications for the installation and implementation of soil erosion and sediment control measures for the Project. In the event of a conflict between this SWPCP and the E&SCP the more stringent requirement shall be followed. A summary of major differences between the AIM Project E&SCP and this SWPCP/General Permit is provided in Table 1-2 below.

TABLE 1-2

Major Differences Between AIM Project E&SCP and the SWPCP General Permit

Activity	Synopsis of Connecticut SWPCP/General Permit: Reference	E&SCP Requirement: Reference
Aquifer Protection Area Hazardous Material Handling Requirements	SWPCP: Storage and refueling to be conducted outside of APA Section 4.7	SPCC spill prevention requirements Section 4.1
Stabilization Practices	Required when construction activities cease or disturbed areas are inactive for at least 30 days. Stabilization shall occur within 7 days Section 4.1.1	The disturbed ROW will be seeded within 6 working days of final grading Section 3.6
Stormwater Inspections	SWPCP: At least once per week and Within 24 hours after storm event that generates discharge Next working day for storm event <0.5 inches that occurs on a non-working day and Once per month for 3 months after temporary or final stabilization Section 5.2	Inspect temporary erosion control measures at least: a. On a daily basis in areas of active construction or equipment operation; b. On a weekly basis in areas with no construction or equipment operation; and c. Within 24 hours of each 0.5 inch of rainfall. Follow-up inspections at end of first and second growing season Section 2.1 and 8.1
Stormwater Inspection Reports	Inspection reports to contain specific elements and to be signed by an "authorized representative" and include a specific certification statement Section 5.2	Quarterly activity reports documenting the results of follow-up inspections Section 8.3
Corrective Measures and SWPCP Amendment	Non-engineered corrective actions shall be implemented on site within 24 hours and incorporated into a revised Plan within three (3) calendar days of the date of inspection. Engineered corrective measures shall be implemented on site within seven (7) days and incorporated into a revised Plan within ten (10) days of the date of inspection Section 5.2	Quarterly activity reports documenting the results of follow-up inspections Section 8.3
Contractor Certification	SWPCP: Contractor Certification and Signatures Required Appendix E	Algonquin is evaluating contractor bids and will obtain contractor signature prior to construction

1.3 Plan Organization

The SWPCP is organized into eight parts including a summary of the key provisions of the SWPCP (Section 1.0); a site description (Section 2.0); a description of the construction sequence (Section 3.0); a description of the stormwater controls to be used to attain SWPCP objectives (Section 4.0); inspection procedures (Section 5.0); monitoring procedures (Section 6.0), Contractor requirements (Section 7.0), recordkeeping requirements (Section 8.0), and references are provided in Section 9.0.

1.4 Revisions to the SWPCP (Section 5(b)(5)(A))

In accordance with the General Permit, the SWPCP will be amended whenever:

(1) there is a change in contractors or subcontractors at the site; or

(2) there is a change in design, construction, operation or maintenance at the site which has the potential for the discharge of pollutants to the waters of the State and which has not otherwise been addressed in the SWPCP; or

(3) if the actions required by the SWPCP fail to prevent applicable forms of pollution.

The Commissioner of the CT DEEP may also require the registrant to revise the SWPCP if it does not meet one or more of the minimum requirements of the General Permit.

Notwithstanding anything to the contrary set forth in this document, nothing stated herein shall be construed to indicate that any state, regional, or local agency referred to has the power to impose any requirement inconsistent with Federal law or to refuse to issue or to unreasonably delay the issuance or processing of any state, regional, or local permit, license, certificate, approval, review, or other requirement: nor shall this document be construed to limit Algonquin's legal rights under the Natural Gas Act (15 U.S.C. § 717, et seq.), Pipeline Safety Act (49 U.S.C. § 60,101, et seq.), or the United States Constitution, including, but not limited to, the Supremacy Clause and Commerce Clause.

2.0 SITE DESCRIPTION (SECTION 5(B)(1)(B)(II))

2.1 Description of the Construction Activity (Section 5(b)(1)(B)(ii)(a))

The AIM Project is a linear construction project, and as such, this SWPCP addresses construction stormwater management throughout the site as defined below.

> *"Site" means geographically contiguous land on which a construction activity takes place or on which a construction activity for which authorization is sought under this general permit is proposed to take place. Non-contiguous land or water owned by the same person shall be deemed the same site if such land is part of a linear project (as defined in this section) or is otherwise connected by a right-of-way, which such person controls.*
>
> *"Linear Project" includes the construction of roads, railways, bridges, bikeways, conduits, substructures, pipelines, sewer lines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment and associated ancillary facilities in a long, narrow area.*

A more detailed overview of the AIM Project pipeline facilities in Connecticut is provided in Table 2-1 below. Details of the construction activities and sequences are provided in Section 3.0.

2.1.1 AIM Project Pipeline Facilities

TABLE 2-1

Summary of AIM Project Pipeline Facilities in Connecticut

State, Facility Name, Milepost ("MP") Range	Length of Proposed Facilities (miles)	Existing Pipe Removal (Diameter)	New/ Replacement Pipe (Diameter)	County, State, (Length in Miles)	Municipalities (Length in Miles)
Southeast to MLV-19 Take-up & Relay	4.4	26-inch Mainline	42-inch Mainline	Fairfield County, CT (4.4 Miles)	City of Danbury (4.4 Miles)
Line-36A Loop Extension	2.0	N/A	36-inch	Middlesex County, CT (1.8 Miles) Hartford County, CT (0.2 Miles)	Town of Cromwell (1.8 Miles) Town of Rocky Hill (0.2 Miles)
E-1 System Lateral Take-up & Relay	9.1	6-inch E-1 Lateral	16-inch	New London County, CT (9.1 Miles)	Town of Lebanon (3.9 Miles) Town of Franklin (4.5 Miles) City of Norwich (0.7 Miles)
E-1 System Lateral Loop	1.3	N/A	12-inch	New London County, CT (1.3 Miles)	Town of Montville (1.3 Miles)
TOTAL:	**16.8**				

Southeast to Mainline Valve 19 Take-up & Relay: 4.4 miles

Algonquin will take-up and relay a 26-inch diameter mainline pipeline segment with 42-inch diameter pipeline located in Fairfield County, Connecticut. The take-up and relay work will begin at the Southeast Compressor Station (MP 0.0) in the Town of Southeast, New York, and extend northeast across the New York/Connecticut boundary (MP 0.1) into the City of Danbury, Connecticut. The take-up and relay section continues to the northeast up to the existing crossing of Interstate 84. At this point, Algonquin will install the new 42-inch pipeline beneath Interstate 84, the Still River, a railroad line and Mill Plain Road using the horizontal direction drill ("HDD") construction method (MP 1.4 – MP 2.1). This HDD will also use the intersect method with drill rigs set up on both ends of the HDD to drill the pilot hole. The existing 0.7-mile section of 26-inch pipeline will be abandoned in place along this HDD crossing. At the eastern end of the HDD crossing, Algonquin will continue the take-up and relay operation through the City of Danbury ending at the existing Mainline Valve ("MLV")-19 site located east of State Route 39 (Clapboard Ridge Road).

Line-36A Loop Extension: 2.0 miles

Algonquin will extend its existing Line-36A loop pipeline with approximately 2.0 miles of additional 36-inch diameter pipeline in Middlesex County and Hartford County, Connecticut (Line-36A Loop Extension). This 2.0-mile loop extension will begin at Algonquin's existing Cromwell Compressor Station (MP 0.0) and extend downstream (east) to a termination point located approximately 1,400 feet west of the Connecticut River. The loop extension will be located within the Towns of Cromwell and Rocky Hill.

E-1 System Lateral Take-up & Relay: 9.1 miles

Algonquin will take-up and relay approximately 9.1 miles of 6-inch diameter pipeline with 16-inch diameter pipeline along its existing E-1 System Lateral in New London County, Connecticut *(E-1 System Lateral Take-up & Relay).* The take-up and relay will begin at State Route 289 (MP 0.0) in the Town of Lebanon and extend to the southeast through the Town of Franklin, ending approximately 900 feet northwest of Plain Hill Road in the City of Norwich. This section of the E-1 System Lateral is being replaced because the existing 6-inch diameter pipeline cannot support the proposed incremental capacity of the AIM Project.

E-1 System Lateral Loop: 1.3 miles

Algonquin will extend its existing Line-E-1L pipeline with approximately 1.3 miles of additional 12-inch diameter pipeline loop along its existing E-1 System Lateral (E-1 System Lateral Loop). The 1.3-mile loop pipeline will begin at the existing Montville M&R Station (MP 0.0) located on the north side of Fitch Hill Road and extend approximately 1.3 miles to the south, ending about 100 feet north of Raymond Hill Road. The entire loop pipeline is located within the Town of Montville in New London County, Connecticut.

2.1.2 AIM Project Aboveground Facilities

In addition to the pipeline work noted above, the proposed AIM Project aboveground facilities in Connecticut that involves ground disturbance include modifications to two existing compressor stations, modifications to 13 existing M&R stations, construction of one new M&R stations, and the removal of one existing M&R station. A summary of the Project aboveground facilities is provided in Table 2-2 below.

TABLE 2-2

Summary of AIM Project Existing and Proposed Aboveground Facilities

Algonquin Facility Name	Milepost a/	Location (Municipality, County, State)
Modifications to Existing Compressor Stations		
Cromwell Compressor Station ➢ Install 1 new compressor unit ➢ Install gas cooling for new unit and 2 existing turbine compressors	N/A	Town of Cromwell, Middlesex, CT
Chaplin Compressor Station ➢ Install 1 new compressor unit ➢ Restage 2 existing compressor units ➢ Install gas cooling for new unit and 2 existing compressor units ➢ Station piping modifications	N/A	Town of Chaplin, Windham, CT
New M&R Stations		
Oakland Heights M&R Station ➢ New metering, regulating and heating facilities	N/A	City of Norwich, New London, CT
Existing M&R Station Modifications		
West Danbury M&R Station o Uprate existing facilities and inlet piping for new 850 psig inlet pressure o Replace existing ultrasonic meter with new ultrasonic meters and a low flow meter	MP 1.2	City of Danbury, Fairfield, CT
Southbury M&R Station o Piping Modifications o Add low flow meter o Increase size of piping	N/A	Town of Southbury, New Haven, CT
Waterbury M&R Station o Replace existing meter with ultrasonic meters and a low flow meter o Upgrade regulation o Replace existing building	N/A	City of Waterbury, New Haven, CT
North Haven M&R Station o Replace existing meter with ultrasonic meters and a low flow meter	N/A	Town of North Haven, New Haven, CT
Guilford M&R Station o Rebuild entire station within existing property o Add filter separator	N/A	Town of Guilford, New Haven, CT
Farmington M&R Station o Remove upstream pressure regulation o Add low flow meter o Upgrade downstream pressure regulation	N/A	Town of Farmington, Hartford, CT
Glastonbury M&R Station o Replace inlet piping and inlet header o Replace existing meters with ultrasonic meters and low flow meter	N/A	Town of Glastonbury, Hartford, CT
Middletown M&R Station o Add redundant turbine meter run	N/A	City of Middletown, Middlesex, CT
Salem Pike M&R Station o Minor modifications to aboveground station piping and regulation	N/A	City of Norwich, New London, CT
Montville M&R Station o Replace existing metering with ultrasonic meters and a low flow meter o Replace inlet piping from heater to metering	MP 0.0	Town of Montville, New London, CT

TABLE 2-2 **Summary of AIM Project Existing and Proposed Aboveground Facilities**		
Algonquin Facility Name	**Milepost a/**	**Location (Municipality, County, State)**
Willimantic M&R Station o Rebuild entire station on adjacent new parcel o Removal of existing M&R station except communications (after new station in-service)	N/A	Village of Willimantic, Town of Windham, Windham, CT
Pomfret M&R Station o Add redundant meter run	N/A	Town of Pomfret, Windham, CT
Putnam M&R Station o Add redundant meter run	N/A	Town of Putnam, Windham, CT
Removal of Existing M&R Station		
Greenville M&R Station o Remove existing M&R station (after Oakland Heights M&R in-service)	N/A	City of Norwich, New London, CT

2.2 Area of Disturbance (Section 5(b)(1)(B)(ii)(b))

As "Total disturbance" is defined as the total area on a site where soil will be exposed or susceptible to erosion during the course of all phases of a project, it has been conservatively calculated to encompass the entire width of the construction limits identified on the drawings for pipeline areas and compressor stations.

Algonquin has estimated a total construction land disturbance for the AIM Project facilities in Connecticut at approximately 190 acres for the pipeline facilities and approximately 33 acres for the aboveground facilities.

2.3 Runoff Considerations (Section 5(b)(1)(B)(ii)(c))

Pipeline construction activities are not anticipated to substantially alter existing surface water drainage/runoff patterns. Based upon the nature of the project involving the temporary disturbance of the pipeline right-of-way ("ROW"), the impervious area before construction and the impervious area after construction will remain approximately equivalent. Any temporary features such as stabilized construction entrances, etc. will be removed at the completion of the Project. For this reason the runoff coefficient is not anticipated to significantly change once construction is complete.

A detailed drainage analysis for the Chaplin Compressor Station development prepared by Baker is provided in Appendix F. A detailed drainage analysis for the Cromwell Compressor Station development prepared by Baker is provided in Appendix G.

2.4 Receiving Waters (Section 5(b)(1)(B)(ii)(d))

Surface water resources were initially identified using USGS topographic maps and subsequently verified and surveyed during wetland field delineations conducted in 2013. Surface water resources documented in the AIM Project area include rivers, streams and associated tributaries, lakes, and small ponds. The following sections describe the surface water resources in the AIM Project area.

The AIM Project facilities in Connecticut are located within 18 subbasin level watersheds throughout the state (*see* Table 2-3). These watersheds encompass several major rivers including Housatonic River, South Central Coast, Connecticut River, and Thames River.

TABLE 2-3

Watersheds Crossed by the AIM Project in Connecticut

State, Facility	Hydrologic Unit Code	Watershed Name	Total Watershed Drainage Area (square miles)
PIPELINE FACILITIES			
Southeast to MLV-19 Take-up & Relay	11000050801	Still River-headwaters to Limekiln Brook	39.55
Line-36A Loop Extension	10802050506	Connecticut mainstem-Hog Brook to Mattabesset River	30.34
	10802050603	Mattabesset River-Webster Brook to mouth	39.50
E-1 System Lateral Take-up & Relay	11000030102	Susquetonscut Brook	15.36
	11000030103	Yantic mainstem	50.59
E-1 System Lateral Loop	11000030202	Stony Brook	22.06
ABOVEGROUND FACILITIES			
Chaplin Compressor Station	11000020205	Mount Hope River	36.64
Cromwell Compressor Station	10802050603	Mattabesset River-Webster Brook to mouth	39.50
Farmington M&R Station	10802070404	Pequabuck River	39.15
Glastonbury M&R Station	10802050503	Salmon Brook	20.17
Greenville M&R Station	11000020303	Shetucket mainstem	60.89
Guilford M&R Station	11000040208	Coastal drainages-Tuttles Point to Quinnipiac River	14.27
Middletown M&R Station	10802050704	Connecticut mainstem-Mattabesset River to Salmon River	51.52
Montville M&R Station	11000030202	Stony Brook	22.06
North Haven M&R Station	11000040105	Quinnipiac mainstem-Hanover Pond Dam to mouth	48.65
Oakland Heights M&R Station	11000020303	Shetucket mainstem	60.89
Pomfret M&R Station	11000010403	Quinebaug River-French River to Moosup River	41.52
Putnam M&R Station	11000010403	Quinebaug River-French River to Moosup River	41.52
Salem Pike M&R Station	11000030203	Pawcatuck mainstem-Yantic River to mouth	57.29
Southbury M&R Station	11000050903	Pomperaug River	34.82
Waterbury M&R Station	11000051205	Naugatuck mainstem-Hancock Brook to Beacon Hill Brook	28.50
Willimantic M&R Station	11000020108	Willimantic mainstem	56.53

The Lake Kenosia watershed is 3,020 acres in area and contains land in Ridgefield, Connecticut and neighboring New York State. Lake Kenosia is designated for water supply use only in a water supply emergency during winter months (HVCEO, 2013). The Lake Kenosia public water supply watershed protection zone is crossed by the Southeast to MLV-19 Take-up & Relay pipeline segment in Danbury between MP 0.0 and MP 2.69. In Connecticut, stream use designations are regulated under the CT DEEP Water Quality Standards described in Section 22a-246 of the Connecticut General Statutes. Designated uses include Class AA (suitable for drinking), Class A (habitat and potential drinking water) and Class B (suitable for recreation) (CT DEEP, 2013). Refer to Table 2-4 below for the water quality classification of waterbodies crossed in Connecticut by the AIM Project pipeline facilities. Table 2-4 lists the waterbodies/receiving waters crossed by the AIM Project.

TABLE 2-4

Waterbodies Crossed by the AIM Project Facilities in Connecticut

Facility, Waterbody ID	Waterbody Name	MP a/	Municipality	County	Crossing Width (Feet) b/	Flow Type	FERC Classification	Fishery Type	State Water Quality Classification c/	Proposed Crossing Method d/
PIPELINE FACILITIES										
Southeast to MLV 19 Take-up & Relay										
B13-SELR-S8	Sawmill River	0.27	Danbury	Fairfield	8	P	Minor	Warmwater	AA	Dry Crossing
A13-SELR-S1	UNT to Still River	1.04	Danbury	Fairfield	0.5	I	Minor	Warmwater	AA	Dry Crossing
A13-SELR-S3	UNT to Still River	1.25	Danbury	Fairfield	9	I	Minor	Warmwater	AA	Dry Crossing
B13-SELR-S12 e/	Still River	1.74	Danbury	Fairfield	12	P	Intermediate	Warmwater (Trout)	AA	HDD
A13-SELR-S6	UNT to Boggs Pond Brook	3.03	Danbury	Fairfield	6	I	Minor	Warmwater	AA	Dry Crossing
B13-SELR-S1	UNT to Boggs Pond Brook	3.33	Danbury	Fairfield	2	I	Minor	Warmwater	AA	Dry Crossing
B13-SELR-S3	UNT to Boggs Pond Brook	3.55	Danbury	Fairfield	1	I	Minor	Warmwater	AA	Dry Crossing
B13-SELR-S4	Boggs Pond Brook	3.72	Danbury	Fairfield	8	P	Minor	Warmwater	AA	Dry Crossing
B13-SELR-S6	UNT to Kohanza Brook	3.92	Danbury	Fairfield	4	I	Minor	Warmwater	AA	Dry Crossing
B13-SELR-S7	Kohanza Brook	4.08	Danbury	Fairfield	12	I	Minor	Warmwater	AA	Dry Crossing
Line 36-A Loop Extension										
B13-CLR-S1	Coles Brook	0.05	Cromwell	Middlesex	4	P	Minor	Warmwater	A	Dry Crossing
B13-CLR-S2	UNT to Dividend Brook	0.79	Cromwell	Middlesex	1	I	Minor	Coldwater	A	Dry Crossing
B13-CLR-S2C	UNT to Dividend Brook	0.88	Cromwell	Middlesex	1	I	Minor	Coldwater	A	Dry Crossing

TABLE 2-4

Waterbodies Crossed by the AIM Project Facilities in Connecticut

Facility, Waterbody ID	Waterbody Name	MP a/	Municipality	County	Crossing Width (Feet) b/	Flow Type	FERC Classification	Fishery Type	State Water Quality Classification c/	Proposed Crossing Method d/
B13-CLR-S2B	UNT to Dividend Brook	0.90	Cromwell	Middlesex	2	I	Minor	Coldwater	A	Dry Crossing
B13-CLR-S2D	UNT to Dividend Brook	0.90	Cromwell	Middlesex	1.5	I	Minor	Coldwater	A	Dry Crossing
B13-CLR-S2E	UNT to Dividend Brook	0.91	Cromwell	Middlesex	2	P	Minor	Coldwater	A	Dry Crossing
E-1 System Lateral Take-up & Relay										
A13-ELR-S1	Susquetonscut Brook	0.67	Lebanon	New London	37	P	Intermediate	Warmwater (Trout)	A	Dry Crossing
A13-ELR-S2	UNT to Susquetonscut Brk	0.70	Lebanon	New London	1.5	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S1	UNT to Susquetonscut Brk	1.21	Lebanon	New London	0.5	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S4B	UNT to Susquetonscut Brk	1.82	Lebanon	New London	0.75	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S4A	UNT to Susquetonscut Brk	1.85	Lebanon	New London	3	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S2A	Susquetonscut Brook	2.01	Lebanon	New London	29	P	Intermediate	Warmwater (Trout)	A	Dry Crossing
A13-ELR-S2E	UNT to Susquetonscut Brk	2.14	Lebanon	New London	2	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S2C	UNT to Susquetonscut Brk	2.14	Lebanon	New London	2	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S2D	UNT to Susquetonscut Brk	2.16	Lebanon	New London	2	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S2B	UNT to Susquetonscut Brk	2.16	Lebanon	New London	2	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S3	UNT to Susquetonscut Brk	2.34	Lebanon	New London	1	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S4	UNT to Susquetonscut Brk	2.47	Lebanon	New London	1	I	Minor	Warmwater	A	Dry Crossing

TABLE 2-4

Waterbodies Crossed by the AIM Project Facilities in Connecticut

Facility, Waterbody ID	Waterbody Name	MP a/	Municipality	County	Crossing Width (Feet) b/	Flow Type	FERC Classification	Fishery Type	State Water Quality Classification c/	Proposed Crossing Method d/
A13-ELR-S6A	UNT to Susquetonscut Brk	3.04	Lebanon	New London	1	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S8B	UNT to Susquetonscut Brk	3.24	Lebanon	New London	11	P	Intermediate	Warmwater	A	Dry Crossing
A13-ELR-S8A	UNT to Susquetonscut Brk	3.15	Lebanon	New London	1	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S9B	UNT to Susquetonscut Brk	3.52	Lebanon	New London	7	P	Minor	Warmwater	A	Dry Crossing
A13-ELR-S10	UNT to Susquetonscut Brk	3.76	Lebanon	New London	4	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S16	UNT to Susquetonscut Brk	4.33	Franklin	New London	1	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S15	UNT to Susquetonscut Brk	4.47	Franklin	New London	4	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S14	UNT to Susquetonscut Brk	4.68	Franklin	New London	5	P	Minor	Warmwater	A	Dry Crossing
B13-ELR-S13A	UNT to Susquetonscut Brk	4.80	Franklin	New London	3	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S13B	UNT to Susquetonscut Brk	4.80	Franklin	New London	2	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S11	UNT to Susquetonscut Brk	4.91	Franklin	New London	1.5	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S10	UNT to Susquetonscut Brk	4.93	Franklin	New London	1.5	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S9C	UNT to Susquetonscut Brk	5.04	Franklin	New London	2	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S9B	UNT to Susquetonscut Brk	5.26	Franklin	New London	3	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S9	UNT to Susquetonscut Brk	5.51	Franklin	New London	1	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S5A	UNT to Susquetonscut Brk	5.82	Franklin	New London	2	I	Minor	Warmwater (Trout)	A	Dry Crossing

TABLE 2-4

Waterbodies Crossed by the AIM Project Facilities in Connecticut

Facility, Waterbody ID	Waterbody Name	MP a/	Municipality	County	Crossing Width (Feet) b/	Flow Type	FERC Classification	Fishery Type	State Water Quality Classification c/	Proposed Crossing Method d/
B13-ELR-S5B	Susquetonscut Brook	5.83	Franklin	New London	37	P	Intermediate	Warmwater (Trout)	A	Dry Crossing
A13-ELR-S11	UNT to Susquetonscut Brk	6.10	Franklin	New London	1	I	Minor	Warmwater	A	Dry Crossing
A13-ELR-S50	UNT to Susquetonscut Brk	6.52	Franklin	New London	17	I	Intermediate	Warmwater	A	Dry Crossing
B13-ELR-S23	UNT to Susquetonscut Brk	7.16	Franklin	New London	5	I	Minor	Warmwater	A	Dry Crossing
B13-ELR-S22 e/	Johnnycake Brook (Ponded)	7.28	Franklin	New London	56	N/A	Intermediate	Warmwater	A	Dry Crossing
B13-ELR-S19	UNT to Elisha Brook	8.32	Franklin	New London	1	I	Minor	Coldwater (Trout)	A	Dry Crossing
B13-ELR-S18	Elisha Brook	8.51	Norwich	New London	6	P	Minor	Coldwater (Trout)	A	Dry Crossing
B13-ELR-S25	UNT to Norwichtown Brook	8.83	Norwich	New London	2	P	Minor	Warmwater	A	Dry Crossing
B13-ELR-S25A	UNT to Norwichtown Brook	8.87	Norwich	New London	1	E	Minor	Warmwater	A	Dry Crossing
B13-ELR-S24	UNT to Norwichtown Brook	8.92	Norwich	New London	1	E	Minor	Warmwater	A	Dry Crossing
B13-ELR-S17	UNT to Norwichtown Brook	9.06	Norwich	New London	2	E	Minor	Warmwater	A	Dry Crossing
E-1 System Lateral Loop										
B13-ELP-S3	UNT to Stony Brook	0.04	Montville	New London	13	P	Minor	Coldwater (Trout)	A	Dry Crossing
B13-ELP-S2	UNT to Stony Brook	0.16	Montville	New London	1.5	I	Minor	Coldwater (Trout)	A	Dry Crossing
B13-ELP-S4	UNT to Stony Brook	0.32	Montville	New London	10	I	Minor	Coldwater (Trout)	A	Dry Crossing
B13-ELP-S4A	UNT to Stony Brook	0.34	Montville	New London	1	I	Minor	Coldwater (Trout)	A	Dry Crossing

TABLE 2-4

Waterbodies Crossed by the AIM Project Facilities in Connecticut

Facility, Waterbody ID	Waterbody Name	MP a/	Municipality	County	Crossing Width (Feet) b/	Flow Type	FERC Classification	Fishery Type	State Water Quality Classification c/	Proposed Crossing Method d/
B13-ELP-S5	Falls Brook	0.80	Montville	New London	25	P	Intermediate	Coldwater (Trout)	A	Dry Crossing
B13-ELP-S6	UNT to Stony Brook	0.94	Montville	New London	5	I	Minor	Coldwater (Trout)	A	Dry Crossing
B13-ELP-S7	UNT to Stony Brook	1.18	Montville	New London	1	I	Minor	Coldwater (Trout)	A	Dry Crossing
ABOVEGROUND FACILITIES										
None										

NOTES:

a/ MP is the approximate pipeline entry point of each waterbody.
b/ Crossing width measured from water's edge.
c/ State Designations and Use Descriptions:
Connecticut:
AA – These waters can be used as existing or proposed drinking water sources, habitat for fish and other aquatic life or wildlife, recreation, and industrial or agricultural water supply.
A – These waters are appropriate for fish, aquatic life and wildlife habitat, potential drinking water supply, recreation, navigation, and industrial or agricultural water supply.
B - These waters are appropriate for fish, aquatic life and wildlife habitat, recreation, navigation, and industrial or agricultural water supply.
d/ The proposed pipeline crossing methods of "dry" and, "HDD" are described in detail in Algonquin's E&SCP.
e/ Indicates partial estimated delineation via aerial imagery within construction workspace.

2.5 Wetlands (Section 5(b)(1)(B)(ii)(e))

Wetlands are defined by the U.S. Army Corps of Engineers ("USACE") as areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, and bottomlands. Algonquin conducted wetland delineation surveys along the AIM Project pipeline and aboveground facilities between the spring and fall of 2013. Wetland boundaries were delineated using the methodology described in the USACE's Wetlands Delineation Manual (Environmental Laboratory, 1987) and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2). The 1987 Manual and more recent supplements identify three environmental factors to consider when making wetland determinations: indicators of hydrophytic vegetation, hydric soil, and wetland hydrology.

The AIM Project pipeline components will cross a total of 84 wetlands. No wetland resources will be affected by the work associated with the aboveground facilities. This will result in a total of 28.61 acres of temporary wetland impacts. Since hydrologic conditions during operation of the pipeline will be returned to pre-construction conditions, there will be no permanent loss of wetlands. Table 2-5 provides a summary of wetland impacts by facility. The wetlands are shown on the Project Alignment Sheets provided in Appendix B.

TABLE 2-5

Summary of Wetland Impacts in Connecticut

Pipeline Construction Activity	**Total Wetlands Impacted** (acreage)
Southeast to MLV-19 Take-up & Relay	8.17
Line-36A Loop Extension	3.09
E-1 System Lateral Take-up & Relay	15.61
E-1 System Lateral Loop	1.74
Subtotal	**28.61**

2.6 Impaired Waters (Section 5(b)(1)(B)(ix))

Stormwater runoff from the Project does not discharge to any of the "impaired waters for construction stormwater discharges" that are listed in the General Permit.

3.0 CONSTRUCTION ACTIVITIES AND SEQUENCE

The AIM Project pipeline facilities are located in a wide variety of land use settings including areas of undeveloped woodlands, farmlands, suburban residential neighborhoods, and moderately populated urban areas. Given the wide mix in land use types in the Project construction areas, several construction techniques will be utilized for the Project as described in the following sections.

3.1 Pipeline Construction Activities/Sequence (Section 5(b)(1)(B)(iii))

The construction sequence for the AIM Project will include the following construction activities:

- Clearing operations, where required;
- Installation and maintenance of erosion control devices;
- ROW and temporary construction workspace grading;
- Removal and abandonment of existing pipeline;
- Trench excavation;
- Blasting, where required;
- Stringing;
- Bending;
- Welding;
- Nondestructive weld inspection;
- Coating application, inspection and repair;
- Lowering-in;
- Tie-ins;
- Backfilling;
- Cleaning;
- Hydrostatic testing; and
- Restoration and revegetation.

At this time, no construction contracts have been awarded to any pipeline construction contractors to construct the AIM Project. Algonquin is currently evaluating a number of bids received from experience contractors and plans to select the contractors by April 2015. Algonquin has consulted with CT DEEP on the construction procedures to be used to install the AIM Project facilities. These procedures are detailed in the AIM Project E&SCP provided in Appendix D.

3.2 Construction Sequence (Section 5(b)(1)(B)(iii))

The proper sequencing of construction activities represents a key element in the Project's SWPCP. Accordingly, soil erosion and sediment control procedures will be in place and functional after clearing activities, but prior to beginning intrusive work. The Project pipeline alignment sheets provided in Appendix B of this SWPCP include information on erosion and sedimentation controls in the Project work area. The alignment sheets show the proposed location of silt fence, trench breakers, and interceptor dikes. The following sections summarize the general sequence of erosion and sedimentation ("E&S") related activities that will be employed to stabilize the ROW during construction and minimize the off-site migration of soils.

3.2.1 Site Mobilization and Erosion Control Measures (Section 5(b)(2)(A))

The following measures will be implemented prior to excavation work in the construction work area.

1. Survey the construction ROW: The construction ROW will be surveyed to clearly stake out the construction workspace and existing pipelines.

2. Install stabilized construction entrances: Rock access pads will be installed at all construction vehicle entrance/exits onto public roads. Construction entrances are typically 50 feet in length and 20 feet in width, if site conditions allow. The construction entrance will be flared to allow safe travel for entering and exiting vehicles. The pad will typically consist of a bed of 4 to 6-inch stone approximately 6 inches deep. Figure 5 of the E&SCP provides a typical detail of a rock access pad.

3. Install temporary erosion controls: During construction, runoff and erosion will be controlled using temporary sediment barriers such as silt fence, sand bags, staked straw or hay bales, and diversion dikes. These E&S measures shall be installed following vegetative clearing operations in the construction work areas. Section 3.5.2 and Figures 7, 8, 9 of the E&SCP provide typical specifications for silt fence and straw bale erosion control barriers. The locations of temporary sediment barriers are shown on the Project construction alignment sheets provided in Appendix B of this SWPCP. These sediment barrier locations are subject to change based on field conditions with approval from the Project Environmental Inspector.

4. Install temporary storm drain inlet protection: Inlet protection will be installed to prevent sediment from entering street drainage catch basins. Refer to Figure 10 of the E&SCP for the typical specifications for temporary storm drain protection.

5. Install check dams: Temporary stone or sandbag check dams will be constructed across drainage ways, as necessary. The primary function of these devices is to limit erosion by reducing velocities that degrade small open channels where permanent stabilization is impractical due to short periods of usefulness and time constraints of construction. Drainage way check dams will be installed in accordance with Figure 9 in the E&SCP.

3.2.2 Construction (Section 5(b)(1)(B)(iii))

The construction phase includes the following activities: grading, trench excavation and backfilling, new pipeline fabrication, existing pipeline removal, pipe tie-in, trench dewatering, hydrostatic testing. The sequence of E&S measures typically employed during pipeline construction is provided below:

1. Maintain rock access pads: Maintenance will be done in accordance with the schedule on Figure 5 of the E&SCP.

2. Maintain temporary erosion control structures: Maintain silt fence and straw bales in accordance with the schedules on Figures 7 and 8.

3. Implement topsoil segregation techniques in wetlands: During construction in wetlands, soil will be segregated and stockpiled for pipeline installation as well as grading purposes (except in areas where standing water is present or soils are saturated or frozen). In unsaturated wetlands, twelve inches of topsoil will be excavated and segregated from subsoil spoil piles. Section 3.5.3 and Figure 11 of the E&SCP provide additional details on topsoil segregation specifications.

4. Conduct trench dewatering: Dewatering will be conducted as previously described in Section 3.5.6 of the AIM Project E&SCP.

5. Control fugitive dust emissions: Algonquin has developed a Dust Control Plan for the AIM Project. A copy of this plan is included in Appendix H. Dust control will be implemented by Algonquin and its contractor(s) in areas of active construction. The primary means of dust control for the AIM Project will be vehicle and equipment speed control and the use of graveled construction entrances (rock access pads). If these measures do not effectively mitigate excessive dust migration, wet suppression through the application of water using water trucks will be employed. No surface water sources are proposed to be used as a water source. Water will be obtained from municipal sources (hydrant) from locations to be determined along the Project. The application and quantity of water to be used for dust suppression will be commensurate with field conditions during construction. Any required state and local approvals will be acquired as needed to withdraw water from municipal sources. Water spray will be regulated to avoid water pooling and the generation of mud that could be tracked onto paved roadways.

3.2.3 Site Restoration, Clean-up, and Stabilization (Section 5(b)(2)(A)(i))

Upon completion of the construction phase, the trench will be properly backfilled and the segregated topsoil will be evenly spread to restore original conditions. The ROW will be graded and original contours will be restored to pre-construction conditions as closely as possible. Post-construction site stabilization measures will be implemented to speed restoration of the construction work areas and minimize erosion and sedimentation impacts. The sequence of restoration activities is provided as follows:

1. Install trench plugs: Trench plugs will be installed, as necessary, in accordance with Figures 16 and 17 of the E&SCP. Estimated trench plug locations are shown on the Project alignment sheets provided in Appendix B of this SWPCP.

2. Restore all construction work areas: Areas disturbed by construction will be restored back to pre-construction grades and contours and segregated topsoil will be replaced to match pre-construction profiles, to the extent possible.

3. Install permanent interceptor dikes: Permanent interceptor dikes are intended to reduce runoff velocity, divert water, and prevent sediment from migrating along sloping areas into sensitive areas following construction. These permanent structures will be installed, as needed, in the construction ROW. Until stable vegetation conditions are established, temporary sediment barriers and energy dissipating structures will be located at the end of permanent interceptor dikes, as needed. Estimated interceptor dike locations are shown on the Project alignment sheets provided in Appendix B of this SWPCP.

4. Permanently stabilize construction ROW: Following final grading, the construction ROW will be permanently stabilized and prepared for re-vegetation. A combination of mulch and erosion control fabric/matting is typically used to stabilize exposed soils on the construction ROW. Mulching specifications are described in Section 3.6.3 of the E&SCP and erosion control fabric is described in Section 3.6.1.2 and Figures 23, 22, 33 of the E&SCP.

5. Apply fertilizer and add soil pH modifiers: Fertilizer and pH modifiers will be applied in accordance with the specifications in Section 3.6.2 and Appendix B of the E&SCP.

6. Prepare seedbed: The seedbed in disturbed areas will be prepared to a depth of 3-4 inches to provide a firm seedbed. When hydro-seeding, scarify the seedbed to facilitate the lodging and germination of seed.

7. Seeding: Disturbed areas will be seeded in accordance with the specifications in Section 3.6.2 and Appendix B of the E&SCP.

8. Mulch: Seeded areas will be mulched with straw in accordance with the specifications in Section 3.6.3 of the E&SCP.

9. Winter Stabilization: If necessary, winter stabilization measures will be implemented in accordance with Section 3.6.4 of the E&SCP.

10. Remove erosion control devices: Following site stabilization, temporary erosion control devices will be removed from the construction work space.

In addition, pursuant to Section 5(b)(2)(c)(i)(b) of the General Permit, retention of the water quality volume is not required since the post development runoff characteristics are not anticipated to differ significantly from predevelopment conditions for this linear project.

3.3 Compressor Station Construction Procedures (Section 5(b)(1)(B)(v)(j))

As previously noted, modifications to the existing Chaplin and Cromwell Compressor Stations will require an expansion of existing impervious surfaces. Drainage calculations and design plans are provided in Appendices F and G.

3.4 Schedule of Construction Activities

Construction of the Project pipeline facilities, new M&R stations, and modifications to Algonquin's existing compressor stations and M&R stations would occur over a 1.5-year period to accommodate multiple work locations and the need for scheduled system outages for the numerous tie-ins along Algonquin's system. Construction would begin in the 2nd Quarter of 2015 with a projected in-service date of November 2016. Table 3-1 provides a preliminary construction schedule by year and construction spread.

While the overall schedule for the AIM Project is about 1.5 years of construction, pipeline construction generally proceeds at rates ranging from several hundred feet to one mile per day. Due to the assembly-line method of construction, construction activities in any one area would last from several weeks to several months on an intermittent basis. This schedule shall be revised as necessary to keep this SWPCP current.

TABLE 3-1

AIM Project Preliminary Construction Schedule for Connecticut Facilities

AIM Project Facilities	Approximate Milepost Range	Start	Finish	Approximate Length (miles)
2015 PIPELINE CONSTRUCTION				
Construction Spread 2 • I-84 / Still River HDD	1.4 – 2.1	May 2015	Oct. 2015	0.7
Construction Spread 3 • Cromwell Discharge (Line-36A Loop Extension)	0.0 – 2.0	May 2015	Oct. 2015	2.0
Construction Spread 4 • E-1 System Take-up & Relay • E-1 System Loop	0.0 - 9.1 0.0 – 1.3	May 2015	Oct. 2015	9.1 1.3

TABLE 3-1

AIM Project Preliminary Construction Schedule for Connecticut Facilities

AIM Project Facilities	Approximate Milepost Range	Start	Finish	Approximate Length (miles)
2016 PIPELINE CONSTRUCTION				
Construction Spread 3 a/	0.0 – 4.4	March 2016	Oct. 2016	4.4
• Southeast to MLV Take-up & Relay				
ABOVEGROUND FACILITIES				
Existing Compressor Station Modifications	N/A			
Chaplin		May 2015	Oct. 2015	N/A
Cromwell		May 2015	Oct. 2015	N/A
New M&R Stations				
Oakland Heights M&R Station		April 2016	Oct. 2016	N/A
Existing M&R Station Modifications	N/A			
West Danbury M&R Station		April 2016	Oct. 2016	N/A
Southbury M&R Station		April 2015	Oct. 2015	N/A
Waterbury M&R Station		April 2016	Oct. 2016	N/A
North Haven M&R Station		April 2016	Oct. 2016	N/A
Guilford M&R Station		April 2015	Oct. 2015	N/A
Farmington M&R Station		April 2016	Oct. 2016	N/A
Glastonbury M&R Station		April 2015	Oct. 2015	N/A
Middletown M&R Station		April 2015	Oct. 2015	N/A
Montville M&R Station		April 2015	Oct. 2015	N/A
Salem Pike M&R Station		April 2015	Oct. 2015	N/A
Willimantic M&R Station		April 2015	Oct. 2015	N/A
Putnam M&R Station		April 2016	Oct. 2016	N/A
Pomfret M&R Station		April 2016	Oct. 2016	N/A
M&R Station Removal	N/A			
Greenville M&R Station		April 2016	Oct. 2016	N/A

a/ The HDD crossing of I-84/Still River will be completed in 2015.

4.0 CONTROLS

4.1 Erosion and Sediment Controls (Section (5)(b)(2)(A))

Algonquin's AIM Project, E&SCP is provided in Appendix D of this SWPCP. As previously noted, the E&SCP is designed to provide specifications for the installation and implementation of soil erosion and sediment control measures for the Project. In the event of a conflict between this SWPCP and the E&SCP the more stringent requirement shall be followed.

One goal of this Plan is to control erosion on the site and to control movement of sediment into adjacent wetlands, watercourses or storm sewer systems. Note that erosion and sediment controls shall conform to the requirements of the previously referenced "Connecticut Guidelines for Soil Erosion and Sediment Control," dated May 2002, which will hereafter be referred to as the Guidelines.

To meet the goals of this Plan, stabilization, structural and maintenance practices shall be implemented by the construction contractor/subcontractors (herein after referred to collectively as the Contractor), as outlined below.

4.1.1 Stabilization Practices Section 5(b)(2)(A)(i))

Both temporary and permanent stabilization practices shall be implemented to minimize erosion of soil from the disturbed site areas during and after construction. When construction activities have permanently ceased, or if they are temporarily suspended for more than 30 days, or when final grades are reached in any portion of the site, stabilization practices shall be implemented within six days as indicated within Section 3.6 of the E&SCP provided as Appendix D, but in no cases shall stabilization be conducted later than 7 days after final grading.

The stabilization practices to be implemented during the Project are as follows:

- **Temporary Vegetative Cover** – Due to the relatively short nature of each phase of the proposed project activities, it is not likely that temporary stabilization will be required. However, if any exposed areas or stockpiles will be inactive for more than 30 days and have not yet reached finished grades, they shall receive a temporary vegetative cover. The temporary vegetative cover shall consist of annual rye grass. The rye grass shall be planted at a rate of not less than 1 pound per 1,000 square feet. Also, fertilizer shall be applied at a rate of 7.5 pounds per 1,000 square feet of 10-10-10 or equivalent and limestone shall be applied at a rate of 90 pounds per 1,000 square feet. Seed bed preparation and seeding shall be conducted as outlined in the Guidelines.

- **Permanent Vegetative Cover** – Permanent vegetation shall be hydroseeded on exposed areas within 6 days of final grading, weather and soil conditions permitting, but in no cases shall stabilization be conducted later than 7 days after final grading. The final vegetative cover shall consist of a grass seed mix consisting of bentgrass, fescue, trefoil and ryegrass as defined in Appendix B of the E&SCP. Acceptable planting periods are from April 1 through June 15 and September 1 through October 15.

4.1.2 Structural Practices (Section 5(b)(2)(A)(ii))

Structural practices shall be implemented to control the movement of sediment and minimize the discharge of pollutants from the site. The structural practices to be implemented during construction are shown on the Project alignment sheets contained in Appendix B.

- **Filtration barriers** – Silt fence, backed by straw bales, will be installed along the toe of all critical slopes (e.g., at the toe of the landfill slopes and also along the southern edge of the cap construction area). The silt fence and straw bales will reduce downgradient siltation by acting as sediment filters. These filters will remove sediment transported by sheet flow from stormwater runoff**.**

- **Rock Access Pad/Construction Entrances** – To prevent soil or sediment from being carried off site by construction equipment, temporary rock access pad/construction entrances will be installed before construction traffic into and out of the Project area begins. The width of the anti-tracking apron shall not be less than the width of any ingress or egress. Adjacent roadways shall be swept daily to remove any material that may be tracked onto pavement.

- **Erosion control blankets** –After placement of final cover, jute netting will be installed on the 3H:1V side slopes, along with Green Armor System (Enkamat 7010 Turf Reinforcement Mat infilled with Flexterra FGM) or equivalent where indicated on the contract drawings, or required by the EI, to minimize erosion from the lower portion of the 3H:1V side slope and allow growth of permanent vegetative cover. These controls also retain soil moisture and modify soil temperature to further enhance growth.

4.1.3 Maintenance (Section 5(b)(2)(A)(iii) and 5(b)(2)C))

The erosion and sediment controls must be maintained in a condition that will protect resource areas from pollution during site construction. The Contractor and Algonquin's Environmental Inspectors ("EI") will conduct the following maintenance to ensure the proper performance of erosion and sediment control measures during construction.

- **Temporary and Permanent Vegetation**: Any eroded areas shall be repaired by filling to finished grades, replacing vegetative support material, and seeding, fertilizing and liming, as specified for temporary and permanent stabilization.

- **Filtration Barriers, FFTs and Inlet Sedimentation Control**: Silt fence, hay bales, FFTs and silt sacks shall be inspected within 24 hours of the end of any rainfall that is 0.1 inches or greater. Any required repairs and/or cleaning of sediment shall be made within 24 hours. Should any of these features become ineffective while still needed and require replacement, they shall be replaced promptly.

- Should sediment deposits reach approximately one-half the height of the silt fence barrier, they shall be removed and disposed of on-site as non-structural fill. Any sediment deposits remaining in place after the barrier is no longer required shall be removed and placed in a stockpile surrounded by silt fence in a suitable location.

4.2 Dewatering Wastewaters (Section 5(b)(2)(C))

Some portions of the trench will be excavated to depths below the top of the water table and will, therefore, require dewatering during construction. After the trench water will be discharged into an energy dissipation/sediment filtration device, such as a geotextile filter bag or straw bale structure to prevent heavily silt-laden water from flowing into wetlands and waterbodies in accordance with the AIM Project E&SCP and all applicable permits. The intakes of the hoses used to withdraw the water from the trench will be elevated and screened to minimize pumping of deposited sediments. In addition, the discharge hose will be connected securely to the filter bag with a clamp and monitoring will be conducted to ensure that

all flow from the filter bag is infiltrating into the underlying soil. If a pumping operation causes turbidity problems, the operation shall cease until feasible means of controlling turbidity are determined and implemented. As required by the General Permit, dewatering wastewaters discharged to surface waters shall be discharged in a manner that minimizes the discoloration of the receiving waters or will be discharged in a manner that results in a visible oil sheen, floating solids, or foaming in the receiving water.

4.3 Post-Construction Stormwater Management (Section 5(b)(2)(C))

At the end of construction, all areas disturbed by construction activities shall be stabilized consistent with criteria provided in Section 8 of the E&SCP. As a result, the potential for erosion along the pipeline ROW and at the above-ground facility locations after construction is minimal. Properly maintained grassed areas will serve as a filter to remove sediment from runoff. The goal of the post-construction stormwater management is to remove 80 percent of the total suspended solids from the stormwater runoff. All post-construction stormwater management measures that will be taken are shown on the Project alignment sheets in Appendix B.

4.4 Waste Disposal (Section 5(b)(2)(D)(i))

The contractor shall handle and manage waste disposal in accordance with applicable federal, state and local regulations and requirements. Specific elements of waste disposal are described below.

Sediment removal: Accumulated sediments will be removed from erosion and sediment control devices and will be spread within the existing construction workspaces.

Solid waste materials: All solid waste materials including litter, debris, building materials, hardened concrete waste that is generated during construction and operation of the Project will be handled, transported, and disposed of in accordance with applicable federal, state and local regulations and requirements.

The AIM Project in Connecticut crosses one known site that has reported groundwater contamination. Algonquin is coordinating with the CT DEEP on the management of groundwater during construction as outlined below.

4.4.1 Lightolier Property

The E-1 System Lateral Take-up and Relay will traverse the Lightolier property from MP 8.49 to MP 8.6 located at 40 Wisconsin Avenue in Norwich. Algonquin proposes to replace the existing 6-inch diameter pipeline with a new 16-inch diameter pipeline along this segment. The work would be conducted in a 75-foot construction ROW.

Based on historical environmental studies completed by GZA, Haley and Aldrich and others, groundwater may be encountered at 5-6 feet below surface grade along the southeastern portion of the Lightolier site that intersects Wisconsin Avenue.

Current Groundwater Conditions

Trichloroethene ("TCE"), heavy metals and cyanide were historically released at Lightolier (the site) from a wastewater sump and TCE degreaser unit. Lightolier historically engaged in metal plating activities. Groundwater cleanup has been underway at the site since the 1980s. These assessment and remediation reports for Lightolier are on-file at CTDEEP. CTDEEP has classified groundwater at the site as GA.

Presently, CTDEEP has approved of monitored natural attenuation as the selected active groundwater remediation for the property. Recent contaminant concentration in groundwater include 6 ug/l TCE from the overburden aquifer and 100 ug/l TCE from the deeper bedrock aquifer, which have been declining over time. These concentrations are from the site complex and not necessarily specifically at MP 8.49 to MP 8.6. General groundwater flow in both overburden and bedrock aquifers is south toward Elisha Brook.

Contaminated Groundwater Management and Dewatering Procedures

Except for the Wisconsin Avenue intersection proximal to Lightolier, planned excavation **does not** anticipate intercepting groundwater during earthwork activities. It is expected that all excess contaminated groundwater generated proximal to MP 8.49 to MP 8.6 will require treatment prior to discharge to the nearest approved sanitary sewer. Subsequent treatment and discharge will be in accordance with the CT DEEP General Permit for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer (CT DEEP WD-REG-007). Groundwater may also be transported off-site for disposal.

Summarized below are the management procedures that will be implemented on this segment at the site and Wisconsin Avenue intersection.

- Ensure health and safety of all workers and the public;
- Estimate groundwater flow rates and quantities;
- Prepare and implement a Dewatering Plan;
- Obtain applicable state and local discharge permits for any storage, treatment, discharge and/or disposal;
- Properly size, provide, and operate required water handling and treatment equipment;
- Arrange for and store the subject dewatering wastewater;
- Coordinate, collect, and analyze wastewater samples, in accordance with the applicable discharge permits;
- Collect screening and discharge samples, as required by the applicable governmental authorities;
- Arrange for and cause the discharge of the collected wastewater in accordance with this Plan and applicable Permits; and
- Treated batches of wastewater will not be discharged until analytical results are received that confirm discharge effluent limits are met.

It is anticipated that contaminated wastewater will be conveyed to a manhole by means of pipe or hosing along Wisconsin Avenue. The system design will accommodate the anticipated dewatering rates based on construction activities, municipality/utility limitations, and permit requirements. Fractionation tanks will be utilized as the means and methods for storing and handling excess wastewater.

The basic system should include a removal sump, and/or hosing from the excavation to a feed pump that conveys water through 25 to 5-micron bag filters for particulate removal, plus carbon canisters for volatile organic compounds removal, prior to discharge into the nearest sanitary manhole. The equipment will be installed in a location and manner in accordance with the manufacturer's recommendations. A flow meter to record total daily flows will be installed and used continuously in all conveyance systems.

4.5 Washout Areas (Section 5(b)(2)(D)(ii))

Washout of containers, vehicles, and equipment will be minimized on the Project to the extent practicable. If required due to the nature of the construction activities washout activities will be limited to a designed

washout area. There will be no surface discharge of washout wastewaters. In addition, dumping of liquid wastes in storm sewers is prohibited.

4.6 Vehicle Tracking and Dust Control (Section 5(b)(2)(D)(iii))

Algonquin has developed a Dust Control Plan for the AIM Project that is provided in Appendix H. Off-site vehicle tracking of sediments and the generation of dust will be minimized. Wet dust suppression will be used, in accordance with section 22a-174-18(b) of the Connecticut General Statutes, for any construction activity that causes airborne particulates. The volume of water sprayed for controlling dust will be minimized so as to prevent the runoff of water. No discharge of dust control water will contain or cause a visible oil sheen, floating solids, visible discoloration, or foaming in the receiving stream.

4.7 Spill Control (Section 5(b)(2)(D)(v))

Algonquin has prepared a Spill Prevention Control and Countermeasures Plan ("SPCC Plan") to address the handling of construction fuels, lubricants and other hazardous materials. The SPCC Plan provides a set of minimum requirements to be used by the contractor in developing their own Project-specific SPCC Plan. The SPCC Plan is included in the AIM Project E&SCP in Appendix D. Key hazardous material containment requirements are outlined below.

The AIM SPCC Plan requires that single wall tanks be provided with temporary secondary containment that will hold at least 110 percent of the tank capacity of the largest tank inside the containment area and provides the following spill control/containment requirements;

- Containment capacity shall apply to pumps, generators, compressors or other petroleum powered equipment used on site for dewatering and other activities during construction.
- PCB (50 parts per million or greater) storage tanks shall be double-walled or have secondary containment that will hold 200 percent of the tank capacity;
- All containers with a storage capacity greater than 55 gallons shall have temporary containment; and
- All pumps and other portable fuel burning equipment used during construction will be sited in secondary containment.

The following portions of the AIM Project cross designed aquifer protection areas ("APAs") in Connecticut.

- *Cromwell pipeline segment – MP 1.38 to 2.0*
- *Southeast pipeline segment – MP 2.25 to 2.59*
- *E-1 System Loop – MP 0.0 to 0.21*

For these segments, additional hazardous material handling/spill prevention precautions include:

a) storage of fuel and maintenance chemical fluids for vehicles and equipment, as well as any other hazardous materials, shall be stored outside of APA and watershed areas;
b) vehicle maintenance and refueling shall be conducted outside APA and watershed areas to the extent possible;
c) if it is necessary to conduct equipment refueling or minor maintenance activities in APA or watershed areas, precautions shall be taken to prevent and contain any potential chemical or fuel spillage; and
d) any refueling from mobile fuel trucks and minor or emergency vehicle maintenance within the APA shall take place on an impervious containment pad.

5.0 INSPECTION

Consistent with the General Permit requirement; "All construction activities submitting a registration for this General Permit shall be inspected initially for Plan implementation and then weekly for routine inspections." Each type of inspection is described below.

5.1 Plan Implementation Inspection (Section 5(b)(4)(A))

As required by the General Permit, the disturbed areas will be independently inspected for plan implementation at least once within 90 days of the start of construction activity. The objective of the plan implementation inspection shall be to confirm compliance with the General Permit and proper initial implementation of all controls measures designated for the initial phase of construction.

As outlined in the AIM Project E&SCP (*see* Appendix D), full time EIs will be designated by Algonquin during active construction or restoration. Algonquin intends to hire a minimum of two EIs to oversee construction of the Connecticut facilities. The EIs will have peer status with all other activity inspectors and will report directly to the Resident Engineer/Chief Inspector who has overall authority on the construction spread. The EIs will have the authority to stop activities that violate the environmental conditions of the FERC certificate (if applicable), other federal and state permits, or landowner requirements, and to order corrective action. The EIs will be required to meet General Permit definition of Qualified Inspector. All of these individuals will be provided appropriate environmental training and the Project EI's will meet the General Permit requirements for a Qualified Inspector.

In addition to the independent inspection provided by the EIs, the AIM Project will also be attended by a full-time FERC inspector who has authority to enforce applicable requirements, including those specified in the General Permit.

As outlined in Section 2.1 of the AIM Project's E&SPC, inspection of temporary erosion control measures are more stringent than the conditions set forth in the General Permit.

5.2 Routine Inspections (Section 5(b)(4)(A))

To comply with the inspection conditions as set forth by the General Permit and the Plan for the AIM Project until a Notice of Termination has been submitted, Algonquin's s designated EIs will conduct routine inspections in the following manner:

- On a daily basis in areas of active construction or equipment operation;
- On a daily basis along the E-1 System Take-up & Relay segment regardless of whether there is active construction (FERC requirement).
- On a weekly basis in areas with no construction or equipment operation; and
- Within 24 hours of each 0.5 inch of rainfall.

At a minimum, the EIs will inspect:

- Construction activities for compliance with the requirements of the General Permit, the Plan, the E&SCP, the construction drawings, the environmental conditions of the FERC's Orders (if applicable), proposed mitigation measures, other federal or state environmental permits and approvals, and environmental requirements in landowner easement agreements;
- Disturbed areas of the construction activity that have not been finally stabilized;

- Temporary sediment barriers daily in areas of active construction to ensure proper functioning and maintenance;
- Sediment barriers in other areas on a weekly basis throughout construction, and within 24 hours following storm events;
- Structural control measures;
- Soil stockpile areas;
- Washout areas; and
- Locations where vehicles enter or exit the site.

In addition to inspection activities, the EIs will also be responsible for identifying, documenting, and overseeing corrective actions as necessary to bring an activity back into compliance.

To ensure compliance with the General Permit, Algonquin's EIs will conduct inspections as follows.

- For storms that end on a weekend, holiday or other time after which normal working hours will not commence within 24 hours, an inspection is only required within 24 hours for storms that equal or exceed 0.5 inches.
- For storms of less the 0.5 inches, an inspection will occur immediately upon the start of the subsequent normal working hours. Where areas that have been temporarily or finally stabilized, inspections will be conducted at least once every month for three months.
- Disturbed areas and areas used for storage of materials that are exposed to precipitation will be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the plan will be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be visually inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

Based on the results of the inspections, the description of potential sources and pollution prevention measures identified in this SWPCP shall be revised as appropriate as soon as practicable after such inspection. Such modifications shall provide for timely implementation of any changes to the site within 24 hours and implementation of any changes to the SWPCP within three calendar days following the inspection.

A report shall be prepared and retained as part of the plan. This report will summarize:

- the scope of the inspection;
- name and qualifications of personnel making the inspection;
- the date of the inspection;
- the weather conditions including precipitation information, and
- major observations relating to erosion and sediment controls and implementation of the SWPCP.

The report will also discuss implementation of the plan including a description of the stormwater discharges from the site and any water quality monitoring performed during the inspection. The report and all actions taken shall be retained as part of the SWPCP for at least five (5) years after the date of inspection. The report shall be signed by the permittee or his/her authorized representative in accordance with the "Certification of Documents" section of the General Permit as noted below.

Unless otherwise specified in this General Permit, any document, including but not limited to any notice, information or report, which is submitted to the commissioner under this general permit shall be signed by the permittee, or a duly authorized representative of the permittee, and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows:

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that a false statement made in this document or its attachments may be punishable as a criminal offense, in accordance with section 22a-6 of the Connecticut General Statutes, pursuant to section 53a-157b of the Connecticut General Statutes, and in accordance with any other applicable statute."

A copy of the Inspection Report Form and Stormwater Monitoring Reports are provided in Appendix C.

6.0 MONITORING

Monitoring requirements under the General Permit are based on the amount of site disturbance and whether Registration is required. Algonquin consulted with CT DEEP relative to the need to conduct monitoring for the installation of a natural gas pipeline project. Since the AIM Project is linear and does not have point source discharges of stormwater, CT DEEP indicated that turbidity monitoring was not necessary in this instance and that Algonquian shall strictly comply with the Inspection Procedures of the General Permit.

7.0 CONTRACTORS

7.1 General (Section 5(b)(1)(B)(iii))

All Contractors and subcontractors who will perform construction activities on site that may reasonably be expected to cause or have the potential to cause pollution of the waters of the State will be identified once they are hired by Algonquin.

7.2 Certification Statement (Section 5(b)(1)(B)(iii)(b))

All Contractors and subcontractors must sign the certification included in Appendix E. All signed certifications shall be included in this SWPCP.

8.0 RECORDKEEPING

8.1 General (Section 5(d))

For a period of at least five (5) years from the date that construction is complete, the permittee shall retain copies of this SWPCP, all reports required by the General Permit, and records of all data used to complete the registration for the General Permit, unless the commissioner specifies another time period in writing.

Inspection records must be retained as part of the Plan for a period of five (5) years after the date of inspection. Inspection records shall be maintained both at the closest construction field office as well as stored electronically at a central location.

The permittee shall retain an updated copy of the Plan required by the General Permit at the construction site from the date construction is initiated at the site until the date construction at the site is completed. A copy the AIM Project General Permit shall be maintained on-site during active construction and shall also be maintained at the closest construction field office.

9.0 REFERENCES

CTDEEP. 2013. Water Quality Standards. Online:
http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325620&deepNav_GID=1654

[HVCEO] Housatonic Valley Council of Elected Officials. 2013. Danbury, CT Water Supply Resource Inventory. Online:
http://www.hvceo.org/water/WATERDANBURYMAIN.php
Accessed October 1st, 2013.

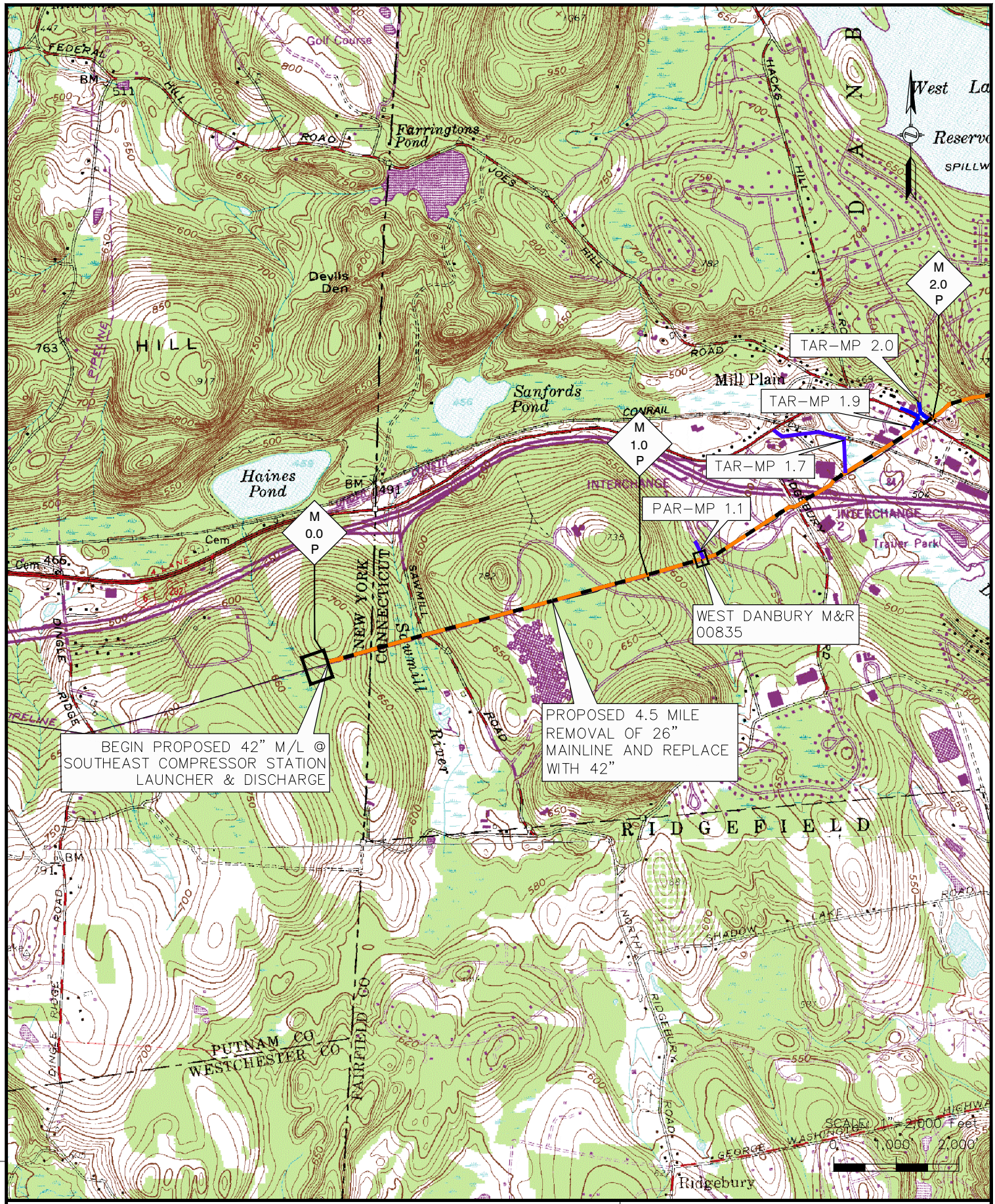
APPENDIX A

USGS SITE LOCATION MAPS

8.5”x11” USGS QUADRANGLE EXCERPTS

SOUTHEAST TO MLV 19 TAKE-UP & RELAY PIPELINE

CITY OF DANBURY
FAIRFIELD COUNTY, CONNECTICUT



ALGONQUIN INCREMENTAL MARKET PROJECT
SOUTHEAST DISCHARGE – USGS QUAD EXCERPT (SOUTHEAST, NY – DANBURY, CT)

LOC.: PUTNAM COUNTY, NEW YORK & FAIRFIELD COUNTY, CONNECTICUT			REV.: L
CKD. BY: JP	ENG.: CCW	DATE: 02/2014	W.O.: 101490
DRN. BY: CLP	SCALE: 1"=2,000'	DWG. NO.: SQ–E–6501	SHEET 1 OF 2

I.G. #

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

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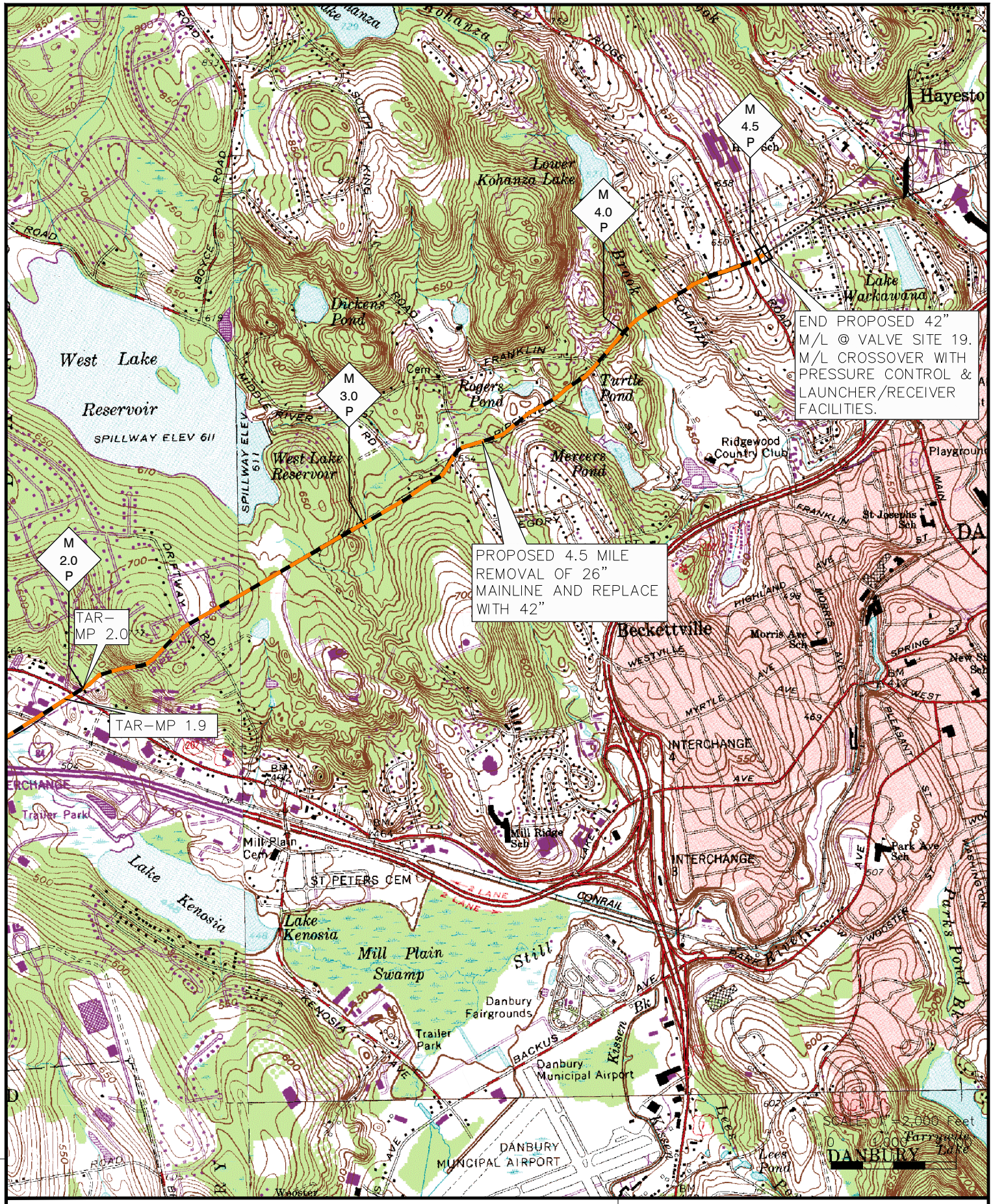

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CKD. BY: JP	ENG.: CCW	DATE: 02/2014	W.O.: 101490
DRN. BY: CLP	SCALE: 1"=2,000'	DWG. NO.: SQ–E–6502	SHEET 2 OF 2

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

I.G. #

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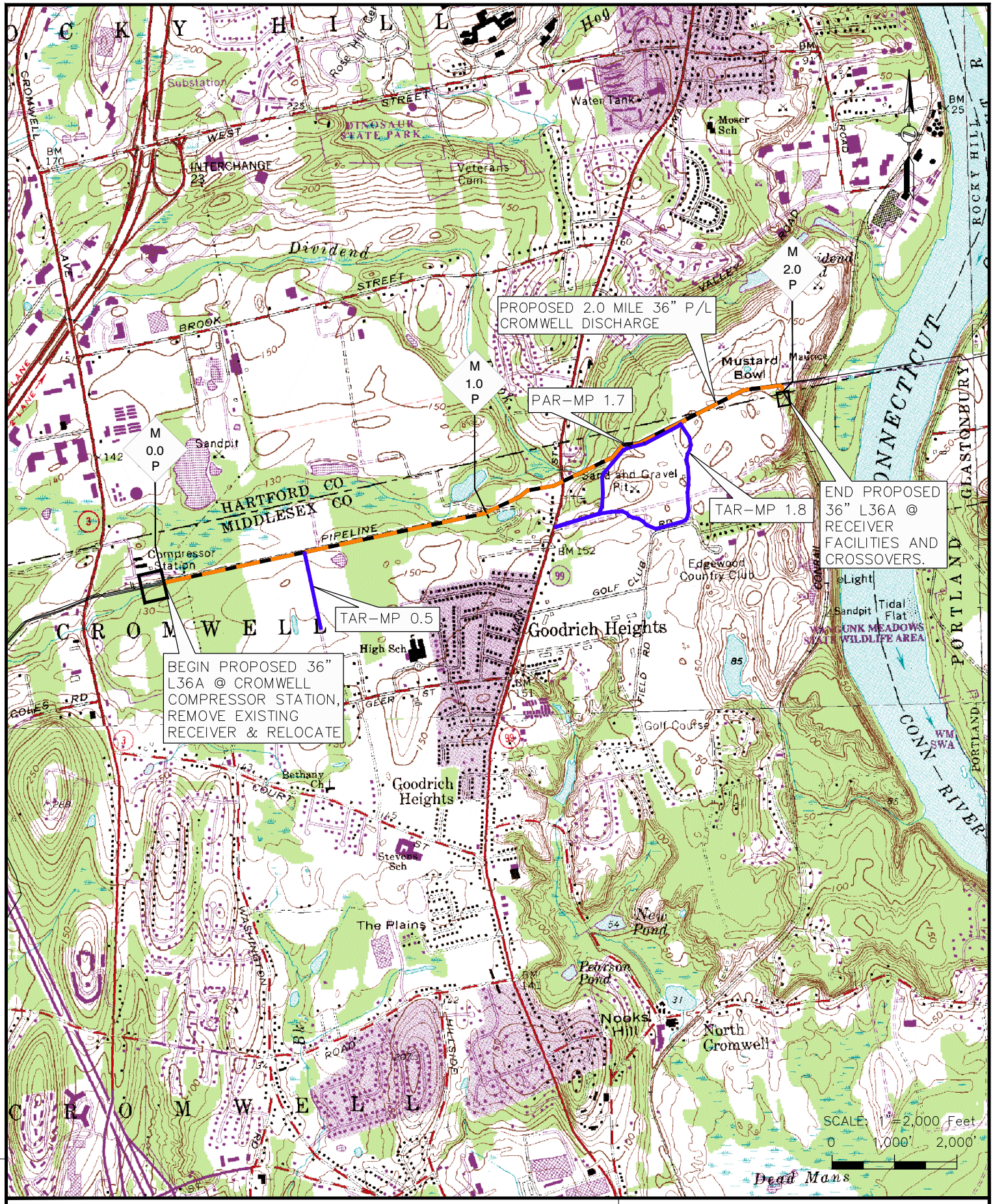
8.5”x11” USGS QUADRANGLE EXCERPTS

LINE-36A LOOP EXTENSION

TOWN OF CROMWELL
MIDDLESEX COUNTY, CONNECTICUT

TOWN OF ROCKY HILL
HARTFORD COUNTY, CONNECTICUT



ALGONQUIN INCREMENTAL MARKET PROJECT
CROMWELL DISCHARGE – USGS QUAD EXCERPT (CROMWELL – ROCKY HILL, CT)

LOC.: MIDDLESEX & HARTFORD COUNTIES, CONNECTICUT			REV.: M
CKD. BY: JP	ENG.: CCW	DATE: 02/2014	W.O.: 101490
DRN. BY: CLP	SCALE: 1"=2,000'	DWG. NO.: CJ-E-6501	SHEET 1 OF 1

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

I.G. #

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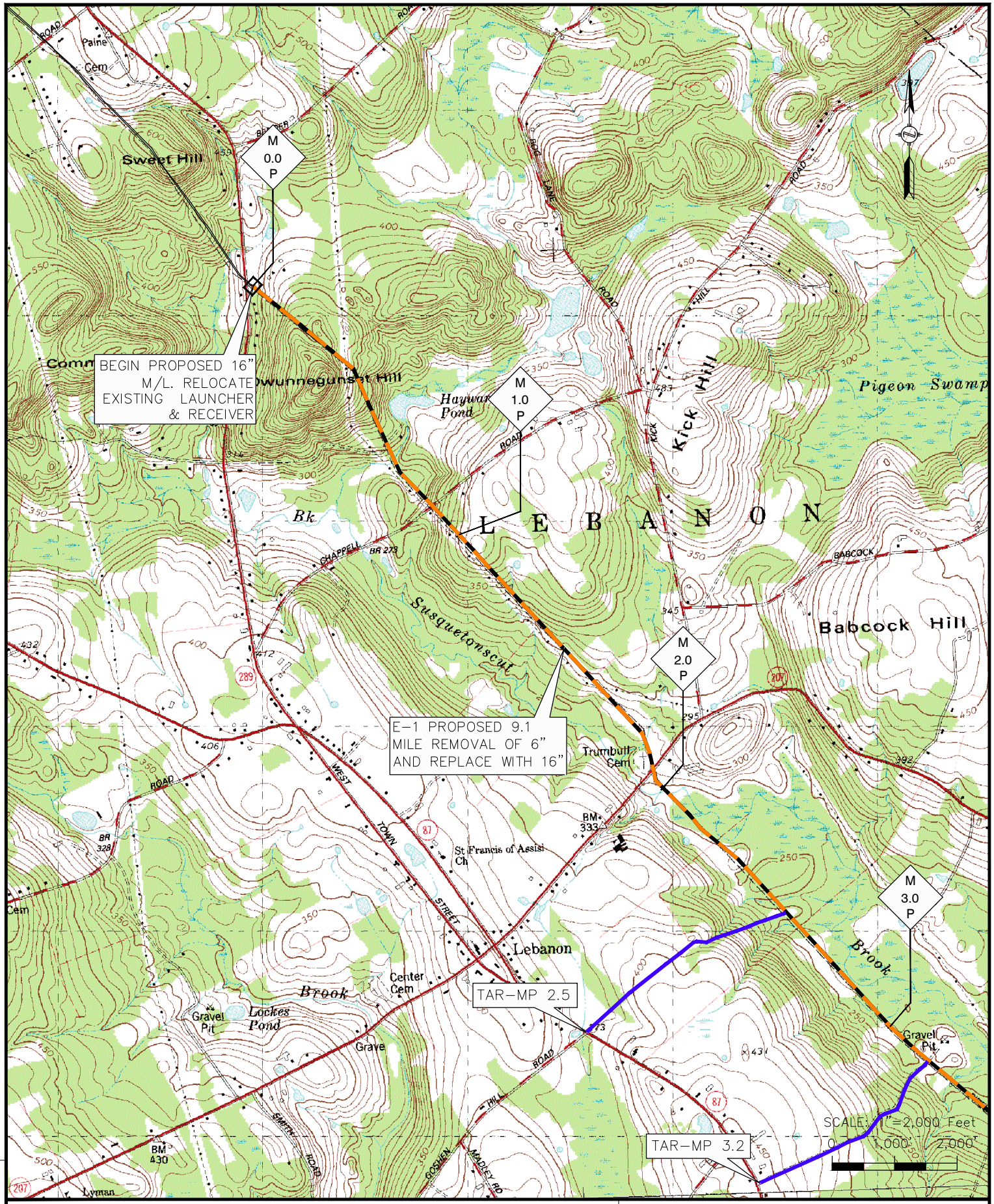
8.5”x11” USGS QUADRANGLE EXCERPTS

E-1 SYSTEM LATERAL TAKE-UP & RELAY PIPELINE

TOWN OF LEBANON
TOWN OF FRANKLIN
CITY OF NORWICH
NEW LONDON COUNTY, CONNECTICUT



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CKD. BY: JP	ENG.: CCW	DATE: 02/2014	W.O.: 101490
DRN. BY: CLP	SCALE: 1"=2,000'	DWG. NO.: CJ-E-6511	SHEET 1 OF 3

I.G. #

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

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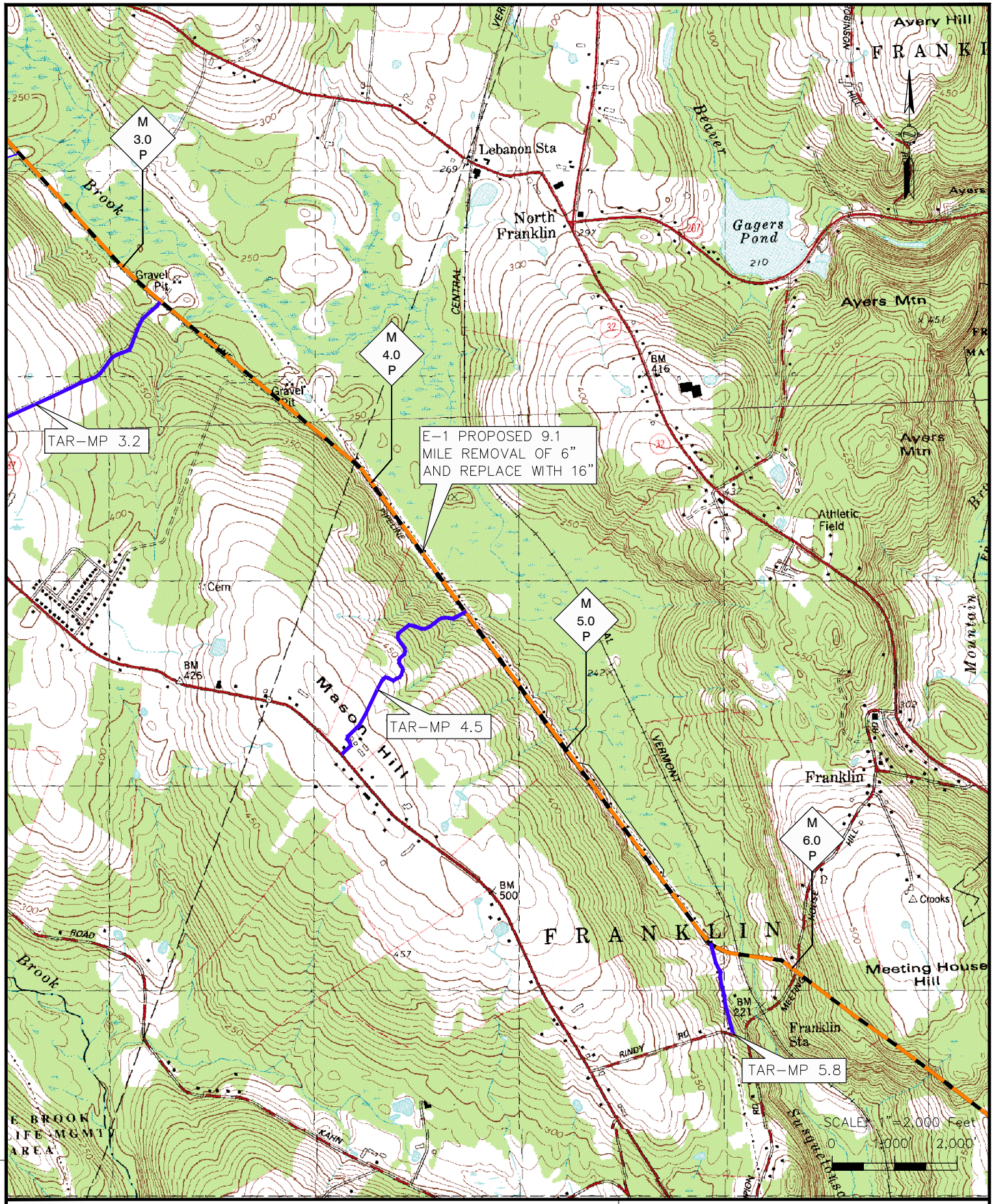

ALGONQUIN INCREMENTAL MARKET PROJECT
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I.G. #

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Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

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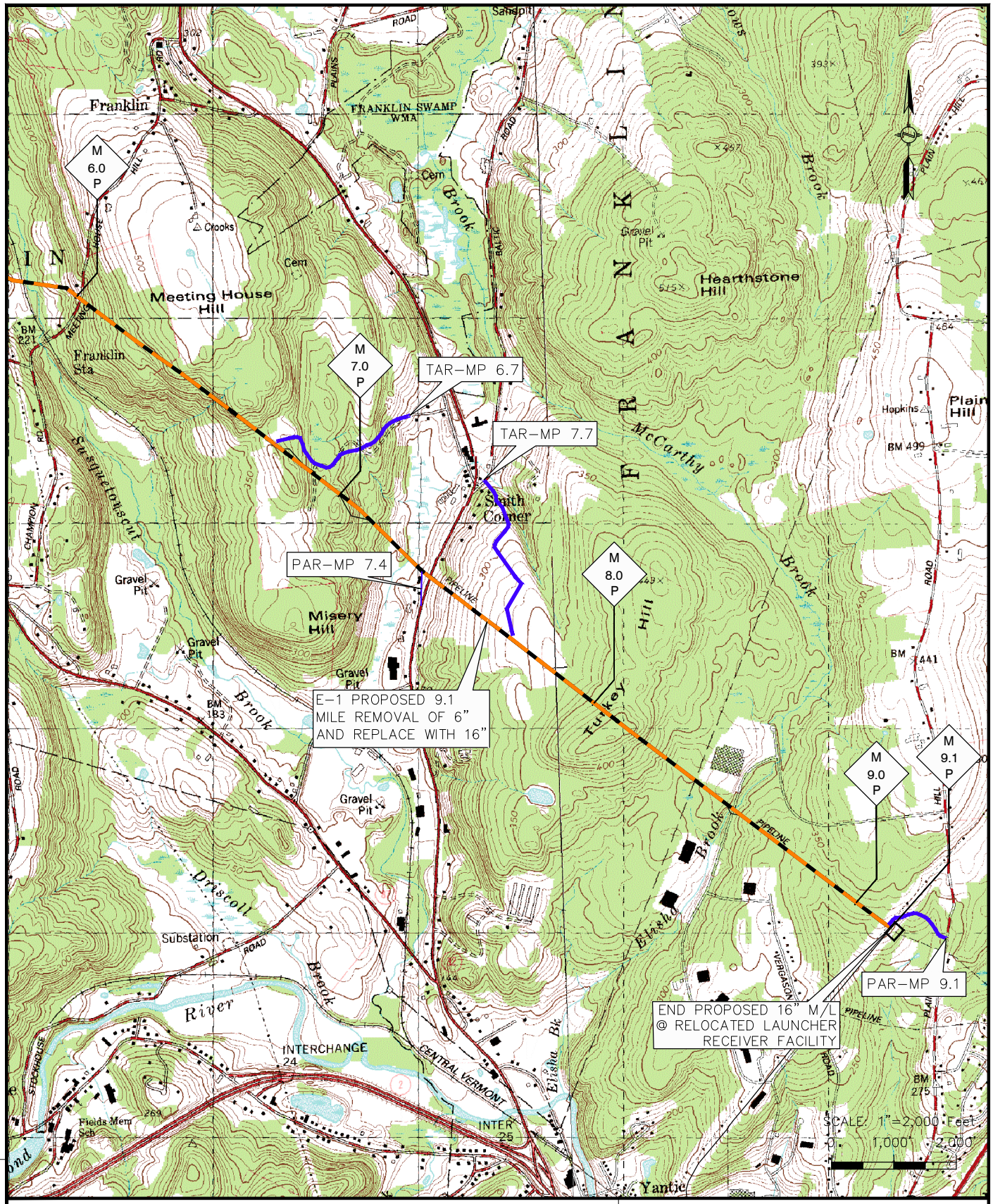

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CKD. BY: JP	ENG.: CCW	DATE: 02/2014	W.O.: 101490
DRN. BY: CLP	SCALE: 1"=2,000'	DWG. NO.: CJ–E–6513	SHEET 3 OF 3

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

I.G. #

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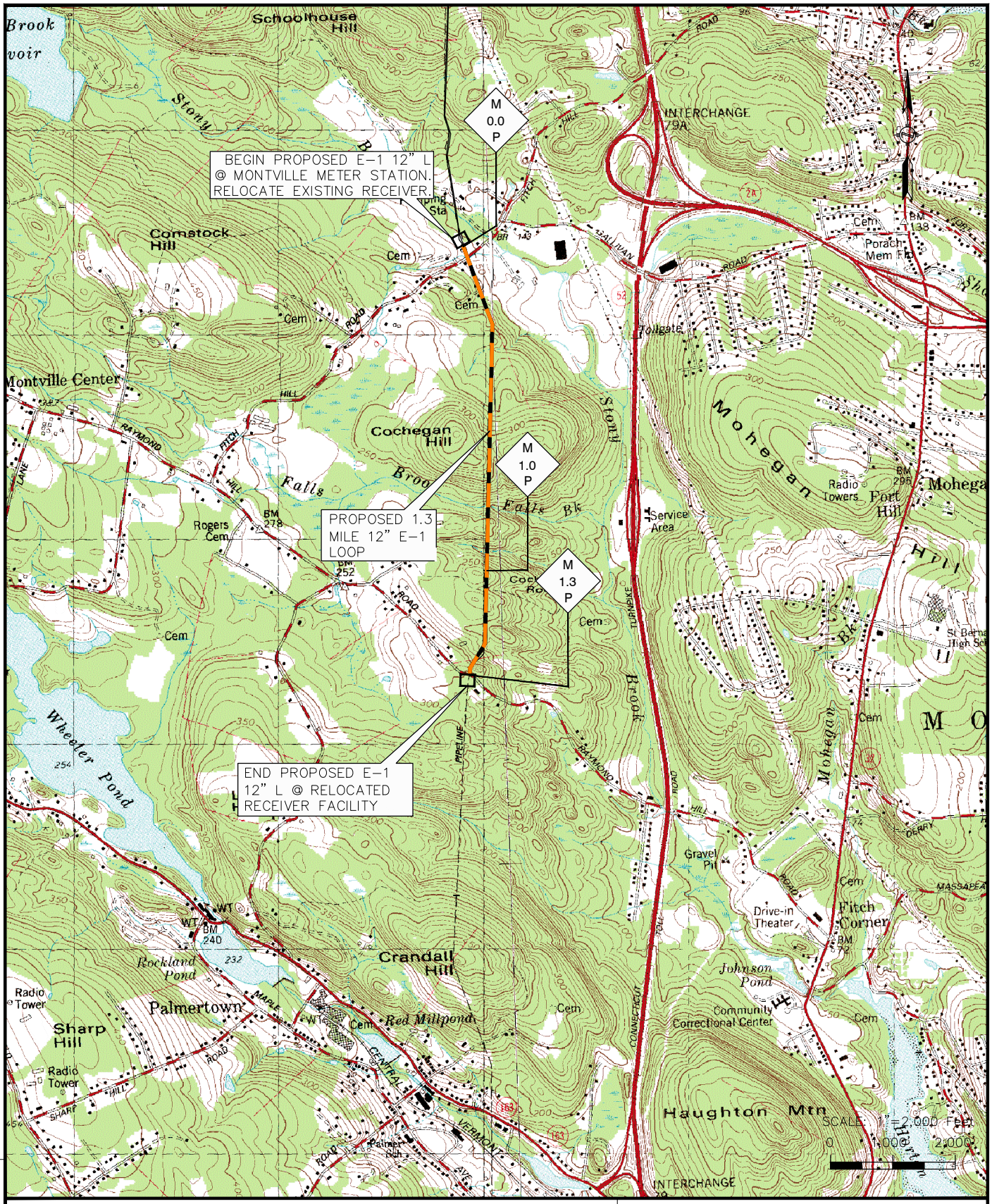
8.5”x11” USGS QUADRANGLE EXCERPTS

E-1 SYSTEM LATERAL LOOP PIPELINE

TOWN OF MONTVILLE
NEW LONDON COUNTY, CONNECTICUT



ALGONQUIN INCREMENTAL MARKET PROJECT
CROMWELL DISCHARGE – USGS QUAD EXCERPT (MONTVILLE, CT)

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Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

I.G. #

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APPENDIX B

AIM PROJECT ALIGNMENT SHEETS DEPICTING EROSION AND SEDIMENT CONTROL MEASURES

[PROVIDED UNDER SEPARATE COVER]

APPENDIX C

INSPECTION REPORT FORM AND STORM WATER MONITORING REPORT

INSPECTION REPORT FORM

Date of Inspection _____

Inspector's Name _____

Employed By _____

Circle Type of Inspection: Monthly / Weekly / Within 24 hrs of Storm

Stabilization Practices [1]

Major Observations or Deficiencies	Actions Taken	Date Completed

Structural Practices [2]

Major Observations or Deficiencies	Actions Taken	Date Completed

_____ _____

Signature of Inspector Date

_____ _____

Signature of Owner Date

[1]Stabilization practices to be inspected include: grading, disturbed area, temporary vegetative cover, permanent vegetative cover.

[2]Structural practices to be inspected include: filtration barriers, fiber filtration tubes, erosion control blankets, anti-tracking aprons, temporary sedimentation basins, inlet sedimentation controls and detention basins.

Connecticut Department of
Energy & Environmental Protection
Bureau of Materials Management & Compliance Assurance
Water Permitting & Enforcement Division

General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, issued 8/21/13, effective 10/1/13
Stormwater Monitoring Report

SITE INFORMATION

Permittee: _____

Mailing Address: _____

Business Phone: _____ ext.: _____ Fax: _____

Contact Person: _____ Title: _____

Site Name: _____

Site Address: _____

Receiving Water (name, basin): _____

Stormwater Permit No. GSN _____

SAMPLING INFORMATION (Submit a separate form for each outfall)

Outfall Designation: _____ Date/Time Collected: _____

Outfall Location(s) (lat/lon or map link): _____

Person Collecting Sample: _____

Storm Magnitude (inches): _____ Storm Duration (hours): _____

Size of Disturbed Area at any time: _____

MONITORING RESULTS

Sample #	Parameter	Method	Results (units)	Laboratory (if applicable)
1	Turbidity			
2	Turbidity			
3	Turbidity			
4	Turbidity			

(provide an attachment if more than 4 samples were taken for this outfall) Avg =

STATEMENT OF ACKNOWLEDGMENT

I certify that the data reported on this document were prepared under my direction or supervision in accordance with the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities. The information submitted is, to the best of my knowledge and belief, true, accurate and complete.

Authorized Official: _____

Signature: _____ Date: _____

Please send completed form to:

DEPARTMENT OF ENERGY & ENVIRONMENTAL PROTECTION
BUREAU OF MATERIALS MANAGEMENT AND COMPLIANCE ASSURANCE
79 ELM STREET
HARTFORD, CT 06106-5127
ATTN: NEAL WILLIAMS

APPENDIX D

EROSION AND SEDIMENTATION CONTROL PLAN ("E&SCP")

SPILL PREVENTION CONTROL AND COUNTERMEASURE ("SPCC") PLAN

EROSION AND SEDIMENTATION CONTROL PLAN

Company: ALGONQUIN GAS TRANSMISSION, LLC

Project: ALGONQUIN INCREMENTAL MARKET PROJECT
("AIM Project")

Location: NEW YORK
CONNECTICUT
RHODE ISLAND
MASSACHUSETTS

Person Responsible:
Address:

Telephone:

Prepared by: Environmental Construction Permitting
5400 Westheimer Court, SP-777
Houston, Texas 77056-5310

Effective January 17, 2003
Revised October 8, 2013 for the AIM Project

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APPENDIX B – SEED MIX RECOMMENDATIONS

1. INTRODUCTION

1.1 Purpose of this Plan

This Erosion and Sedimentation Control Plan (Plan) has been prepared for use by the Company and its contractors as a guidance manual for minimizing erosion of disturbed soils and transportation of sediments off the right-of-way (ROW) and into sensitive resources (wetlands, streams, and residential areas) during natural gas pipeline construction. The procedures developed in this Plan, which represent the Company's best management practices, are designed to accommodate varying field conditions while maintaining rigid minimum standards for the protection of environmentally sensitive areas.

This Plan is designed to provide specifications for the installation and implementation of soil erosion and sediment control measures while permitting adequate flexibility to use the most appropriate measures based on site-specific conditions. The intent of this Plan is to provide general information on the pipeline construction process and to describe specific measures that will be employed during and following construction to minimize impacts to the environment along the pipeline ROW.

The goal of this Plan is to preserve the integrity of environmentally sensitive areas and to maintain existing water quality by implementing the following objectives:

- Minimize the extent and duration of disturbance;
- Protect exposed soil by diverting runoff to stabilized areas;
- Install temporary and permanent erosion control measures; and
- Establish an effective inspection and maintenance program.

1.2 Guidelines and Requirements

The measures described in this Plan have been developed based on guidelines from the Federal Energy Regulatory Commission (FERC), United States Army Corps of Engineers (COE), the United States Fish and Wildlife Service (USF&W), the United States Department of Agriculture, and the Natural Resource Conservation Service, as well as from the Company's significant experience and practical knowledge of pipeline construction and effective environmental protection measures. Lessons and insights gained during pipeline construction projects along the Company's pipeline system and comments from agency representatives are also incorporated into this Plan.

Any deviation from the placement of the structures specified in the construction drawings, or changes in the design of control measures as set forth in this Plan, must be approved by the Company's Environmental Construction Permitting Department and must have the concurrence from the appropriate permitting agency.

Pursuant to changes in the FERC regulations, interstate pipeline companies are now required to comply with the FERC's Upland Erosion Control, Revegetation, and Maintenance Plan and the FERC's Wetland and Waterbody Construction and Mitigation Procedures (Plan and Procedures, 5/31/13 Version), unless approval to deviate from the Plan and Procedures is received from the appropriate state agency.

The following identifies the differences between this Plan and the FERC's Plan and Procedures as well as the reasons behind the differences:

1. FERC Plan (Section V.C.1 and V.C.3): Perform compaction testing in residential areas disturbed by construction activities and perform appropriate soil compaction mitigation in severely compacted residential areas.

   This Plan: Compaction testing and mitigation are not required in residential areas.

   Reason to Deviate: This Plan requires that topsoil either be segregated or replaced in residential areas. Topsoil that is segregated or replaced results in little compaction and provides a suitable medium for grass. Most yard areas that are sown in grass do not require deep root penetration. In the event that the grass needs deeper root penetration, the subsequent freeze-thaw cycles of the upper portions of the subsoil will provide natural mitigation of any compacted areas of the ROW within 2-3 years. Post-construction monitoring will be conducted during this timeframe as discussed in Section 8.1.

1.3 Surveys, Permits, and Notifications

The Company shall perform the required environmental field surveys and acquire the necessary environmental permits prior to start of construction of the project. The Company shall notify the appropriate federal and state agencies prior to, during, and/or subsequent to the construction of the project, as identified in the Clearance Package/ Permit Book.

1.4 Inquiries

Inquiries regarding this Plan should be addressed to the Manager, Environmental Construction Permitting Department; shown on the front cover; P.O. Box 1642; Houston, Texas 77056. For field conditions requiring an immediate response, contact the Area Manager at the address shown on the front cover.

2. SUPERVISION AND INSPECTION

To effectively mitigate project-related impacts, the Plan must be properly implemented in the field. Quick and appropriate decisions in the field regarding critical issues such as stream and wetland crossings, placement of erosion controls, trench dewatering, spoil containment, and other construction related items are essential.

To ensure that the Plan is properly implemented, at least one Environmental Inspector (EI) will be designated by the Company for each construction spread during active construction or restoration. The EI will have peer status with all other activity inspectors and will report directly to the Resident Engineer/ Chief Inspector who has overall authority on the construction spread. On smaller projects, the EI role may be carried out by the Resident Engineer/ Chief Inspector or a Craft Inspector, as designated by the Company. The EI will have the authority to stop activities that violate the environmental conditions of the FERC's Orders (if applicable), other federal and state permits, or landowner requirements, and to order corrective action.

2.1 Responsibilities of the Environmental Inspector

At a minimum, the EI shall be responsible for:

1. Inspecting construction activities for compliance with the requirements of this Plan, the construction drawings, the environmental conditions of the FERC's Orders (if applicable), proposed mitigation measures, other federal or state environmental permits and approvals, and environmental requirements in landowner easement agreements;
2. Identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance;
3 Verifying that the limits of authorized construction work areas and locations of access roads are visibly marked before clearing, and maintained throughout construction;
4 Verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
5 Identifying erosion/sediment control and stabilization needs in all areas;
6 Ensuring that the location design of slope breakers will not cause erosion or direct water into sensitive environmental resource areas, including cultural resources sites, wetlands, waterbodies, and sensitive species habitat;
7 Verifying that dewatering activities are properly monitored and do not result in the deposition of sand, silt, and/or sediment into a sensitive environmental resource areas, including wetland or waterbody, cultural resource sites, and sensitive species habitats; stopping dewatering activities if such deposition is occurring and ensuring the design of the discharge is changed to prevent reoccurrence; and verifying that dewatering structures are removed after completion of dewatering activities;

8 Ensuring that subsoil and topsoil are tested in agricultural areas to measure compaction and determine the need for corrective action;

9 Advising the Chief Inspector when environmental conditions (such as wet weather or frozen soil) make it advisable to restrict or delay construction activities to avoid topsoil mixing or excessive compaction;

10 Ensuring restoration of contours and topsoil;

11 Verifying that the soils imported for agricultural or residential use have been certified as free of noxious weeds and soil pests, unless otherwise approved by the landowner;

12 Ensuring that erosion controls are properly installed to prevent sediment flow into environmental resource (e.g., wetlands, waterbodies, cultural resource sites, and sensitive species habitats) and onto roads and determining the need for additional erosion control devices;

13 Inspecting temporary erosion control measures at least:

a. On a daily basis in areas of active construction or equipment operation;
b. On a weekly basis in areas with no construction or equipment operation; and
c. Within 24 hours of each 0.5 inch of rainfall.

14 Ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification, or as soon as conditions allow if compliance with this time frame would result in greater environmental impacts;

15 Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase;

16 Ensuring that the Contractor implements and complies with the Company's Spill Prevention Control and Countermeasure (SPCC) Plan; and

17 Keeping records of compliance with the environmental conditions of the FERC's Orders, proposed mitigation measures, and other Federal or state environmental permits during active construction and restoration; and

18 Verifying that locations for any disposal of excess construction materials for beneficial reuse comply with Section 3.5.3.2 and 3.5.3.3 of this Plan.

2.2 Environmental Training for Construction

If required by the FERC's Orders, environmental training will be given to both the Company personnel and contractor personnel whose activities will impact the environment during pipeline construction. The level of training will be commensurate with the type of duties of the personnel. All construction personnel from the chief inspector, EI, craft inspectors, contractor job superintendent to loggers, welders, equipment operators, and laborers will be given some form of environmental training. In addition to the EI, all other construction personnel are expected to play an important role in maintaining strict compliance with all permit conditions to protect the environment during

construction. Training will be given prior to the start of construction and throughout the construction process, as needed, and will cover the following issues:

- The specifics of this Plan and the SPCC Plan;
- Job or activity specific permit requirements;
- Company policies and commitments;
- Cultural resource procedures and restrictions;
- Threatened and endangered species restrictions; and
- Any other pertinent information related to the job.

3. CONSTRUCTION TECHNIQUES FOR NATURAL GAS PIPELINES

3.1 Typical ROW Requirements

Pipeline construction workspace requirements are a function of pipe diameter, equipment size, topography, geological rock formations, location of construction such as at road crossings or river crossings, pipeline crossovers, methods of construction such as boring or open-cut construction, or existing soil conditions encountered during construction. As the diameter of the pipeline being installed increases, so does the depth of trench, excavated spoil material, equipment size, and ultimately the amount of construction work space that will be required to construct the project. All construction activities are restricted to the ROW limits identified on the construction drawings. However, in limited, non-wetland areas, the construction ROW width may be expanded by up to 25 feet without approval from the FERC for the following situations:

1. To accommodate full construction ROW topsoil segregation;

2. To ensure safe construction where topographic conditions (i.e., side-slopes) or soil limitations exist; and

3. For truck turn-arounds where no reasonable alternative access exits in limited, non-wetland or non-forested areas.

Use of these limited areas is subject to landowner approval and compliance with all applicable survey, mitigation, and reporting requirements.

The U.S. Department of Transportation (DOT) and Occupational Safety and Health Administration (OSHA) have established minimum size and area requirements for worker safety involving construction activities. See Figures 1, 2, and 3 for typical construction ROW widths. Additional construction ROW may be required at specific locations to construct a pipeline including, but not limited to, steep side or vertical slopes, road crossings, crossovers, areas requiring topsoil segregation, and staging areas associated with wetland and waterbody crossings. These locations are shown on the construction drawings.

3.2 Access Roads

All access to the construction ROW will be limited to existing roads and minimized in wetlands to the extent practical. Additional access roads to the ROW are required at various points along the project ROW where other road crossings (paved or gravel/state/local roads) do not exist. Examples of types of access used include abandoned town roads, railroad ROWs, powerline service roads, logging roads and farm roads. Improvements to access roads (i.e., grading, placing gravel, replacing/installing culverts, and trimming overhanging vegetation) may be required due to the size and nature of the equipment that would utilize the road (Figure 4).

1. Access to the ROW during construction and restoration activities is permitted only by the new or existing access roads identified on the construction drawings.

2. Contractor shall maintain safe conditions at all road crossings and access points during construction and restoration. All access roads will be maintained during construction by grading and the addition of gravel or stone when necessary.

3. Contractor will implement all appropriate erosion and sedimentation control measures for construction/improvement of access roads.

4. Contractor shall ensure that all paved road surfaces utilized during construction are kept free of mud and debris to the extent practical.

5. If crushed stone pads are used in residential or agricultural areas, place the stone on synthetic fabric to facilitate rock removal after construction (Figure 5).

6. Minimize the use of tracked equipment on public roadways. Remove any soil or gravel spilled or tracked onto roadways daily or more frequent as necessary to maintain safe road conditions. Repair any damages to roadway surfaces, shoulders, and bar ditches.

7. All access roads across a waterbody must use an equipment bridge in accordance with Section 5.2.2.

8. The only access roads, unless otherwise permitted, that can be used in wetlands other than the construction ROW are those existing roads requiring no modification or improvements, other than routine, and no impact on the wetland.

9. Limit construction equipment operating in wetland areas to that needed to clear the ROW, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the ROW. All other construction equipment shall use access roads located in upland areas to the maximum extent practical. Where access roads in upland areas do not provide reasonable access, limit all other construction equipment to one pass through the wetland using the ROW, whenever practical.

10. For access through a saturated wetland, unless otherwise authorized by agency permits, use timber mats or an equivalent (Figure 6).

3.3 Pipe and Contractor Wareyards

Pipe and contractor wareyards are required for storing and staging equipment, pipe, fuel, oil, pipe fabrication, and other construction related materials. The Contractor shall perform the following measures at pipe and contractor wareyards:

1. Strip and segregate topsoil in agricultural lands;

2. Install erosion control structures as directed by the EI, outlined in this Plan, or identified on the construction drawings, and maintain them throughout construction and restoration activities;

3. Implement and comply with the SPCC Plan; and

4. Restore and revegetate all disturbed areas in accordance with the measures outlined in this Plan and as directed by the EI.

3.4 Off-ROW Disturbance

With certain exceptions, which are required in order to comply with FERC Plan and Procedures, all construction activities are restricted to within the limits identified on the construction drawings (exceptions include the installation of slope breakers, installation of energy-dissipating devices, installation of dewatering structures, and drain tile repair which are subject to applicable survey requirements). However, in the event that off-ROW disturbance occurs, the following measures will be implemented:

1. The EI will immediately report the occurrence to the Chief Inspector and ROW Agent;

2. The conditions that caused the disturbance will be evaluated by the Chief Inspector and the EI, and they will determine whether work at the location can proceed under those conditions; and

3. If deemed necessary by the Chief Inspector and EI, one or more of the following corrective actions will be taken: immediate restoration of the original contours, seeding and mulching of the disturbed area, and/or installation of erosion control devices. The Company's Environmental Construction Permitting Department will be notified as soon as practical.

3.5 Construction Sequence

Natural gas pipelines are installed using conventional overland buried pipeline construction techniques. These activities are necessary for the installation of a stable, safe, and reliable transmission facility consistent with DOT requirements and regulations. This section provides an overview of the equipment and operations necessary for the installation of a natural gas pipeline, describes potential impacts that may occur from each operation, and identifies the measures that will be implemented to control these potential impacts. This section also discusses in detail the erosion and sediment control techniques that apply to each construction activity including clearing, grading, trenching, lowering-in of pipe, backfilling, and hydrostatic testing. ROW restoration will be addressed in Section 3.6.

Installation of the pipeline will typically proceed from one end of the construction spread to the other in an assembly line or "mainline" fashion. The spacing between the individual crews responsible for each interdependent activity is based on anticipated rate of progress. The activities listed below are normally performed in the following sequence:

- Survey and Flag the ROW;
- Clearing the ROW;
- Installing temporary sediment barriers;
- Grading the ROW;
- Installing temporary interceptor dikes;
- Trenching/excavating the trench;

- Pipe stringing and bending;
- Welding and weld inspection;
- Trench dewatering;
- Lowering the pipe into the trench;
- Backfilling the trench;
- Hydrostatic testing of pipe; and
- ROW restoration and clean-up.

Obstacles to the mainline technique are often encountered and are not considered to be out of the ordinary. These obstacles, which include side hill crossings, rock, wetlands, streams, roads, and residential areas, do not normally interrupt the assembly line flow.

3.5.1 Clearing

Clearing operations will include the removal of vegetation within the construction ROW. Various clearing methods will be employed depending on tree size, contour of the land, and the ability of the ground to support clearing equipment. Vegetative clearing will either be accomplished by hand or by cutting equipment. The following procedures will be standard practice during clearing:

1. Prior to beginning the removal of vegetation, the limits of clearing will be established and identified in accordance with the construction drawings;

2. All construction activities and ground disturbance will be confined to within the ROW shown on the construction drawings;

3. Clearly mark and protect trees to be saved as per landowner requests or as otherwise required;

4. All brush and trees will be felled into the construction ROW to minimize damage to trees and structures adjacent to the ROW. Trees that inadvertently fall beyond the edge of the ROW will be immediately moved onto the ROW and disturbed areas will be immediately stabilized;

5. Trees will be chipped or cut into lengths identified by the landowner and then stacked at the edge of the ROW or removed;

6. Brush and limbs may be disposed of in one or more of the following ways depending on local restrictions, applicable permits, construction Line List stipulations, and landowner agreements:

    a. Stockpiled along the edge of the ROW;
    b. Burned;
    c. Chipped, spread across the ROW in upland areas, and plowed in; or
    d. Hauled off site.

7. Existing surface drainage patterns will not be altered by the placement of timber or brush piles at the edge of the construction ROW.

3.5.2 Installing Temporary Sediment Barriers

Sediment barriers, which are temporary erosion controls intended to minimize the flow of sediment and to prevent the deposition of sediments beyond approved workspaces or into sensitive resources, shall be installed following vegetative clearing operations. They may be constructed of materials such as silt fence, staked straw bales, compacted earth (e.g., drivable berms across travel lanes), sandbags, or an equivalent material as identified by the EI (Figures 7, 8, 9 and 10). Where permitted by regulatory agencies, hay bales may be used in lieu of straw bales with the following restrictions**:** hay bales shall not be used for mulching and the Contractor is responsible for their removal and disposal.

Install temporary sediment barriers at the base of slopes adjacent to road crossings and at waterbody and wetland crossings in accordance with Sections 5.2.4 and 6.2.2 respectively.

1. Do not stake or trench in place straw bales used on equipment bridges or on mats across the travel lane.

2. Inspect temporary sediment barriers daily in areas of active construction to ensure proper functioning and maintenance. In other areas, sediment barriers will be inspected and maintained on a weekly basis throughout construction, and within 24 hours following storm events.

3. Maintain all temporary sediment barriers in place until permanent revegetation measures are successful or the upland areas adjacent to wetlands, waterbodies, or roads are stabilized.

4. Remove temporary sediment barriers from an area when replaced by permanent erosion control measures or when the area has been successfully restored as specified in Section 8.1.

3.5.3 Grading

The construction ROW will be graded as needed to provide a level workspace for safe operation of heavy equipment used in pipeline construction. The following procedures will be standard practice during grading:

3.5.3.1 Topsoil Segregation

Topsoil segregation methods will be used in all residential areas and when the construction ROW is wider than 30 feet in cultivated or rotated croplands, managed pastures, hayfields, and other areas at the landowner's or land managing agency's request.

a. Prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or from the trench line and subsoil storage area (ditch plus spoil side method) as stipulated in the Construction Contract or Line List (Figure 11).

b. Segregate at least 12 inches of topsoil in deep soils with more than 12 inches of topsoil. In soils with less than 12 inches of topsoil, make every effort to segregate the entire topsoil layer.

c. Where topsoil segregation is required, maintain separation of salvaged topsoil and subsoil throughout all construction activities.

d. For wetlands, segregate the top 12 inches of topsoil within the ditchline, except in areas where standing water is present or soils are saturated.

e. Leave gaps in the topsoil piles for the installation of temporary interceptor dikes to allow water to be diverted off ROW.

f. Topsoil replacement (i.e., importation of topsoil) may be used as an alternative to topsoil segregation if approved by the landowner and Chief Inspector.

g. Never use topsoil for padding the pipe, constructing temporary slope breakers or trench plugs, improving or maintaining roads, or as a fill material.

h. Stabilize topsoil piles and minimize loss due to wind and water erosion with use of sediment barriers, mulch, temporary seeding, tackifiers, or functional equivalents, where necessary.

3.5.3.2 Tree Stump Removal and Disposal

a. Remove tree stumps in upland areas along the entire width of the permanent ROW to allow adequate clearance for the safe operation of vehicles and equipment. Stumps within the temporary ROW will be removed or ground to a suitable height that will allow the safe passage of equipment, as stipulated by the Chief Inspector or EI.

b. Dispose of stumps by one of the following methods, pending approval by the Chief Inspector and the landowner, and in accordance with regulatory requirements:

- Buried at a Company-approved off-site location (except in wetlands and agricultural areas);
- Burned;
- Chipped, spread across the ROW in upland areas, and plowed in; or
- Ground to grade in wetlands, excess chips will be removed for proper disposal.

c. Grading operations and tree stump removal in wetland areas will be conducted in accordance with Section 6.2.1.

3.5.3.3 Rock Disposal

Rock (including blast rock) will be disposed of in one or more of the following ways:

a. Buried on the ROW or in approved construction work areas either in the ditchline or as fill during grade cut restoration in accordance with the Construction specifications. In cultivated/ agricultural lands, wetlands, and residential areas, rock may only be backfilled to the top of the existing bedrock profile;

b. Windrowed per written landowner agreement with the Company;

c. Removed and disposed of at a Company-approved site; or

d. Used as riprap for stream bank stabilization where allowed by an applicable regulatory agency(s) (Figure 34).

3.5.4 Installing Temporary Interceptor Dikes

1. Temporary interceptor dikes, which are temporary erosion control measures intended to reduce runoff velocity and divert water off the construction ROW, shall be installed following grading operations (Figure 12). The interceptor dikes are to be installed on all disturbed areas as necessary to avoid excessive erosion. Temporary interceptor dikes may be constructed of materials such as compacted soil, silt fence, staked straw bales or sand bags. If permitted by regulatory agencies, hay bales may be used in lieu of straw bales with the following restrictions: hay bales shall not be used for mulching and the Contractor is responsible for their removal and disposal.

   Temporary slope breakers must be installed on slopes greater than 5 percent where the base of the slope is less than 50 feet from waterbody, wetland or road crossing at the spacing indicated below (closer spacing should be used if necessary). Where the base of the slope is equal or greater than 50 feet from a waterbody, wetland, or road crossing, install interceptor dikes at a spacing necessary to avoid excessive erosion.

Slope (%)	**Spacing (feet)**
<5	No Structure
5 - 15	300
> 15 - 30	200
> 30	100

2. Direct the outfall of each temporary interceptor dike to a stable, well vegetated area or construct an energy-dissipating device (silt fence, staked straw bales, erosion control fabric) at the end of the interceptor dike.

3. Position the outfall of each temporary interceptor dike to prevent sediment discharge into wetlands, waterbodies, or other sensitive resources.

4. Install temporary interceptor dikes across the entire ROW at all waterbody and wetland crossings, as well as the base of slopes adjacent to roads, when directed by the EI.

5. Drivable berms, which are smaller versions of interceptor dikes constructed of compacted soil or sand bags, may be used in place of staked straw bales at the entrances and exits of travel lanes at road crossings, waterbodies, and wetlands. They are installed the width of the travel lane at the start of the equipment crossing and made low enough to allow equipment and other vehicles to pass. Yet, they reduce and divert water runoff from sensitive environmental resources.

6. Inspect temporary interceptor dikes daily in areas of active construction to insure proper functioning and maintenance. In other areas, the interceptor dikes will be inspected and

maintained on a weekly basis throughout construction, and within 24 hours following storm events.

3.5.5 Trenching

The trench centerline will be staked after the construction ROW has been prepared. In general, a trench will be excavated to a depth that will permit burial of the pipe with a minimum of 3 feet of cover (Figure 13). Overland trenching may be accomplished using a conventional backhoe or a rotary wheel-ditching machine. In shale or rocky areas where the use of the wheel-ditching machine is limited, a tractor-drawn ripper will be employed to break and loosen hard substratum material. In areas where rock cannot be ripped, drilling and blasting may be required. A backhoe may then be used to remove rock and soil from the ditch.

The following procedures will be standard practice during ditching:

1. Flag drainage tiles damaged during ditching activities for repair; and
2. Place spoil at least 10 feet upgradient from the edge of waterbodies. Spoil will be contained with erosion and sedimentation control devices to prevent spoil materials or heavily silt-laden water from transferring into waterbodies and wetlands or off of the ROW.

3.5.5.1 Temporary Trench Plugs

Temporary trench plugs are intended to segment a continuous open trench prior to backfill. Along steep slopes, they serve to reduce erosion and sedimentation in the trench and minimize dewatering problems at the base of slopes where sensitive environments such as waterbodies and wetlands are frequently located. In addition, they provide access across the trench for wildlife and livestock.

a. Temporary trench plugs may consist of unexcavated portions of the trench, compacted subsoil, sandbags, or some functional equivalent.

b. Position temporary trench plugs, as necessary, to reduce trenchline erosion and minimize the volume and velocity of trench water flow at the base of slopes.

c. Do not use topsoil for installing temporary soft trench plugs.

d. Coordinate with the landowner to identify optimal locations for the placement of temporary hard trench plugs designed to provide access for livestock.

e. Temporary trench plugs may be used in conjunction with interceptor dikes to prevent water in the trench from overflowing into sensitive resource areas (Figure 14). Attempt to divert trench overflow to a well-vegetated off-ROW location or construct an energy-dissipating device.

3.5.6 Trench Dewatering

Trench dewatering may be periodically required along portions of the proposed pipeline prior to and/or subsequent to installation of the pipeline to remove collected water from the trench.

1. Trench dewatering will be conducted (on or off the construction ROW) in such a manner that does not cause erosion and does not result in silt-laden water flowing into any waterbody or wetland.

2. The intakes of the hoses used to withdraw the water from the trench will be elevated and screened to minimize pumping of deposited sediments.

3. Water may be discharged into areas where adequate vegetation is present adjacent to the construction ROW to function as a filter medium.

4. Where vegetation is absent or in the vicinity of waterbody/ wetland areas, water will be pumped into a filter bag (Figure 15) or through a structure composed of sediment barriers. When using filter bags, secure the discharge hose to the bag with a clamp.

5. Remove dewatering structures as soon as practicable after the completion of dewatering activities.

3.5.7 Pipe Installation

3.5.7.1 Stringing and Bending

Following trench excavation, pipe sections will be delivered to the construction site by truck or tracked vehicle, and strung out along the trench. Individual pipe sections will be placed on temporary supports or wooden skids and staggered to allow room for work on the exposed ends. Certain pipe sections will be bent, as necessary, to conform to changes in slope and direction of the trench.

3.5.7.2 Welding and Weld Inspection

Once the bending operation is complete, the pipe sections will be welded together on supports using approved welding procedures that comply with Company welding specifications. After welding, the welds will be inspected radiographically or ultrasonically to ensure their structural integrity.

3.5.7.3 Lowering-in

Lowering-in consists of placing the completed pipeline sections into the trench where a tie-in weld will be made. Lowering-in is usually accomplished with two or more sideboom tractors acting in unison and spaced so as not to buckle or otherwise damage the pipe. The pipeline will be lifted from the supports, swung out over the trench, and lowered directly into the trench. The equipment uses a “leap frogging” technique requiring sufficient area to safely move around other tractors within the construction ROW to gain an advanced position on the pipe.

3.5.8 Backfilling

Backfilling consists of covering the pipe with the earth removed from the trench or with other fill material hauled to the site when the existing trench spoil is not adequate for backfill. Backfilling will follow lowering-in of the pipeline as close as is practical.

In areas where the trench bottom is irregularly shaped due to consolidated rock or where the excavated spoil materials are unacceptable for backfilling around the pipe, padding material may be required to prevent damage to the pipe. This padding material will generally consist of sand or screened spoil materials from trench excavation.

1. Under no circumstances shall topsoil be used as padding material.

2. Excess rock, including blast rock, may be used to backfill the trench to the top of the existing bedrock profile in accordance with Company specifications. Rock that is not used to backfill the trench will be treated as described in Section 3.5.3.3.

3. Any excess material will be spread within the ROW in upland areas and land contours will be roughed-in to match adjacent topography.

4. The trench may be backfilled with a crown over the pipe to compensate for compaction and settling. Openings will be left in the completed trench crown to restore pre-construction drainage patterns. Crowning shall not be used in wetland areas.

3.5.8.1 Permanent Trench Plugs

Permanent trench plugs are intended to slow subsurface water flow and erosion along the trench and around the pipe in sloping terrain (Figures 16, 17). Permanent trench plugs will be constructed with sand bags or an equivalent as identified in the permit requirements. On severe slopes greater than 30 percent, “Sakrete” may be used at the discretion of the Chief Inspector.

a. Topsoil shall not be used to construct trench plugs.

b. Permanent trench plugs, which are used in conjunction with interceptor dikes, shall be installed at the locations shown on the construction drawings or as determined by the EI. If not shown, use the following spacing:

Slope (%)	**Spacing (feet)**
<5	No Structure
5 - 15	300
> 15 - 30	200
> 30	100

c. Trench plugs shall be installed at the base of slopes adjacent to waterbodies and wetlands, and where needed to avoid draining of a resource.

3.5.9 Hydrostatic Testing

Once the pipeline is completed and before it is placed into service, it will be hydrostatically tested for structural integrity. Hydrostatic testing involves filling the pipeline with clean water and maintaining a test pressure in excess of normal operating pressures for a specified period of time (typically 8 hours). The testing procedure involves filling the pipeline with test water, performing the pressure test, and discharging the test water.

1. The EI shall notify appropriate state agencies (as identified in the Hydrostatic Test Package) of the intent to use specific test water sources at least 48 hours before testing activities (unless waived in writing).

2. Pumps used for hydrostatic testing within 100 feet of any waterbody or wetland shall be operated and refueled in accordance with the SPCC Plan. Address secondary containment and refueling of these pumps in the SPCC Plan.

3. Do not use state-designated exceptional value waters, waterbodies that provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and/or local permitting agencies grant written permission. Use only the water sources identified in the Clearance Package/Permit Book.

4. Screen the intake hose to minimize the potential for entrainment of fish and other aquatic life.

5. Maintain ambient, downstream flow rates to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

6. Locate hydrostatic test manifolds outside wetlands and riparian areas to the greatest extent practical.

7. For an overland discharge of test water from a new pipeline, dewater into an energy dissipation device constructed of straw bales (Figures 18, 19).

8. For an overland discharge of test water from an existing pipeline, dewater into an energy dissipation device constructed of straw bales and absorbent booms (Figure 18). If required by the appropriate permitting agency, the test water may be discharged through an appropriate filtration system including frac tanks and/ or carbon filters.

9. Dewater only at the locations shown on the construction drawings or locations identified in the Hydrostatic Test Package.

10. Locate all dewatering structures in a well-vegetated and stabilized area, if practical, and attempt to maintain at least a 50-foot vegetated buffer from adjacent waterbody/wetland areas. If an adequate buffer is not available, sediment barriers or similar erosion control measure must be installed.

11. Regulate discharge rate, use energy dissipation device(s), and install sediment barriers, as necessary, to prevent erosion, streambed scour to aquatic resources, suspension of sediments, flooding or excessive stream flow.

12. Do not discharge into state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and local permitting agencies grant written permission.

13. The EI shall sample and test the source water and discharge water in accordance with the permit requirements.

3.6 ROW Restoration and Final Cleanup

Restoration of the ROW will begin after pipeline construction activities have been completed. Restoration measures include the re-establishment of final grades and drainage patterns as well as the installation of permanent erosion and sedimentation control devices to minimize post-construction erosion. Residential areas will be restored in accordance with Section 4.3.3. Property shall be restored as close to its original condition as practical unless otherwise specified by the landowner.

1. The Contractor shall make every reasonable effort to complete final cleanup of an area (including final grading and installation of permanent erosion control structures) within 20 days after backfilling the trench in that area (within 10 days in residential areas). If seasonal or other weather conditions prevent compliance with these time frames, maintain temporary erosion controls (temporary slope breakers, sediment barriers, and mulch) until conditions allow completion of cleanup.

2. The disturbed ROW will be seeded within 6 working days of final grading, weather and soil conditions permitting.

3. If final cleanup and seeding cannot be completed and is delayed until the next recommended growing season, the winter stabilization measures in Section 3.6.4 shall be followed.

4. Grade the ROW to pre-construction contours.

5. Spread segregated topsoil back across the graded ROW to its original profile.

6. Remove excess rock from at least the top 12 inches of soil to the extent practical in all rotated and cultivated cropland, hayfields, managed pastures, residential areas, and other areas at the landowner's request. The size, density, and distribution of rock on the construction ROW should be similar to adjacent areas not disturbed by construction. The landowner or land management agency may approve other provisions in writing.

7. A travel lane may be left open temporarily to allow access by construction traffic if the temporary erosion control structures are installed, regularly inspected and maintained. When access is no longer required, the travel lane must be removed and the ROW restored.

8. Remove all construction debris from all construction work areas unless the landowner or land managing agency approves leaving materials onsite for beneficial reuse, stabilization, or habitat restoration.

9. Remove temporary sediment barriers when replaced by permanent erosion control measures or when revegetation is successful.

3.6.1 Permanent Erosion Control

3.6.1.1 Permanent Interceptor Dikes

Permanent interceptor dikes are intended to reduce runoff velocity, divert water off the construction ROW, and prevent sediment deposition into sensitive resources (Figure 12). Permanent interceptor dikes will be constructed of compacted soil. Stone or some functional equivalent may be used when directed by the EI.

a. Install permanent interceptor dikes in all areas, except cultivated areas and lawns, at the locations shown on the construction drawings or as directed by the EI. If not shown, use the spacing outlined for temporary interceptor dike installation in Section 3.5.4.

b. Install permanent interceptor dikes across the entire ROW at all waterbody and wetland crossings, and at the base of slopes adjacent to roads. When the ROW parallels an existing utility ROW, permanent interceptor dikes may be installed to match existing interceptor dikes on the adjacent undisturbed pipeline ROW.

c. Construct interceptor dikes with a 2 to 8 percent outslope to divert surface flow to a stable vegetative area without causing water to pool or erode behind the interceptor dike. In the absence of a stable vegetative area, install an energy-dissipating device at the end of the interceptor dike (Figure 12).

d. Interceptor dikes may extend slightly (about 4 feet) beyond the edge of the construction ROW to effectively drain water off the disturbed area. Where interceptor dikes extend beyond the edge of the construction ROW, they are subject to compliance with all applicable survey requirements.

e. Install chevron-style interceptor dikes on slopes when directed by the EI (Figure 20).

f. Install a rock-lined drainage swale along the ROW with restricted drainage features when directed by the EI. The drainage swale is generally 8 feet wide and a maximum of 18-24 inches deep (Figure 21).

g. On slopes greater than 30 percent, install interceptor dikes with erosion control fabric on the swale side.

3.6.1.2 Erosion Control Fabric

a. Install erosion control fabric at interceptor dike outlets and drainage swales as necessary or as directed by the EI (Figure 12, 21).

b. Install erosion control fabric or matting on slopes greater than 30 percent adjacent to roads or waterbodies (Figure 22). Anchor the erosion control fabric or matting with staples or other appropriate devices in accordance with the manufacturers' recommendations.

c. The EI will direct the installation of high-velocity erosion control fabric on the swale side of permanent interceptor dikes (Figure 23).

3.6.2 Revegetation and Seeding

Successful revegetation of soils disturbed by project-related activities is essential. Seeding will be conducted using the following requirements:

1. Fertilize and add soil pH modifiers in accordance with the recommendations in Appendix B. Incorporate recommended soil pH modifier and fertilizer into the top 2 inches of soil as soon as practical after application;

2. Seed all disturbed areas within 6 working days of final grading, weather and soil conditions permitting;

3. Prepare seedbed in disturbed areas to a depth of 3 to 4 inches to provide a firm seedbed. When hydroseeding, scarify the seedbed to facilitate lodging and germination of seed;

4. Seed disturbed areas in accordance with the seed mixes, rates, and dates in Appendix B, except in upland areas where landowners or a land management agency may request alternative seed mixes. Seeding is not required in cultivated croplands unless requested by the landowner.

5. Perform seeding of permanent vegetation within the recommended seeding dates as outlined in Appendix B. If seeding cannot be done within those dates, use appropriate temporary erosion control measures discussed in Section 3.5.2 and perform seeding of permanent vegetation at the beginning of the next recommended seeding season. Dormant seeding or temporary seeding of annual species may also be used, if necessary, to establish cover, as approved by the Environmental Inspector. Mulch in accordance with Section 3.6.3. Lawns may be seeded on a schedule established with the landowner;

6. Base seeding rates on Pure Live Seed (PLS). Use seed within 12 months of seed testing;

7. Treat legume seed with an inoculant specific to the species using the manufacturer's recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydroseeding); and

8. Uniformly apply and cover seed in accordance with Appendix B. In the absence of any recommendations from the local soil conservation authorities, landowner, or land managing agency to the contrary. A seed drill equipped with a cultipacker is preferred for application, but broadcast or hydroseeding can be used at double the recommended seeding rates. Where seed is broadcast, firm the seedbed with a cultipacker or roller after seeding. In rocky soils, or where site conditions may limit the effectiveness of this equipment, other alternatives may be appropriate (e.g., use of a chain drag) to lightly cover seed after application, as approved by the EI.

3.6.3 Mulch

Mulch is intended to stabilize the soil surface and shall consist of weed-free straw or hay, wood fiber hydromulch, erosion control fabric, or some functional equivalent as approved by the EI and Chief Inspector. Hay shall not be used for mulch.

1. Mulch all disturbed upland areas (except cultivated cropland) **before** seeding if:

   a. Final cleanup, including final grading and installation of permanent erosion control measures, is not completed in an area within 20 days after the trench in that area is backfilled (10 days in residential areas); or

   b. Construction or restoration activity is interrupted for extended periods, such as when seeding cannot be completed due to seeding period restrictions.

   NOTE: When mulching before seeding, increase mulch application on all slopes within 100 feet of waterbodies and wetlands to a rate of 3 tons/acre of straw or equivalent.

2. Apply mulch on all slopes (except in cultivated cropland) concurrent with or immediately after seeding, where necessary, to stabilize the soil surface and to reduce wind and water erosion. Spread mulch uniformly over the ROW at a rate of 2 tons/acre of straw or equivalent.

3. Mulch with woodchips only under the following conditions with prior approval from the Chief Inspector or the EI:

   a. Do not use more than 1 ton/acre; and

   b. Add the equivalent of 11 lbs/acre available nitrogen (at least 50 % of which is slow release).

4. Ensure that mulch is anchored to minimize loss by wind and water. Anchoring may be achieved by wet soil conditions (when approved by the EI), mechanical means, or with liquid mulch binders.

5 When anchoring with liquid mulch binders, use rates recommended by the manufacturer. **Do not use liquid mulch binders within 100 feet of wetlands and waterbodies,** except where the

product is certified environmentally non-toxic by the appropriate state or federal agency or independent standards-setting organization**.**

6. Do not use synthetic monofilament mesh/netted erosion control materials in areas designated as sensitive wildlife habitat, unless the product is specifically designed to minimize harm to wildlife. Anchor the erosion control fabric with staples or other appropriate devices.

3.6.4 Winter Stabilization

In the event that the final phases of construction or restoration occur too late in the year for cleanup activities to adequately proceed, the following procedures will be implemented along the disturbed ROW at those locations until final restoration measures can be completed. The Company will file for review and written approval from the FERC, a winterization plan if construction continues into the winter season where conditions could delay successful decompaction, topsoil replacement, or seeding until the following spring.

1. Install permanent interceptor dikes at specified intervals on all slopes, or as directed by the EI;

2. Install temporary sediment barriers adjacent to stream and wetland crossings, as well as other critical areas;

3. Seed and mulch the ROW and seed segregated topsoil piles in accordance with Appendix B; and

Remove flumes from waterbody crossings to reestablish natural stream flow.

3.6.5 Winter Construction Plans

If construction is planned to occur during winter weather conditions, develop and file a project-specific winter construction plan with the FERC application. The plan shall address:

1. Winter construction procedures (e.g., snow handling and removal, access road construction and maintenance, soil handling under saturated or frozen conditions, topsoil stripping);

2. Stabilization and monitoring procedures if ground conditions will delay restoration until the following spring (e.g., mulching and erosion controls, inspection and reporting, stormwater control during spring thaw conditions); and

3. Final restoration procedures (e.g., subsidence and compaction repair, topsoil replacement, seeding).

3.7 Unauthorized Vehicle Access to ROW

The Company will offer to install and maintain measures to control unauthorized vehicle access to the ROW based on requests by the manager or owner of forested lands. These measures may include:

- Signs;

- Fences with locking gates;
- Slash and timber barriers, pipe barriers, or a line of boulders across the ROW; or
- Conifers or other appropriate shrubs with a mature height of 4 feet or less across the ROW.

4. SPECIAL CONSTRUCTION METHODS

The Company will utilize the following specialized construction procedures for agricultural areas, road crossings, and residential areas along the pipeline project. The project construction drawings, Line Lists, and Construction Contract will indicate the locations where specialized construction methods will be used.

4.1 Agricultural Areas

4.1.1 Drain Tiles

1. Attempt to locate existing drain tiles and irrigation systems.
2. Develop procedures for constructing through drain tiled areas, maintaining irrigation systems during construction, and repairing drain tiles and irrigation systems after construction.
3. Engage qualified drain tile specialists, as needed, to conduct or monitor repairs to drain tile systems affected by construction. Use drain tile specialist from the project area, if available.
4. Probe all drainage tile systems within the area of disturbance to check for damage.
5. Repair damaged drain tiles to their original condition (Figure 24). Filter-covered drain tiles may not be used unless the local soil conservation authorities and the landowner agrees in writing prior to construction.
6. Ensure that the depth of cover over the new pipeline is sufficient to avoid interference with drain tile systems (existing or proposed). For adjacent pipeline loops in agricultural areas, install the new pipeline with at least the same depth of cover as the existing pipeline(s).

4.1.2 Irrigation

1. Maintain water flow in crop irrigation systems, unless shutoff is coordinated with affected parties.
2. Repair any damage to the systems as soon as practical.

4.1.3 Soil Compaction Mitigation

1. Test topsoil and subsoil for compaction at regular intervals in agricultural areas disturbed by construction activities. Conduct tests on the same soil type under similar moisture conditions in undisturbed areas to identify approximate preconstruction conditions. Use penetrometers or other appropriate devices to conduct tests.
2. Plow severely compacted agricultural areas with a paraplow or other deep tillage implement. In areas where topsoil has been segregated, plow the subsoil before replacing the segregated topsoil. If subsequent construction and cleanup activities result in further compaction, conduct additional tilling.

4.2 Road Crossings

Unpaved private and public roads supporting minimal traffic volumes are usually crossed by boring or by means of an open cut, if this method is approved by the owner or appropriate road management agency. An open cut crossing may involve closing the road to all traffic and constructing an adequate detour around the crossing area, or excavating one-half of the road at a time allowing through traffic to be maintained

(Figure 25). The trench for an open cut crossing is excavated with a backhoe or similar equipment, all backfill is compacted, and the road resurfaced. All state, national, and interstate highways as well as all railroads must be crossed by boring (Figure 26), unless the crossing permit allows an open cut crossing. Access roads shall be used in accordance with Section 3.2.

4.3 Residential Areas

4.3.1 Construction Procedures

Specialized construction procedures will be utilized in areas of heavy residential or commercial/ industrial congestion where residences or business establishments are located within 50 feet of construction work areas.

1. Install safety fence at the edge of the construction ROW for a distance of 100 feet on either side of the residence or business establishment.

2. Attempt to maintain a minimum distance of 25 feet between any residence/business establishment and the edge of the construction work area for a distance of 100 feet on either side of the residence/business establishment.

3. Avoid removal of mature trees and landscaping within the construction work area unless necessary for safe operation of construction equipment, or as specified in landowner agreements.

4. Restore all lawn areas and landscaping immediately following cleanup operations, or as specified in landowner agreements.

5. If seasonal or other weather conditions prevent compliance with these time frames, maintain and monitor temporary erosion controls (sediment barriers and mulch) until conditions allow completion of restoration.

4.3.2 Construction Techniques

In addition to the previously identified specialized procedures, smaller "spreads" of labor and equipment, operating independent of the mainline work force, will utilize either the stove pipe or drag section pipeline construction techniques in those areas of congestion where a minimum distance of 25 feet cannot be maintained between the residence (or business establishment) and the edge of the construction work area. In no case shall the temporary work area be located within 10 feet of a

residence unless the landowner agrees in writing, or the area is within the existing maintained ROW. The following techniques shall be utilized for a distance of 100 feet on either side of the residence or business establishment at the locations identified in the Construction Contract and/or Line List.

1. The stove pipe construction technique is a less efficient alternative to the mainline method of construction, typically used when the pipeline is to be installed in very close proximity to an existing structure or when an open trench would adversely impact a commercial/industrial establishment. The technique involves installing one joint of pipe at a time whereby the welding, weld inspection, and coating activities are all performed in the open trench. At the end of each day after the pipe is lowered-in, the trench is backfilled and/or covered with steel plates or timber mats. The length of excavation performed each day cannot exceed the amount of pipe installed.

2. The drag section construction technique, while less efficient than the mainline method, is normally preferred over the stove pipe alternative. This technique involves the trenching, installation, and backfill of a prefabricated length of pipe containing several segments all in one day. At the end of each day after the pipe is lowered-in, the trench is backfilled and/or covered with steel plates or timber mats. Use of the drag section technique will typically require adequate staging areas outside of the residential and/or commercial/industrial congestion for assembly of the prefabricated sections.

4.3.3 Cleanup and Restoration

1. Reseed all disturbed lawns with a seed mixture acceptable to landowner or comparable to the adjoining lawn.

2. Landowners shall be compensated for damages to ornamental shrubs and other landscape plantings based on the appraised value as set forth in the Guide for Plant Appraisal, authored by the Council of Tree and Landscape Appraisers (CTLA), 8th Edition and published in 1992 by the International Society of Arboriculture.

3. Landowners shall be compensated for damages in a fair and reasonable manner, and as specified in the damage provision within the controlling easement on each property.

5. WATERBODY CROSSINGS

The following section describes the construction procedures and mitigation measures that will be used for pipeline installations at waterbodies. The intent of these procedures is to minimize the extent and duration of project related disturbances within waterbodies.

5.1 Waterbody Definitions

The term "**waterbody"** as used in this Plan includes any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing, and other permanent waterbodies such as ponds and lakes. In this Plan, waterbodies are characterized into three main categories depending on the width of the waterbody. The categories are as follows:

- A **"minor waterbody"** includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction.
- An "**intermediate waterbody"** includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of construction.
- A "**major waterbody"** includes all waterbodies greater than 100 feet wide at the water's edge at the time of construction.
- A "**state designated waterbody**" includes all perennial waterbodies that support coldwater fisheries and warmwater fisheries considered significant by the state.
- A "**non-state designated waterbody**" includes intermittent drainage ditches, intermittent streams, and perennial warmwater streams **not** considered significant by the state.

The waterbody crossing procedures described in this Plan comply with the Section 404 Nationwide permit program terms and conditions (33 CFR Part 330).

5.2 General Waterbody Procedures

Pipeline construction across waterbody channels may result in short term water quality impacts. Decisions regarding waterbody crossing techniques will be based on agency consultations. Mobilization of construction equipment, trench excavation, and backfilling will be performed in a manner that will minimize the potential for erosion and sedimentation within the waterbody channel. Erosion control measures will be implemented to confine water quality impacts within the immediate construction area and to minimize impacts to downstream areas. The length of the crossing, the sensitivity of the area, existing conditions at the time of the crossing, and permit requirements will determine the most appropriate measures to be used.

5.2.1 Time Window for Construction

1. Unless expressly permitted or further restricted by the appropriate federal or state agency in writing on a site-specific basis, instream work, except that required to install or remove equipment bridges, must occur during the following time windows:
   a. Coldwater Fisheries – June 1 through September 30; and
   b. Coolwater and Warmwater Fisheries – June 1 through November 30.

5.2.2 Temporary Equipment Bridges

A temporary equipment bridge is a structure that may be installed across a waterbody to provide a means for construction equipment to cross the stream while minimizing impacts to the channel bottom or banks.

1. Until the equipment bridge is installed, only clearing equipment and equipment necessary for installation of equipment bridges may cross the waterbody and the number of crossings shall be limited to one crossing per piece of equipment, unless otherwise authorized by the appropriate permitting agency.

2. Construct equipment bridges to maintain unrestricted flow and to prevent soil from entering the waterbody. Examples of such bridges include:
   a. Equipment pads and culverts (Figure 27);
   b. Clean crushed stone and culverts (Figure 28);
   c. Flexi-float or portable bridges (Figure 29); or
   d. Equipment pads or railroad car bridges without culverts
3. Construct crossings as close to perpendicular to the axis of the waterbody channel.

4. Design and maintain each equipment bridge to withstand the highest flows that would occur. Align culverts/flumes to prevent bank erosion or streambed scour. If necessary, install energy dissipating devices downstream of the culverts.

5. Do not use soil to construct or stabilize equipment bridges.

6. Design and maintain equipment bridges to prevent soil from entering the waterbody.

7. Remove temporary equipment bridges as soon as practicable after permanent seeding.

8. If there will be more than 1 month between final cleanup and the beginning of permanent seeding and reasonable alternative access to the ROW is available, remove equipment bridges as soon as practical after final cleanup.

9. Obtain any necessary approval from the COE, or the appropriate state agency for permanent bridges.

5.2.3 Clearing and Grading

1. Confine construction activities and ground disturbance to within the ROW boundaries shown on the construction drawings.

2. Restrict extra work areas (such as staging areas and additional spoil storage areas) to those shown only on the construction drawings. All extra work areas must be located at least 50 feet away from the water's edge, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. If site-specific conditions do not permit a 50-foot setback, the Company can receive written approval from the FERC to locate these extra work areas closer than 50 feet from the water's edge.

3. If the pipeline parallels a waterbody, maintain at least 15 feet of undisturbed vegetation between the waterbody (and any adjacent wetland) and the ROW except at the crossing location, except where maintaining this offset will result in greater environmental impact.

4. Clear the ROW adjacent to all waterbodies *up to the high water bank* (where discernible).

5. Immediately remove all cut trees and branches that inadvertently fall into a waterbody and stockpile in an upland area on ROW for disposal.

6. Grade the ROW adjacent to waterbodies *up to within 10 feet of the high water bank*, leaving an ungrubbed vegetative strip intact.

7. Clearing and grading operations may proceed through the 10-foot vegetative strip **only on the working side of the ROW** in order to install the equipment bridge and travel lane. Use temporary sediment barriers to prevent the flow of bank spoil into the waterbody.

8. Maintain adequate flow rates to protect aquatic life and prevent the interruption of existing downstream uses.

5.2.4 Installing Temporary Erosion and Sediment Control

1. Install sediment barriers immediately after initial disturbance of the waterbody or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench), until replacement by permanent erosion controls or restoration of adjacent upland areas is complete.

2. Install sediment barriers across the entire construction ROW at all waterbody crossings, where necessary to prevent the flow of sediments into the waterbody. Temporary or removable sediment barriers such as interceptor dikes or drivable berms as described in Section 3.5.4 may be used in lieu of sediment barriers in front of equipment bridges or timber mats across the travel lane.

These temporary sediment barriers can be removed during the construction day, but must be reinstalled after construction has stopped for the day and/or when heavy precipitation is imminent.

3. Install sediment barriers as necessary along the edge of the construction ROW to contain spoil within the ROW and prevent sediment flow into the waterbody where waterbodies are adjacent or parallel to the construction ROW and the ROW slopes toward the waterbody.

4. Use temporary trench plugs at all waterbody crossings to prevent diversion of water into upland portions of the pipeline trench and to keep any accumulated trench water out of the waterbody. Trench plugs shall be of sufficient size to withstand upslope water pressure.

5.2.5 Various Types of Crossings

Construction at waterbodies will be conducted using two principal crossing methods, a "dry" crossing and a "wet" crossing. The "dry" crossing procedure is further divided into a flumed crossing and a dam and pump crossing. These methods are designed to maintain downstream flow at all times and to isolate the construction zone from the stream flow by channeling the water flow through a flume pipe or by damming the flow and pumping the water around the construction area. The overall objective is to minimize siltation of the waterbody and to facilitate trench excavation of saturated spoil. Unless approved otherwise by the appropriate federal or state agency, pipeline construction and installation must occur using one of the two "dry" crossing methods for waterbodies state-designated as either coldwater or significant coolwater or warmwater fisheries, or federally-designated as critical habitat. The flumed and dam and pump crossing methods are applicable to waterbodies up to 30 feet wide at the water's edge at the time of construction. The two "dry" crossings are further described below in Sections 5.2.5.2 and 5.2.5.3.

The "wet" crossing procedure involves open cutting the waterbody without isolating the construction zone from the stream flow. The objective of this method is to complete the waterbody crossing as quickly as practical in order to minimize the duration of impacts to aquatic resources. All streams, their classifications, timing windows, and crossing procedures will be identified in the Clearance Package/Permit Book and on the construction drawings. Table 6-1 outlines the general procedures to be followed at all waterbody crossings.

5.2.5.1 General Crossing Procedures

1. Dewater trench in accordance with the procedures described in Section 3.5.6.

2. For minor waterbodies:

   a. Place all spoil from the waterbody within the construction ROW at least 10 feet from the water's edge or in the extra work areas shown on the construction drawings. Use sediment barriers to prevent flow of spoil or heavily silt-laden water into the waterbody.

3. For intermediate waterbodies:

a. Less than 30 feet in width, place all spoil from the waterbody within the construction ROW at least 10 feet from the water's edge or in the extra work areas shown on the construction drawings. Use sediment barriers to prevent flow of spoil or heavily silt-laden water into the waterbody.

b. Greater than 30 feet in width, spoil may be temporarily sidecast into the waterbody provided that site specific approval is received from the appropriate permitting agency.

4. For major waterbodies:

   a. Place all upland bank spoil from the waterbody within the construction ROW at least 10 feet from the water's edge or in the extra work areas shown on the construction drawings. Use sediment barriers to prevent flow of spoil or heavily silt laden water into the waterbody.

5. Restore and stabilize the banks and channel in accordance with Section 5.2.6.

6. Crossing of waterbodies when they are dry or frozen and not flowing may proceed using standard upland construction techniques, provided that the Environmental Inspector verifies that water is unlikely to flow between initial disturbance and final stabilization of the feature. In the event of perceptible flow, the project sponsor must comply with all applicable Procedure requirements for "waterbodies" as defined in Section 5.1 of this Plan.

5.2.5.2 Flumed Crossing

The flumed crossing method utilizes a flume pipe(s) to transport stream flow across the disturbed area and allows trenching to be done in drier conditions (Figure 30). The flume pipe(s) installed across the trench will be sized to accommodate anticipated stream flows. This method is utilized for perennial waterbodies (minor and intermediate) up to 30 feet wide that are state designated fisheries including coldwater fisheries and warmwater fisheries considered significant by the state. Flumes are generally not recommended for use on a watercourse with a broad unconfined channel, unstable banks, a permeable substrate, excessive stream flow, or where the installation and construction of the flume crossing will adversely affect the bed or banks of the stream.

1. Cross all minor waterbodies that are state-designated fisheries, as identified in the Clearance Package/ Permit Book, using a dry crossing technique (Figures 30, 31).

2. All construction equipment must cross state-designated fisheries on an equipment bridge as specified in Section 5.2.2.

4. The flumed crossing shall be installed as follows:

   a. Install flume pipe(s) after blasting and other rock breaking measures (if required), but before trenching;

   b. Properly align flume pipe(s) to prevent bank erosion and streambed scour;

c. Use sand bags or equivalent dam diversion structure to provide a seal at either end of the flume to channel water flow (some modifications to the stream bottom may be required to achieve an effective seal);

d. **Do not remove flume pipe** during trenching, pipe laying (thread pipe underneath the flume pipe(s)), or backfilling activities, or initial streambed restoration efforts unless authorized by agency permits; and

e. Remove all flume pipes and dams that are not also part of the equipment bridge as soon as final cleanup of the stream bed and bank is complete.

5.2.5.3 ***Dam and Pump Crossing***

The dam and pump method is presented as an alternative dry crossing procedure to the flumed crossing. The dam and pump crossing is accomplished by utilizing pumps to transport stream flow across the disturbed area (Figure 31). This method involves placing sandbags across the existing stream channel upstream from the proposed crossing to stop water flow and downstream from the crossing to isolate the work area. Pumps are used to pump the water across the disturbed area and back into the stream further downstream. This method is intended for use at perennial waterbodies (minor and intermediate) up to 30 feet wide and state designated fisheries including coldwater fisheries and warmwater fisheries considered significant by the state. The dam and pump procedure allows for more space and flexibility during trenching and pipe installation, which shortens the duration of time spent at the waterbody.

1. The dam and pump method may be used for crossings of waterbodies where pumps can adequately transfer stream flow volumes around the work area, and where there are no concerns about sensitive species passage.

2. Implementation of the dam and pump crossing method will meet the following performance criteria:

   a. Use sufficient pumps, including onsite backup pumps, to maintain downstream flows;

   b. Construct dams with materials that prevent sediment and other pollutants from entering the waterbody (e.g., sandbags or clean gravel with plastic liner);

   c. Screen pump intakes to minimize entrainment of fish;

   d. Prevent streambed scour at pump discharge; and

   e. Continuously monitor the dam and pumps to ensure proper operation throughout the waterbody crossing.

3. The dam and pump crossing shall be installed as follows:

   a. Install and properly seal sandbags at the upstream and downstream location of the crossing;

   b. Create an in-stream sump using sandbags if a natural sump is unavailable for the intake hose;

c. Initiate pumping of the stream around the work area prior to excavating the trench;

d. Screen all intake hoses to prevent the entrainment of fish and other aquatic life;

e. Direct all discharges from the pumps through energy dissipaters to minimize scour and siltation;

f. Monitor pumps at all times until construction of the crossing is completed; and

g. Following construction, remove the equipment crossing and sandbag dams.

5.2.5.4 Wet Crossing

This construction technique is typically used to cross waterbodies that are non state-designated as well as intermediate and major waterbodies with substantial flows that cannot be effectively culverted or pumped around the construction zone using the dry crossing techniques (Figure 32). Non-state designated waterbodies include perennial warmwater streams not considered significant by the state, intermittent drainage ditches, and intermittent streams.

The wet-ditch crossing shall be installed as follows:

1. For minor waterbodies:

   a. Equipment bridges are not required at non state-designated fisheries or protected status (e.g. agricultural or intermittent drainage ditches). However, if an equipment bridge is used, it must be constructed in accordance with Section 5.2.2;

   b. Limit use of equipment operating in the waterbody to that needed to construct the crossing;

   c. Complete trenching and backfilling in the waterbody (not including blasting and other rock breaking measures) within 24 continuous hours; and

   d. If a flume is installed within the waterbody during mainline activities, it can be removed just prior to lowering in the pipeline. The 24-hour timeframe starts as soon as the flume is removed.

2. For intermediate waterbodies:

   a. Limit use of equipment operating in the waterbody to that needed to construct the crossing. All other construction equipment must cross on an equipment bridge as specified in Section 5.2.2; and

   b. Attempt to complete trenching and backfill work within the waterbody (not including blasting and other rock breaking measures) within 48 continuous hours, unless site-specific conditions make completion within 48 hours infeasible.

3. For major waterbodies:

   a. Company will develop site-specific crossing plans to be submitted for approval by the FERC and the appropriate permitting agency; and

b. Construct the crossing in accordance with the measures contained in this Plan to the maximum extent practical.

5.2.5.5 Horizontal Directional Drill

For each waterbody or wetland that would be crossed using the HDD method, prepare a plan that includes:

1. Site-specific construction diagrams that show the location of mud pits, pipe assembly areas, and all areas to be disturbed or cleared for construction;

2. Justification that disturbed areas are limited to the minimum needed to construct the crossing;

3. Identification of any aboveground disturbance or clearing between the HDD entry and exit workspaces during construction;

4. A description of how an inadvertent release of drilling mud would be contained and cleaned up; and

5. A contingency plan for crossing the waterbody or wetland in the event the HDD is unsuccessful and how the abandoned drill hole would be sealed, if necessary.

5.2.6 Restoration

1. Return all waterbody banks to preconstruction contours or to stable angle of repose as approved by the EI.

2. Install erosion control fabric or a functional equivalent on waterbody banks at the time of final bank recontouring. Do not use synthetic monofilament mesh/netted erosion control materials in areas designated as sensitive wildlife habitat unless the product is specifically designed to minimize harm to wildlife. Anchor erosion control fabric with staples or other appropriate devices.

3. Use clean gravel or native cobbles for the upper 12 inches of trench backfill in all waterbodies identified in the Clearance Package/Permit Book as coldwater fisheries.

4. For wet crossings, stabilize waterbody banks and install temporary sediment barriers within 24 hours of completing the crossing. For dry crossings, complete bank stabilization before returning flow to the waterbody channel.

5. Limit the placement of riprap to the slopes along the disturbed waterbody crossing.

6. Install erosion control fabric along waterbodies with low flow conditions (Figure 33).

7. Revegetate disturbed riparian areas with conservation grasses and legumes in accordance with the recommended Upland Seed Mix in Appendix B. In the event that final cleanup is deferred more

than 20 days after the trench is backfilled, all slopes within 100 feet of waterbodies shall be mulched with 3 tons/acre of straw.

8. Remove all temporary sediment barriers when replaced by permanent erosion controls or when restoration of adjacent upland areas is successful as specified in Section 8.1.

9. Install a permanent interceptor dike and a trench plug at the base of slopes near each waterbody crossed. Locate the trench plug immediately upslope of the interceptor dike. Permanent interceptor dikes may not be installed in agricultural areas.

TABLE 5-1: GENERAL WATERBODY CROSSING PROCEDURES

	WATERBODY TYPE					
	MINOR		INTERMEDIATE		MAJOR	
WATERBODY CROSSING ACTIVITIES	Non-State[1] Designated	State[2] Designated	Non-State[3] Designated	State[2] Designated	Non-State[3] Designated	State[2] Designated
Flumed Crossing (Dry) *Section 5.2.5.2, Figure 30*		X		X		
Dam and Pump Crossing (Dry) *Section 5.2.5.3, Figure 31*		X		X		
Wet Crossing *Section 5.2.5.4, Figure 32*	X		X	X	X	X
Construction timing window during the year *Section 5.2.1*		X		X		X
Time to complete construction of crossing (not including blasting) [4]	24 Hours		48 Hours			
Equipment bridge required [5]		X	X	X	X	X

[1] Includes agricultural intermittent drainage ditches, intermittent streams, and perennial warmwater streams not considered significant by the state.

[2] Includes all perennial waterbodies that support coldwater fisheries and warmwater fisheries considered significant by the state.

[3] Includes perennial warmwater streams not considered significant by the state.

[4] If a flume is installed within the waterbody during mainline activities, it can be removed just prior to lowering in the pipeline. The 24-hour timeframe starts as soon as the flume is removed.

[5] An equipment bridge may not be required for a waterbody being crossed by a horizontal directional drill.

6. WETLAND CROSSINGS

6.1 Definition

The term "**Wetland**" as used in this Plan includes any area that satisfies the requirements of the current Federal methodology for identifying and delineating wetlands. Wetland areas have been delineated prior to construction and are identified on the construction drawings.

The wetland crossing procedures described in this Plan comply with the Section 404 Nationwide permit program terms and conditions (33 CFR Part 330). The requirements outlined below do not apply to wetlands in cultivated or rotated cropland. Standard upland protective measures including workspace and topsoiling requirements, will apply to these agricultural wetlands.

6.2 General Procedures

6.2.1 Clearing and Grading

1. Limit construction activity and ground disturbance in wetland areas to a construction ROW width of 75 feet or as shown on the construction drawings. With written approval from the FERC for site-specific conditions, construction ROW width within the boundaries of federally delineated wetlands may be expanded beyond 75 feet.

2. Wetland boundaries and buffers must be clearly marked in the field with signs and /or highly visible flagging until construction-related ground disturbing activities are complete.

3. Restrict extra work areas (such as staging areas and additional spoil storage areas) to those shown only on the construction drawings. All extra work areas must be located at least 50 feet away from wetland boundaries, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. If site-specific conditions do not permit a 50-foot setback, the Company can receive written approval from the FERC to locate these extra work areas closer than 50 feet from the wetland.

4. Aboveground facilities shall not be located in any wetland, except as permitted or where the location of such facilities outside of wetlands would prohibit compliance with DOT regulations.

5. If standing water or saturated soils are present, or if construction equipment causes ruts or mixing of the topsoil and subsoil in wetlands, use low-ground-weight construction equipment or operate normal equipment on timber riprap, prefabricated equipment mats or terra mats on the working side of the ROW during clearing operations. Do not use more than two layers of timber riprap to stabilize the ROW.

6. Cut vegetation just above ground level and grind stumps to ground level, leaving existing root systems in place. Immediately remove all cut trees and branches from the wetland and stockpile in an upland area on ROW for disposal. Woody debris can be burned in wetlands, if approved by

the COE and in accordance with state and local regulations, ensuring that all remaining woody debris is removed for disposal.

7. Limit pulling of tree stumps and grading activities to directly over the trenchline. Do not grade or remove stumps or root systems from the rest of the ROW in wetlands unless the Chief Inspector and EI determine that safety-related construction constraints require removal of tree stumps from under the working side of the ROW.

8. Do not cut trees outside of the construction ROW to obtain timber for riprap or equipment mats.

9. Cleared materials (slash, logs, brush, wood chips) shall not be permanently placed within wetland areas.

6.2.2 Temporary Erosion and Sediment Control

1. Install sediment barriers immediately after initial ground disturbance at the following locations:
   a. Within the ROW at the edge of the boundary between wetland and upland;
   b. Across the entire ROW immediately upslope of the wetland boundary to contain spoil within the ROW and prevent sediment flow into the wetland;
   c. Along the edge of the ROW, where the ROW slopes toward the wetland, to protect adjacent, off ROW wetland; and
   d. Along the edge of the ROW as necessary to contain spoil and sediment within the ROW through wetlands.

2. Maintain all sediment barriers throughout construction and reinstall as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration of adjacent upland areas is complete in accordance with Section 8.1.

6.2.3 Crossing Procedure

1. Minimize the length of time that topsoil is segregated and the trench is open. Do not trench the wetland until the pipeline is assembled and ready for lowering in.

2. Do not use rock, soil imported from outside the wetland, tree stumps, or brush riprap to stabilize the ROW.

3. Perform topsoil segregation in accordance with Section 3.5.3.1 and trench dewatering in accordance with Section 3.5.6.

4. Assemble the pipeline in an upland area unless the wetland is dry enough to adequately support skids and pipe.

5. Use “push pull” or “float” techniques to place the pipe in the trench where water and other site conditions allow.

6. Install trench plugs at wetland boundaries and/or seal the trench bottom as necessary to maintain the original wetland hydrology at locations where the pipeline trench may drain a wetland.

7. Restore pre-construction wetland contours to maintain the original wetland hydrology.

8. Install a permanent interceptor dike and a trench plug at the base of slopes near the boundary between the wetland and adjacent upland areas. In addition, install sediment barriers as outlined in Section 3.5.2. Permanent interceptor dikes shall not be installed in agricultural areas.

9. Restore segregated topsoil to its original position after backfilling is complete. When required, additional fill material imported from off the ROW must be approved by the EI. The original wetland contours and flow regimes will be restored to the extent practical.

6.2.4 Cleanup and Restoration

1. Revegetate the ROW with annual ryegrass at 40 lbs/acre PLS or with the recommended Wetland Seed Mix in Appendix B, unless standing water is present.

2. **Do not use mulch, lime or fertilizer in wetland areas unless required in writing by the appropriate federal or state agency.**

3. Mulch the disturbed ROW only when required by the appropriate land management or state agency, as identified in the Clearance Package/Permit Book.

4. In the event that final cleanup is deferred more than 20 days after the trench is backfilled, all slopes adjacent to wetlands shall be mulched with 3 tons/acre of straw for a minimum of 100 feet on each side of the crossing.

5. Remove all timber riprap and prefabricated equipment mats upon completion of construction.

6. Develop specific procedures in coordination with the appropriate federal or state agencies, where necessary, to prevent the invasion or spread of invasive species and noxious weeds (such as purple loose strife and phragmites).

7. Ensure that all disturbed areas permanently revegetate in accordance with Section 8.1.

8. Remove temporary sediment barriers located at the boundary between wetland and adjacent upland areas after upland revegetation and stabilization of adjacent upland areas are successful as specified in Section 8.1.

7. SPILL PREVENTION CONTROL

7.1 The Contractor shall adhere to the Company's SPCC Plan at all times.

1. Do not store hazardous materials, chemicals, fuels, or lubricating oils within 100 feet of any wetland, waterbody or within any designated municipal watershed area where feasible. If the 100-foot setback cannot be met, this activity can be performed within the 100-foot setback, with EI approval, if done in accordance with the SPCC Plan.

2. Refuel all construction equipment at least 100 feet from any wetland or waterbody, where feasible. If the 100-foot setback cannot be met, this activity can be performed within the 100-foot setback, with EI approval, if done in accordance with the SPCC Plan.

3. Do not perform fondu or concrete coating activities within 100 feet of any wetland or waterbody, unless the location is an existing industrial site designated for such use. If the 100-foot setback cannot be met, these activities can be performed within the 100-foot setback, with EI approval, if done in accordance with the SPCC Plan. These activities can occur closer only if the Environmental Inspector determines that there is no reasonable alternative, and the project sponsor and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;

4. pumps operating within 100 feet of a waterbody or wetland boundary utilize appropriate secondary containment systems to prevent spills; and

5. bulk storage of hazardous materials, including chemicals, fuels, and lubricating oils have appropriate secondary containment systems to prevent spills.

8. POST CONSTRUCTION ACTIVITIES

8.1 Post-Construction Monitoring

All projects conducted under this Plan, with the exception of insitu pipe replacements (i.e. DOT-mandated replacements, line lowerings, and anomaly repairs), shall meet the monitoring requirements set forth in this section. Company personnel shall perform the following:

1. Establish and implement a program to monitor the success of restoration upon completion of construction and restoration activities;

2. Conduct follow-up inspections of all disturbed areas, as necessary to determine the success of revegetation and address landowner concerns. At a minimum, conduct inspections after the first and second growing seasons;

3. Revegetation in non agricultural areas shall be considered successful if the vegetative cover is sufficient to prevent the erosion of soils on the disturbed ROW and density and cover are similar to that in adjacent undisturbed area. Sufficient coverage in upland areas is defined when vegetation has a uniform 70 percent vegetative coverage. In agricultural areas, revegetation shall be considered successful when upon visual survey, crop growth and vigor are similar to adjacent undisturbed portions of the same field, unless the easement agreement specifies otherwise. Revegetation efforts (such as fertilizing or reseeding) will continue until revegetation is successful;

4. Restoration shall be considered successful if the ROW surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless otherwise approved by the land owner or land managing agency), revegetation is successful, and proper drainage has been restored;

5. Monitor and correct problems with drainage and irrigation systems resulting from pipeline construction in active agricultural areas until restoration is successful;

6. Make efforts to control unauthorized off-road vehicle use, in cooperation with the landowner, throughout the life of the project. Maintain signs, gates, and permanent access roads as necessary;

7. Monitor and record the success of wetland revegetation annually until wetland revegetation is successful. Wetland revegetation will be considered successful if all of the following criteria are satisfied: the affected wetland satisfies the current federal definition for a wetland (i.e., soils, hydrology, and vegetation); Vegetation is at least 80 percent of either the cover documented for the wetland prior to construction, or at least 80 percent of the cover in adjacent wetland areas that were not disturbed by construction; if natural rather than active revegetation was used, the plant species composition is consistent with early successional wetland plant communities in the affected ecoregion; and invasive species and noxious weeds are absent, unless they are abundant in adjacent areas that were not disturbed by construction.

8. For any wetland where vegetation is not successful at the end of 3 years after construction, the Company shall develop and implement (in consultation with a professional wetland ecologist) a plan to actively revegetate the wetland with native wetland herbaceous and woody plant species; and

9. Inspect all temporary remaining erosion and sedimentation controls during routine patrols to ensure proper functioning. Any deficiencies found will be reported and corrected as needed. Once the area has revegetated and stabilized, the erosion controls will be removed.

8.2 Post-Construction Maintenance

All projects conducted under this Plan, with the exception of insitu pipe replacements (i.e. DOT-mandated replacements, line lowerings, and anomaly repairs), shall meet the maintenance requirements set forth in this section. The following requirements restrict the amount of routine vegetation mowing or clearing that can occur on new pipeline facilities. Where the newly established pipeline ROW is located on other existing ROWs not affiliated with the Company, the easement holder or owner will continue to maintain their ROWs using procedures specified in their vegetative management programs.

8.2.1 Uplands

Routine maintenance of the ROW is required to allow continued access for routine pipeline patrols, maintaining access in the event of emergency repairs, and visibility during aerial patrols. In upland areas, maintenance of the ROW will involve clearing the entire ROW of woody vegetation.

1. Routine vegetation mowing or clearing over the full width of the permanent right-of-way in uplands shall be conducted no more frequently than once every 3 years. However, to facilitate periodic corrosion and leak surveys, a 10-foot wide corridor centered on the pipeline may be cleared at a frequency necessary to maintained the 10-foot wide corridor in a herbaceous state.

2. In no case shall routine vegetation mowing or clearing occur during the migratory bird nesting season between April 15 and August 1 of any year unless specifically approved in writing by the responsible land management agency or the U.S. Fish and Wildlife Service.

8.2.2 Waterbodies and Wetlands

1. Routine vegetation mowing or clearing practices on the construction ROW adjacent to waterbodies will consist of maintaining a riparian strip that measures 25 feet back from the mean high water mark. This riparian area will be allowed to permanently revegetate with native plant species across the entire ROW.

2. Routine vegetation mowing or clearing over the full width of the construction ROW in wetlands is prohibited.

3. To facilitate periodic corrosion and leak surveys at wetlands and waterbodies, a 10-foot wide corridor centered on the pipeline may be cleared at a frequency necessary to maintain the 10-foot

corridor in an herbaceous state. Trees and shrubs that are located within 15 feet of the pipeline that have roots that could compromise the integrity of the pipeline coating may be cut and removed from the ROW. Do not conduct any routine routine vegetation mowing or clearing in riparian areas that are between HDD entry and exit points.

4. Herbicides or pesticides shall not be used in or within 100 feet of a wetland or waterbody, except as specified by the appropriate federal or state agency.

5. Time of year restrictions (April 15 – August 1 of any year) apply to routine mowing and clearing of riparian areas.

8.3 Reporting

The Company shall maintain records that identify by milepost:

1. Method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;
2. Acreage treated;
3. Dates of backfilling and seeding; and
4. Names of landowners requesting special seeding treatment and a description of the follow-up actions.
5. the location of any subsurface drainage repairs or improvements made during restoration; and
6. any problem areas and how they were addressed.

For the authorized projects, the Company will file quarterly activity reports documenting the results of follow-up inspections and any problem areas, including those identified by the landowner, and corrective actions taken for <u>at least 2 years</u> following construction.

A wetland revegetation monitoring report identifying the status of the wetland revegetation efforts will be filed at the end of 3 years following construction, and annually thereafter documenting progress in these wetlands until revegetation is successful.

APPENDIX A

FIGURES

FIGURE NUMBER	STANDARD NUMBER	DRAWING TITLE
FIGURE #1	ES–0001	TYPICAL CONSTRUCTION WIDTHS ACQUIRING NEW PERMANENT RIGHT–OF–WAY
FIGURE #2	ES–0002	TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT–OF–WAY (MULTIPLE LINE SYSTEM)
FIGURE #3	ES–0003	TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT–OF–WAY (SINGLE LINE SYSTEM)
FIGURE #4	ES–0004	ACCESS ROAD CROSS SECTION
FIGURE #5	ES–0005	ROCK ACCESS PAD INSTALLATION AND MAINTENANCE
FIGURE #6	ES–0006	TYPICAL TEMPORARY ACCESS ROAD THROUGH WETLANDS
FIGURE #7	ES–0007	SILT FENCE INSTALLATION AND MAINTENANCE
FIGURE #8	ES–0008	STRAW BALE INSTALLATION AND MAINTENANCE
FIGURE #9	ES–0009	STRAW BALE INSTALLATION FOR A CHECK DAM IN A DRAINAGE WAY
FIGURE #10	ES–0010	STORM DRAIN INLET PROTECTION
FIGURE #11	ES–0011	R.O.W. TOPSOIL SEGREGATION TECHNIQUES
FIGURE #12	ES–0012	INTERCEPTOR DIKE INSTALLATION AND MAINTENANCE
FIGURE #13	ES–0013	TYPICAL TRENCH DETAIL
FIGURE #14	ES–0014	TEMPORARY TRENCH PLUGS
FIGURE #15	ES–0015	FILTER BAG
FIGURE #16	ES–0016	PERMANENT TRENCH PLUGS
FIGURE #17	ES–0017	TRENCH PLUG DETAIL
FIGURE #18	ES–0018	DEWATERING STRUCTURE FOR HYDROSTATIC TESTING
FIGURE #19	ES–0019	ALTERNATE DEWATERING STRUCTURE FOR HYDROSTATIC TESTING
FIGURE #20	ES–0020	CHEVRON INTERCEPTOR DIKE INSTALLATION AND MAINTENANCE
FIGURE #21	ES–0021	ROCK LINED DRAINAGE SWALE INSTALLATION AND MAINTENANCE
FIGURE #22	ES–0022	TYPICAL MATTING ON SLOPES
FIGURE #23	ES–0023	EROSION CONTROL FABRIC INSTALLATION
FIGURE #24	ES–0024	DRAIN TILE REPAIR PROCEDURE
FIGURE #25	ES–0025	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (OPEN CUT)
FIGURE #26	ES–0026	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (BORED)
FIGURE #27	ES–0027	TEMPORARY EQUIPMENT BRIDGE (EQUIPMENT PADS AND CULVERTS)
FIGURE #28	ES–0028	TEMPORARY EQUIPMENT BRIDGE (CRUSHED STONE AND CULVERTS)
FIGURE #29	ES–0029	TEMPORARY EQUIPMENT BRIDGE (FLEX–FLOAT OR PORTABLE)
FIGURE #30	ES–0030	TYPICAL FLUMED CROSSING
FIGURE #31	ES–0031	TYPICAL DAM AND PUMP CROSSING
FIGURE #32	ES–0032	TYPICAL WET CROSSING
FIGURE #33	ES–0033	TYPICAL MATTING OF STREAMBANKS
FIGURE #34	ES–0034	RIP–RAP PLACEMENT (TYPICAL)

INDEX OF FIGURES

APPENDIX A

DWG. ES–0000 REV.

jwwhorley 01/23/2003

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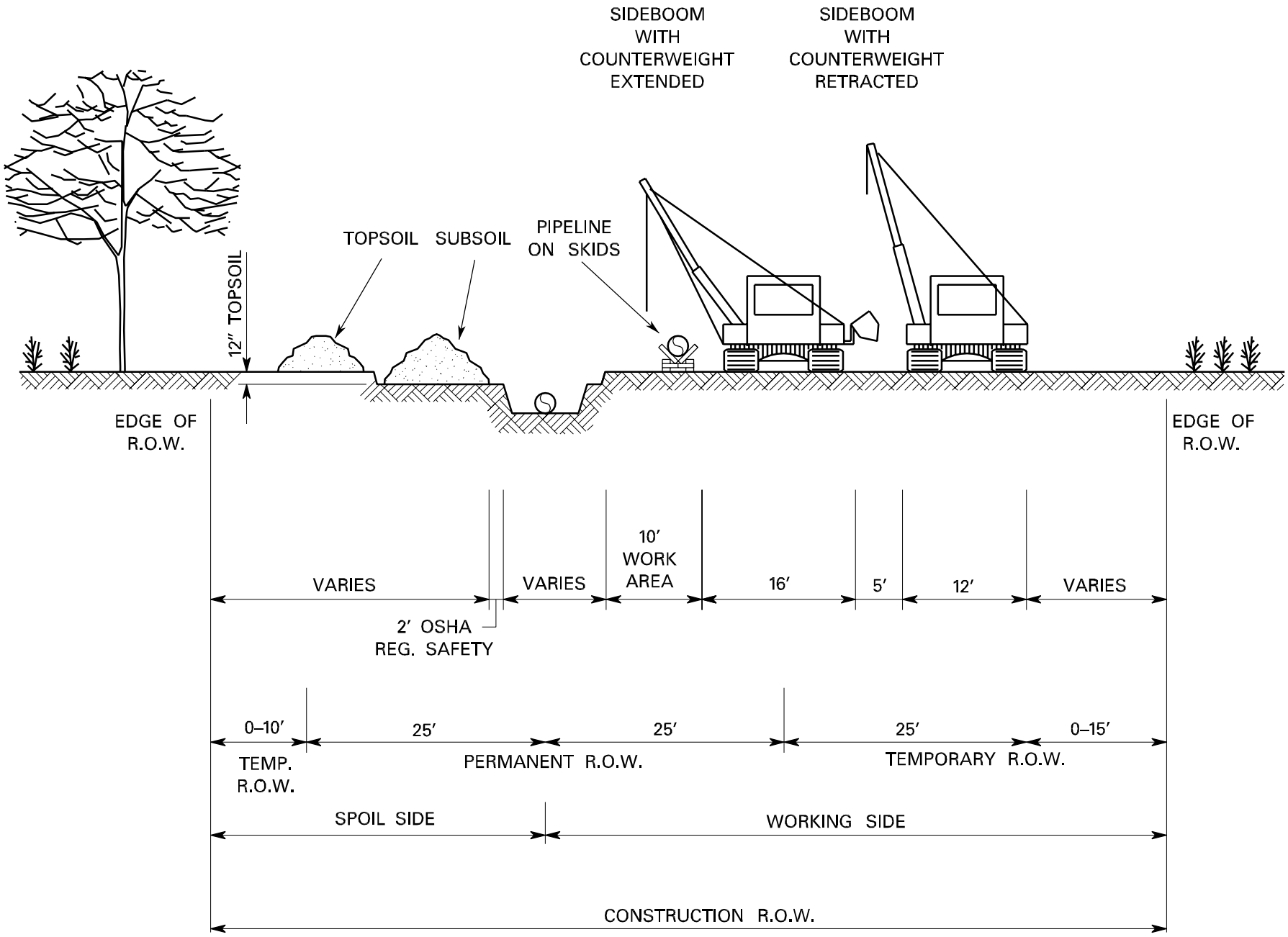

PIPE DIAMETER	SPOIL SIDE (FT.)	WORKING SIDE (FT.)	CONSTRUCTION R.O.W. (FT.)
12" OR LESS	25	50	75
14" – 30"	35	50	85
36" – 42"	35	65	100
WETLANDS	25	50	75

NOTES:

1. ALTHOUGH THE DIMENSIONS SHOWN ARE TYPICAL, SOME VARIATIONS MAY EXIST DUE TO SITE SPECIFIC CONDITIONS. UNLESS OTHERWISE INDICATED ON THE ALIGNMENT SHEETS, THE MAXIMUM WIDTH OF THE CONSTRUCTION RIGHT–OF–WAY SHALL BE AS SHOWN IN THE TABLE FOR THE APPROPRIATE PIPE DIAMETER.

2. TOPSOIL AND SUBSOIL SHALL BE SEGREGATED WITHIN WETLAND, RESIDENTIAL, AGRICULTURAL, PASTURES, HAYFIELDS, AND OTHER AREAS AT LANDOWNER'S OR LAND MANAGING AGENCY'S REQUEST.

TYPICAL CONSTRUCTION WIDTHS ACQUIRING NEW PERMANENT RIGHT–OF–WAY

FIGURE #1

DWG. ES–0001 REV.

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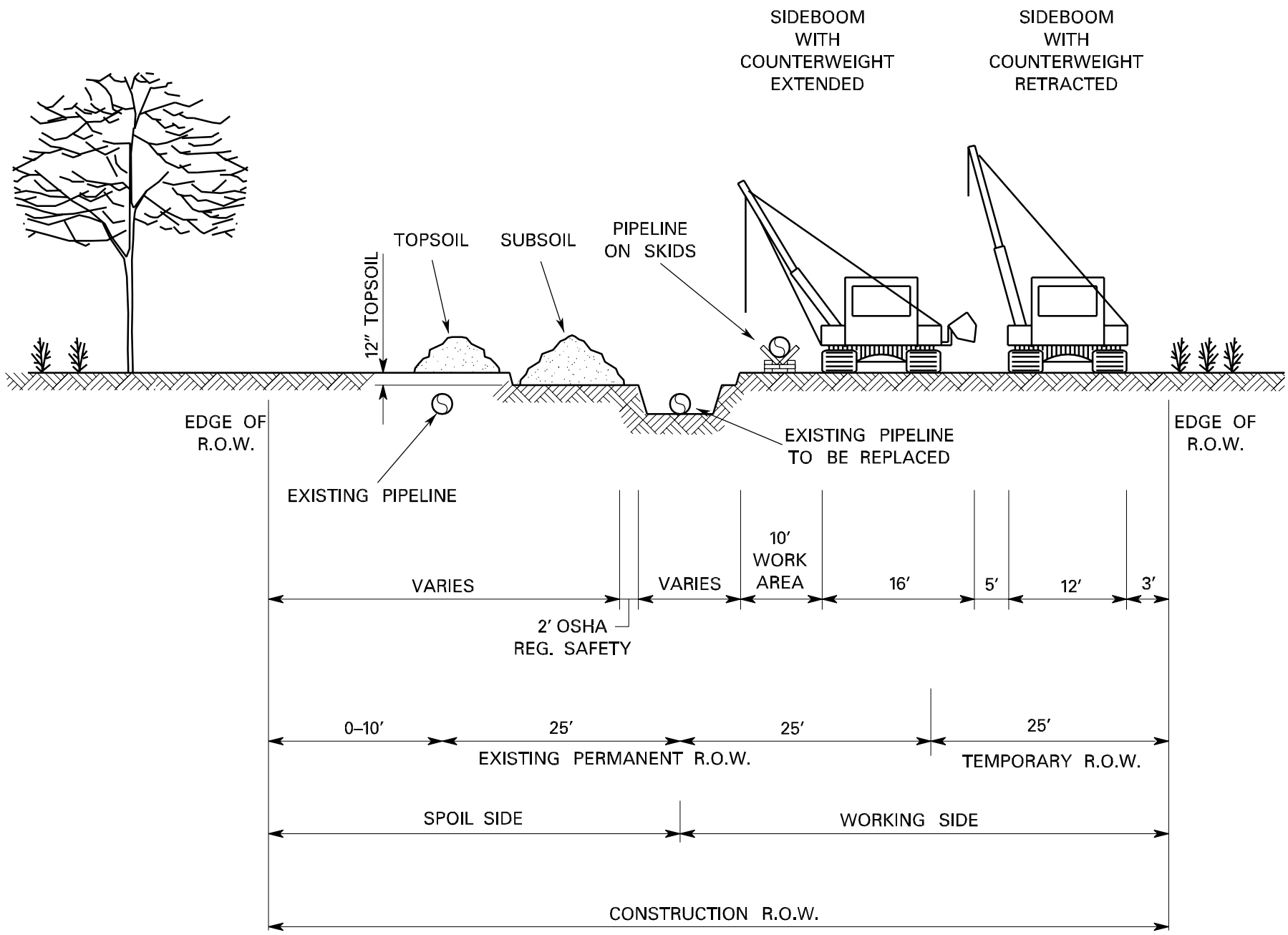

PIPE DIAMETER	SPOIL SIDE (FT.)	WORKING SIDE (FT.)	CONSTRUCTION R.O.W. (FT.)
12" OR LESS	25	50	75
14" – 30"	35	50	85
36" – 42"	35	50	85
WETLANDS	25	50	75

NOTES:

1. ALTHOUGH THE DIMENSIONS SHOWN ARE TYPICAL, SOME VARIATIONS MAY EXIST DUE TO SITE SPECIFIC CONDITIONS. UNLESS OTHERWISE INDICATED ON THE ALIGNMENT SHEETS, THE MAXIMUM WIDTH OF THE CONSTRUCTION RIGHT–OF–WAY SHALL BE AS SHOWN IN THE TABLE FOR THE APPROPRIATE PIPE DIAMETER.

2. TOPSOIL AND SUBSOIL SHALL BE SEGREGATED WITHIN WETLAND, RESIDENTIAL, AGRICULTURAL, PASTURES, HAYFIELDS, AND OTHER AREAS AT LANDOWNER'S OR LAND MANAGING AGENCY'S REQUEST.

3. IF THE WORKING SIDE MUST BE GREATER THAN 50 FEET (i.e. TEMPORARY WORKSPACE IS GREATER THAN 25 FEET), COMPANY MUST REQUEST APPROVAL FROM THE F.E.R.C.

TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT–OF–WAY (MULTIPLE LINE SYSTEM)

FIGURE #2

DWG. ES–0002 REV.

I.G. ESE0002.DGN
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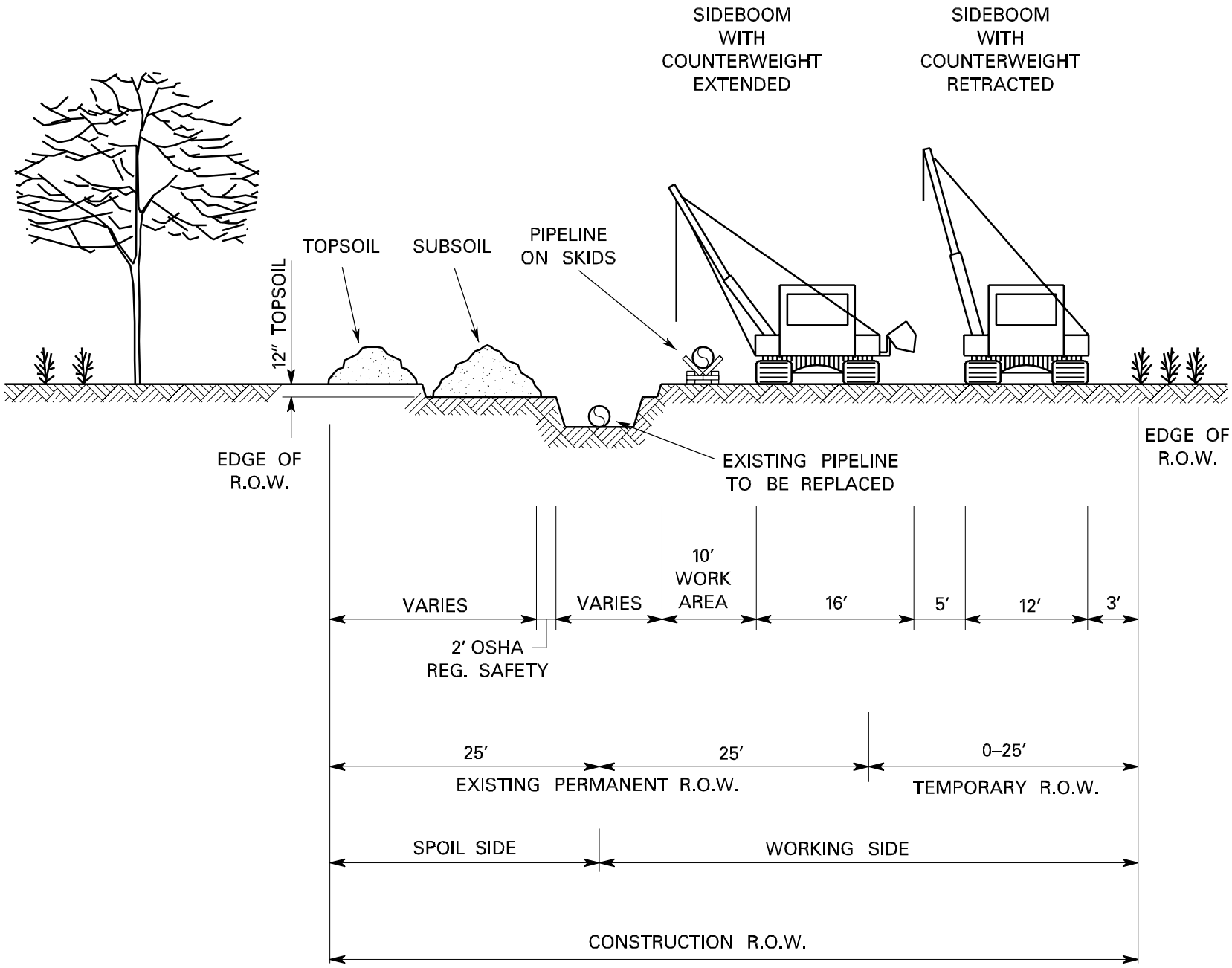

PIPE DIAMETER	SPOIL SIDE (FT.)	WORKING SIDE (FT.)	CONSTRUCTION R.O.W. (FT.)
12" OR LESS	25	25	50
14" – 30"	25	50	75
36" – 42"	25	50	75
WETLANDS	25	50	75

NOTES:

1. ALTHOUGH THE DIMENSIONS SHOWN ARE TYPICAL, SOME VARIATIONS MAY EXIST DUE TO SITE SPECIFIC CONDITIONS. UNLESS OTHERWISE INDICATED ON THE ALIGNMENT SHEETS, THE MAXIMUM WIDTH OF THE CONSTRUCTION RIGHT–OF–WAY SHALL BE AS SHOWN IN THE TABLE FOR THE APPROPRIATE PIPE DIAMETER.

2. TOPSOIL AND SUBSOIL SHALL BE SEGREGATED WITHIN WETLAND, RESIDENTIAL, AGRICULTURAL, PASTURES, HAYFIELDS, AND OTHER AREAS AT LANDOWNER'S OR LAND MANAGING AGENCY'S REQUEST.

3. IF THE WORKING SIDE MUST BE GREATER THAN THE VALUES SHOWN IN THE TABLE, COMPANY MUST REQUEST APPROVAL FROM THE F.E.R.C.

TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT–OF–WAY (SINGLE LINE SYSTEM)

FIGURE #3

DWG. ES–0003 REV.

jwwhorley 01/22/2003
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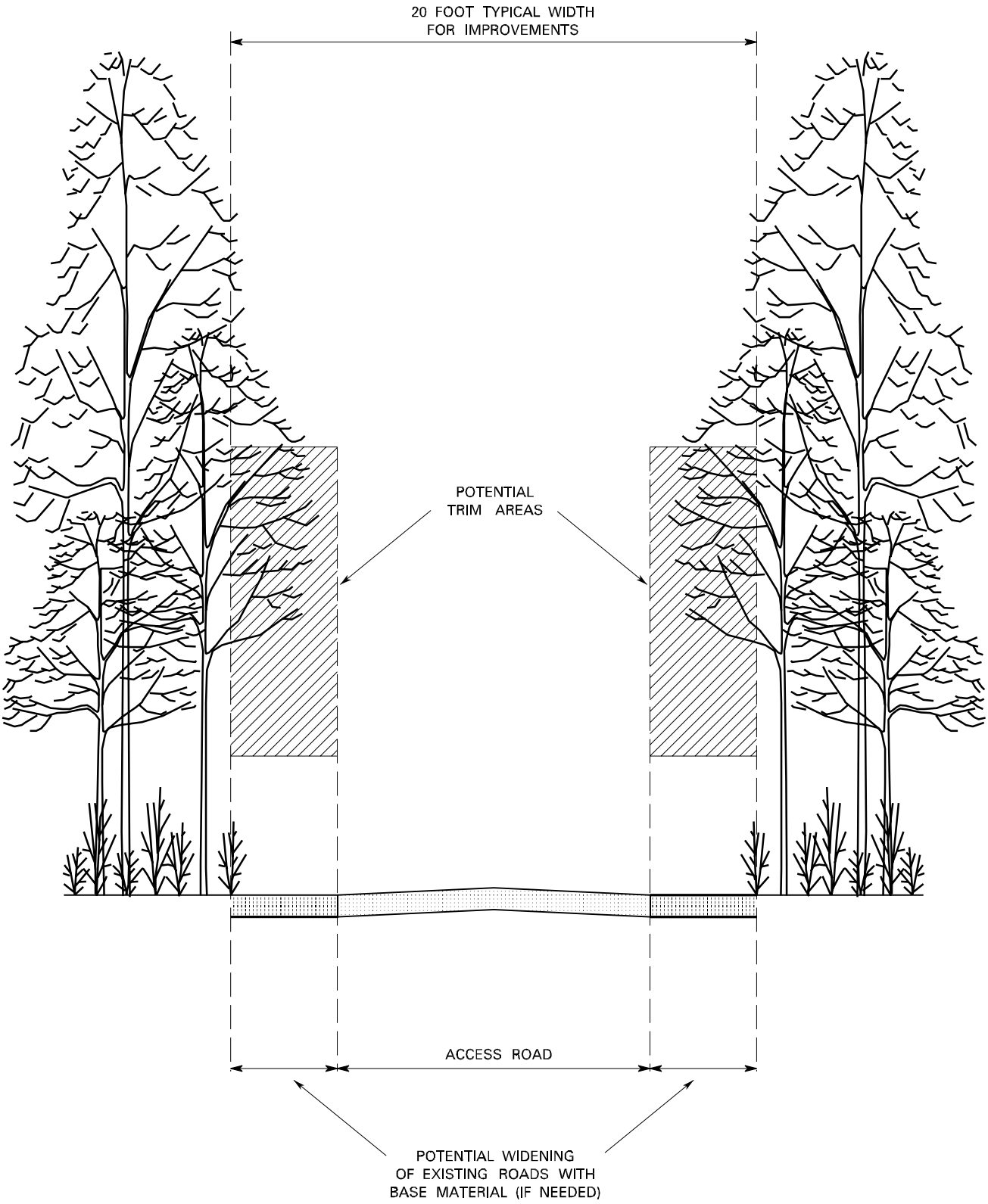

ACCESS ROAD CROSS SECTION

FIGURE #4

DWG. ES–0004

REV.

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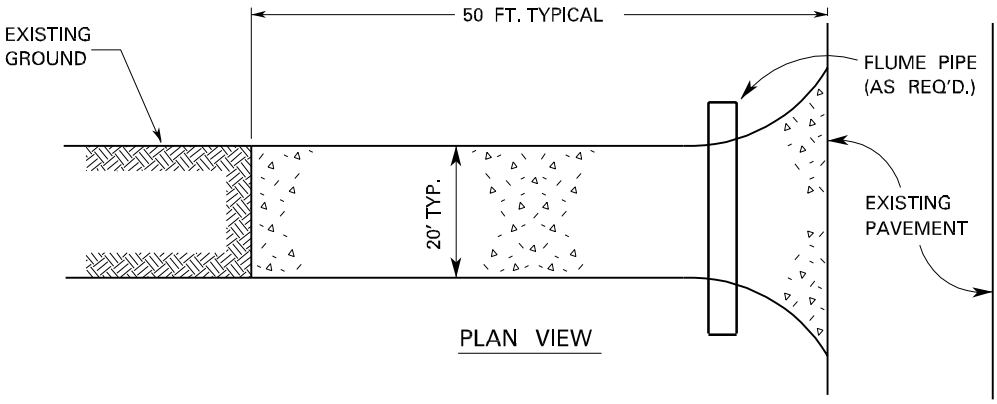
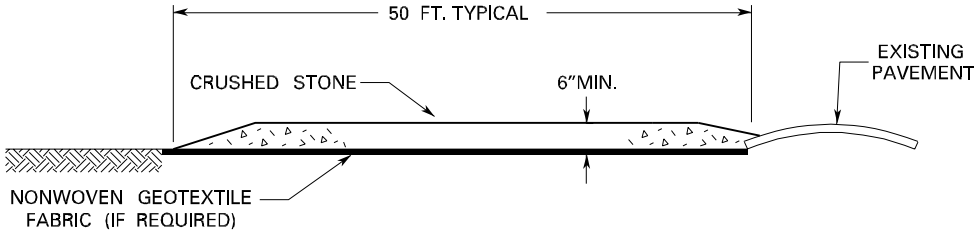


PLAN VIEW



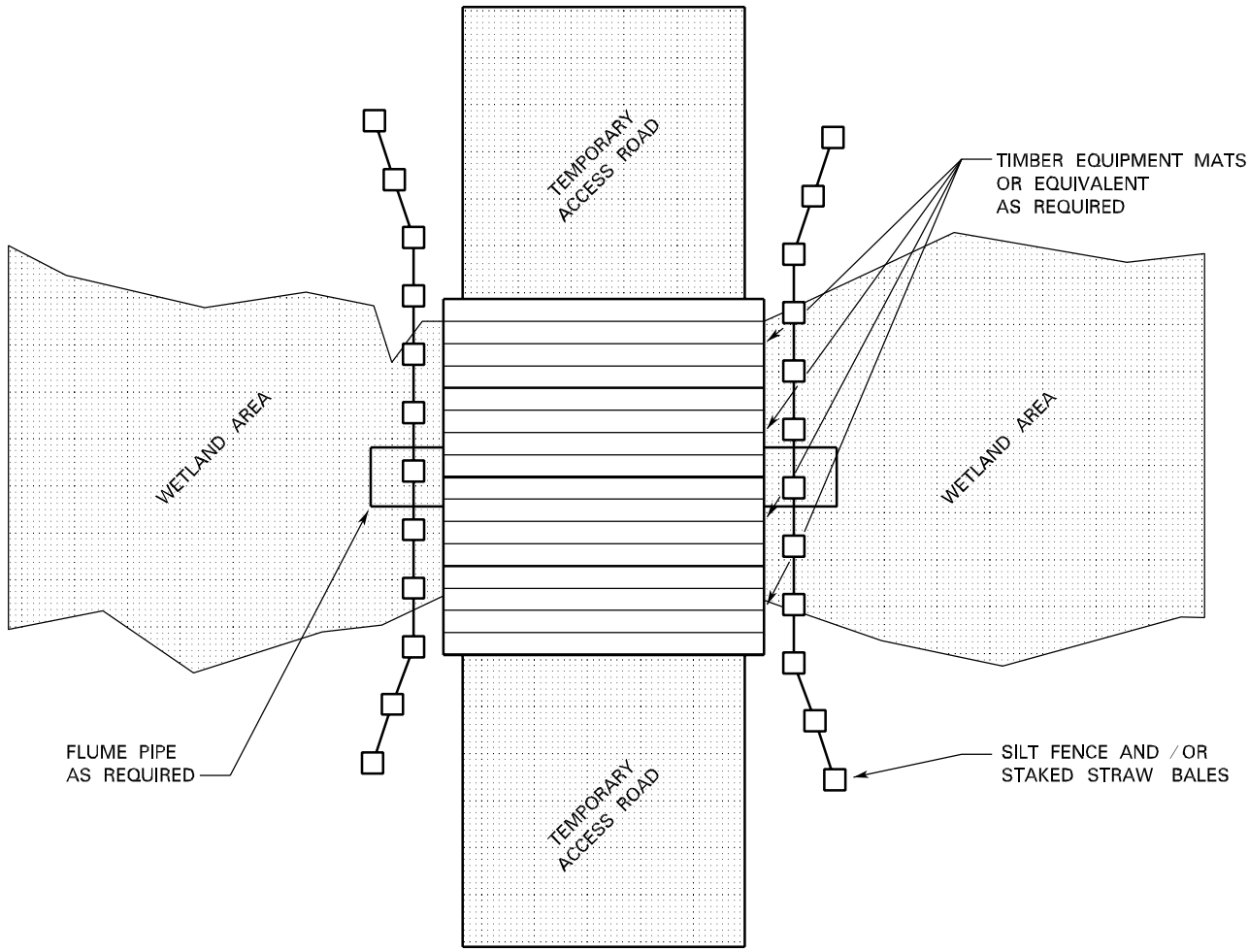
CROSS–SECTION

CONSTRUCTION SPECIFICATIONS:

1. STONE SIZE = 4" – 6" (AVG.) CRUSHED STONE
2. ALL STONE MUST BE PLACED ON NON–WOVEN GEOTEXILE FABRIC IF USED IN RESIDENTIAL OR ACTIVE AGRICULTURAL AREAS.
3. LENGTH = FIFTY (50) FOOT TYPICAL (IF SITE CONDITIONS ALLOW)
4. WIDTH = TWENTY (20) FOOT TYPICAL.
5. THICKNESS = SIX (6) INCHES MINIMUM.
6. ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A DRIVEABLE BERM OR OTHER TEMPORARY EROSION CONTROL DEVICE CAN BE USED.
7. THE ENTRANCE SHALL BE PERIODICALLY INSPECTED AND MAINTAINED IN A CONDITION THAT MINIMIZES TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS–OF–WAY. MAINTENANCE MAY INCLUDE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR THE REPAIR / CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ANY SEDIMENT THAT IS SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS–OF–WAY MUST BE REMOVED AS SOON AS PRACTICAL.

$$$$$USERNAME$$$$
$$$$$$SYTIME$$$$$
I.G.E SE0005. DGN

ROCK ACCESS PAD INSTALLATION AND MAINTENANCE	FIGURE #5	
	DWG. ES–0005	REV.



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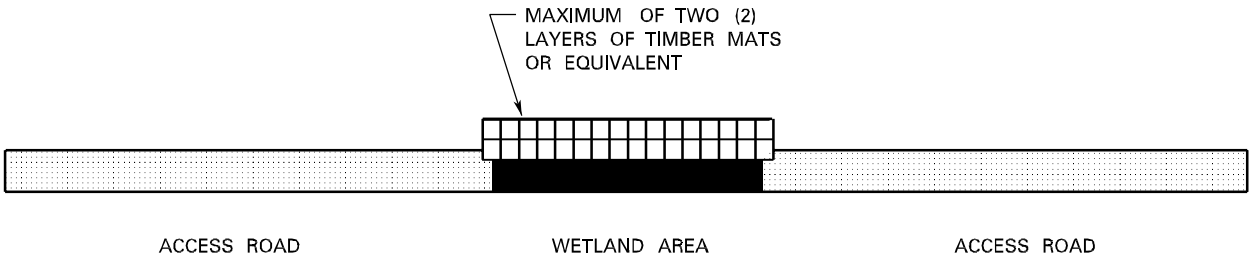

CROSS SECTION
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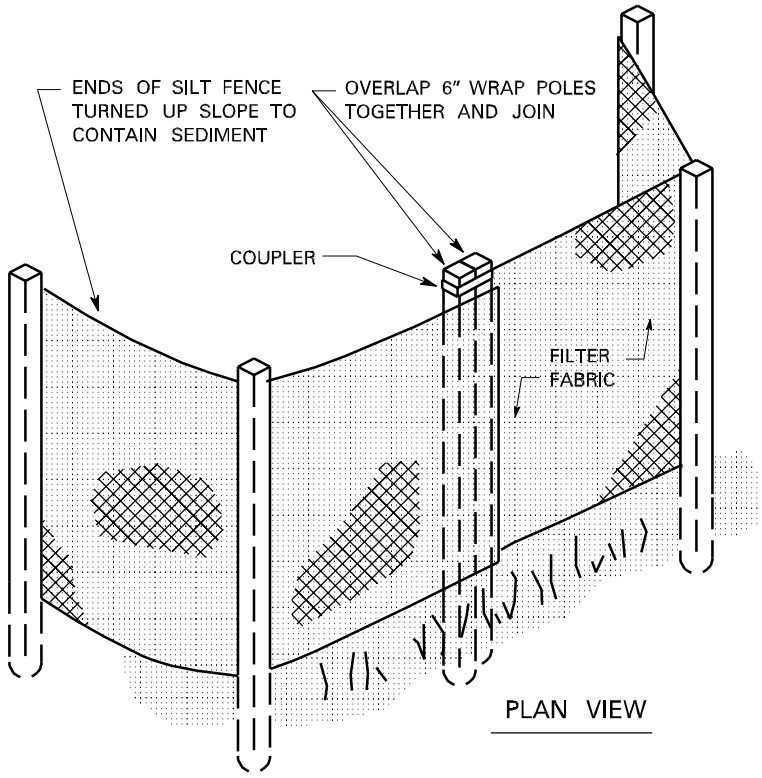
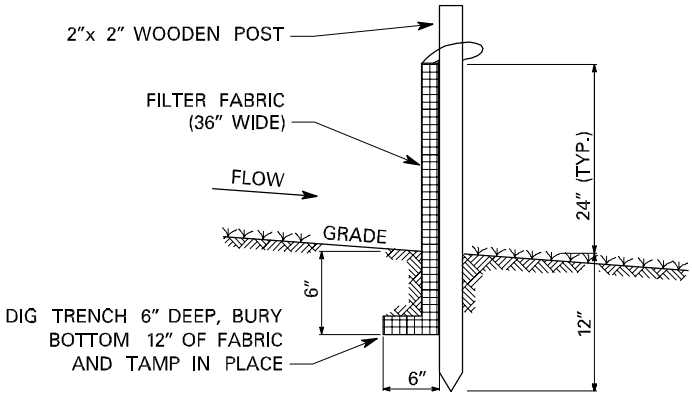
TYPICAL TEMPORARY ACCESS ROAD THROUGH WETLANDS

FIGURE #6

DWG. ES–0006 REV.



PLAN VIEW



CROSS SECTION

INSTALLATION REQUIREMENTS:

- WHEN USING SILT FENCE, PLACE IT:
  - BETWEEN DISTURBED AREAS AND DOWN-SLOPE ENVIRONMENTAL RESOURCE AREAS
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES
  - APPROXIMATELY 6 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT
- USE SANDBAGS OR BACKFILLING TO KEY IN THE BOTTOM OF THE FABRIC WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE ROOTS, ETC.)

MAINTENANCE REQUIREMENTS:

- INSPECT SILT FENCE:
  - DAILY IN AREAS OF ACTIVE CONSTRUCTION
  - WEEKLY IN AREAS WITH NO CONSTRUCTION
  - WITHIN 24 HOURS FOLLOWING EACH MAJOR STORM EVENT
- REPAIR OR REPLACE SILT FENCE AS NEEDED
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA AS NEEDED

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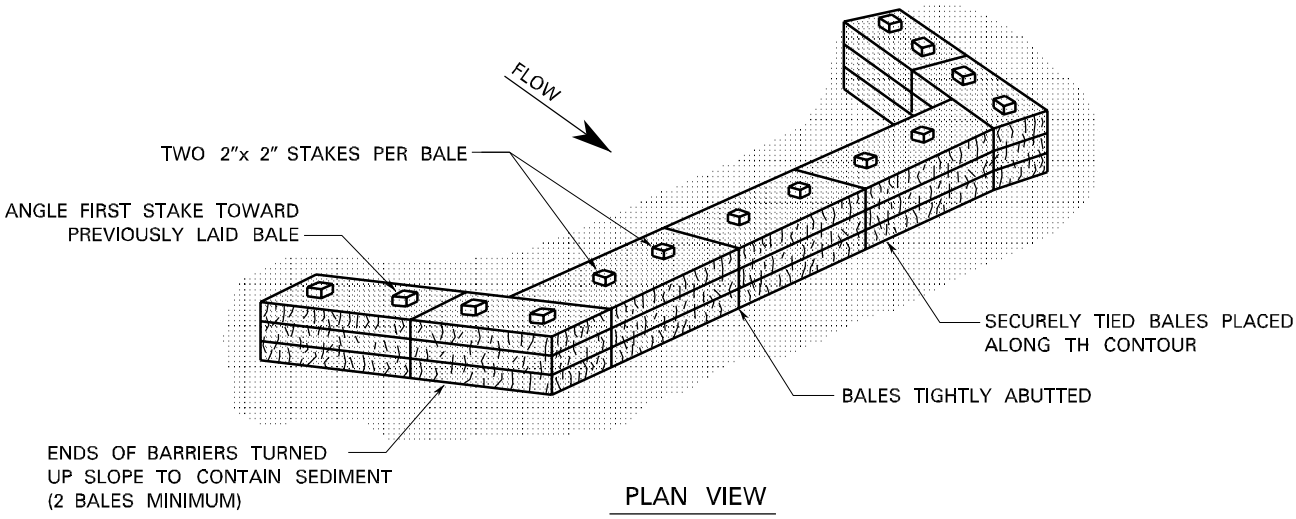
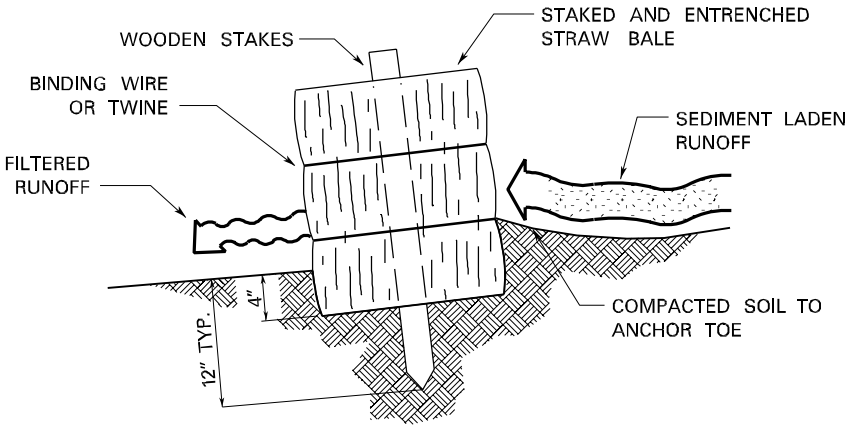
I.G. ESE0007.DGN

	SILT FENCE INSTALLATION AND MAINTENANCE	FIGURE #7
		DWG. ES–0007 REV.



PLAN VIEW



CROSS–SECTION

INSTALLATION REQUIREMENTS:

- WHEN USING STRAW BALES, PLACE THEM:
  - WITH THEIR ENDS TIGHTLY ABUTTING AND EMBEDDED IN THE SOIL A TYPICAL OF 4".
  - BETWEEN DISTURBED AREAS AND DOWN–SLOPE ENVIRONMENTAL RESOURCE AREAS.
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES.
  - APPROXIMATELY 6 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT.
- KEY IN THE BOTTOM OF THE BALE. IN AREAS WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE TREE ROOTS, ETC.), USE NATIVE SOIL AS BACKFILL UP–SLOPE OF THE BALE.
- IF USED IN CONJUNCTION WITH SILT FENCE, BALES ARE PLACED UPSLOPE OF THE SILT FENCE AND DO NOT NEED TO BE TRENCHED IN.

MAINTENANCE REQUIREMENTS:

- INSPECT BALES:
  - DAILY IN AREAS OF ACTIVE CONSTRUCTION.
  - WEEKLY IN AREAS WITH NO CONSTRUCTION.
  - WITHIN 24 HOURS FOLLOWING EACH MAJOR STORM EVENT.
- REPAIR OR REPLACE BALES AS NEEDED.
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA AS NEEDED.

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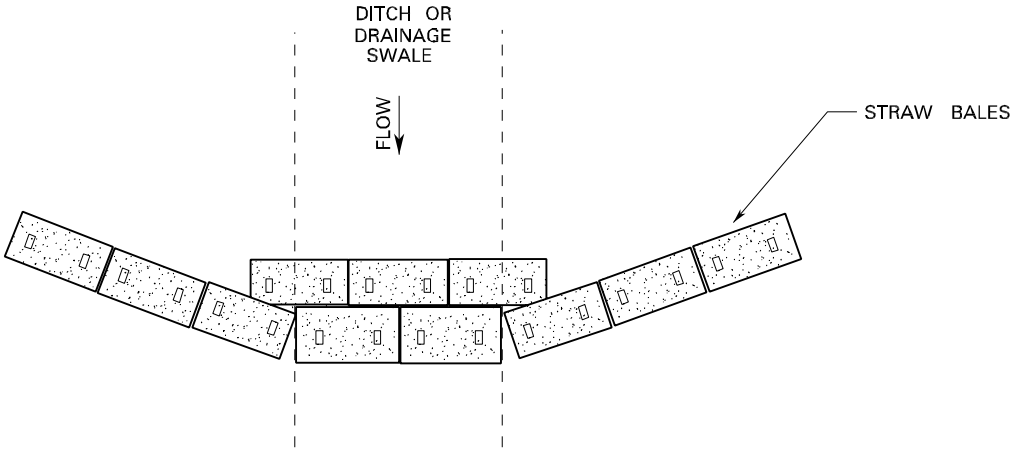
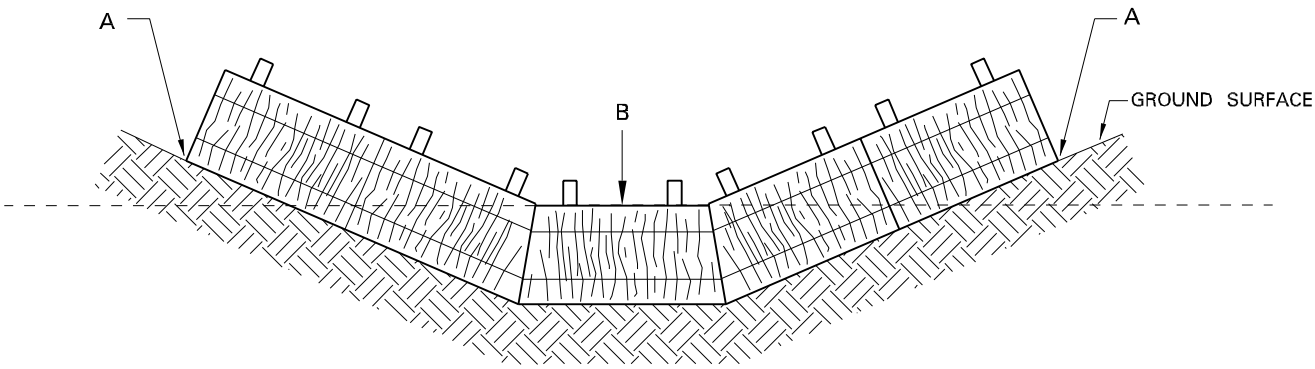
I.G. ESE0008.DGN

	STRAW BALE INSTALLATION AND MAINTENANCE	FIGURE #8
		DWG. ES–0008 REV.



PLAN VIEW
N.T.S.

POINTS A SHALL BE HIGHER THAN POINT B



CROSS–SECTION
N.T.S.

$$$$$USERNAME$$$$$
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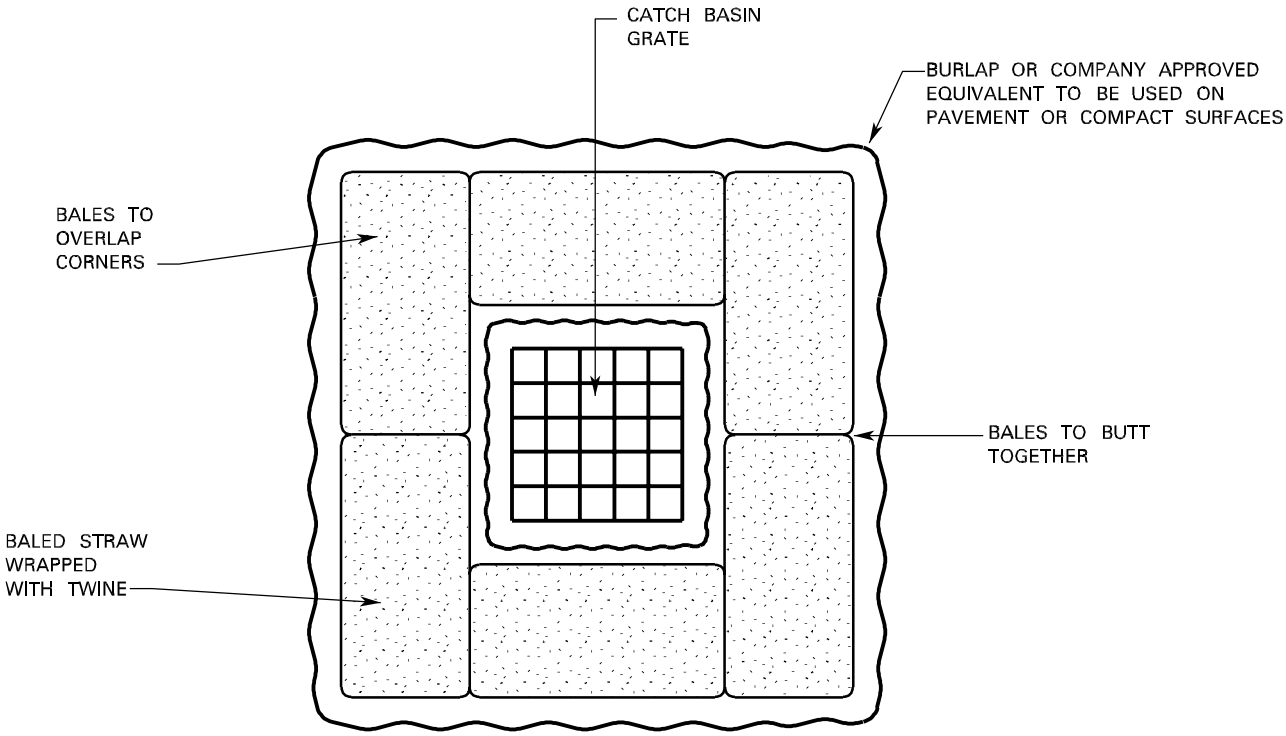
I.G.ESE0009.DGN

	STRAW BALE INSTALLATION FOR A CHECK DAM IN A DRAINAGE WAY	FIGURE #9
		DWG. ES–0009 REV.



1. SURROUND STREET DRAINAGE STRUCTURE INLET WITH BALES PRIOR TO CONSTRUCTION AND MAINTAIN UNTIL CONSTRUCTION IS COMPLETED.

2. FOR BALES PLACED ON PAVEMENT (OR COMPACT SURFACES), PLACE BURLAP OR COMPANY APPROVED EQUIVALENT BETWEEN PAVEMENT AND BALE.

3. REMOVE ACCUMULATED SEDIMENT.

$$$$$USERNAME$$$$$
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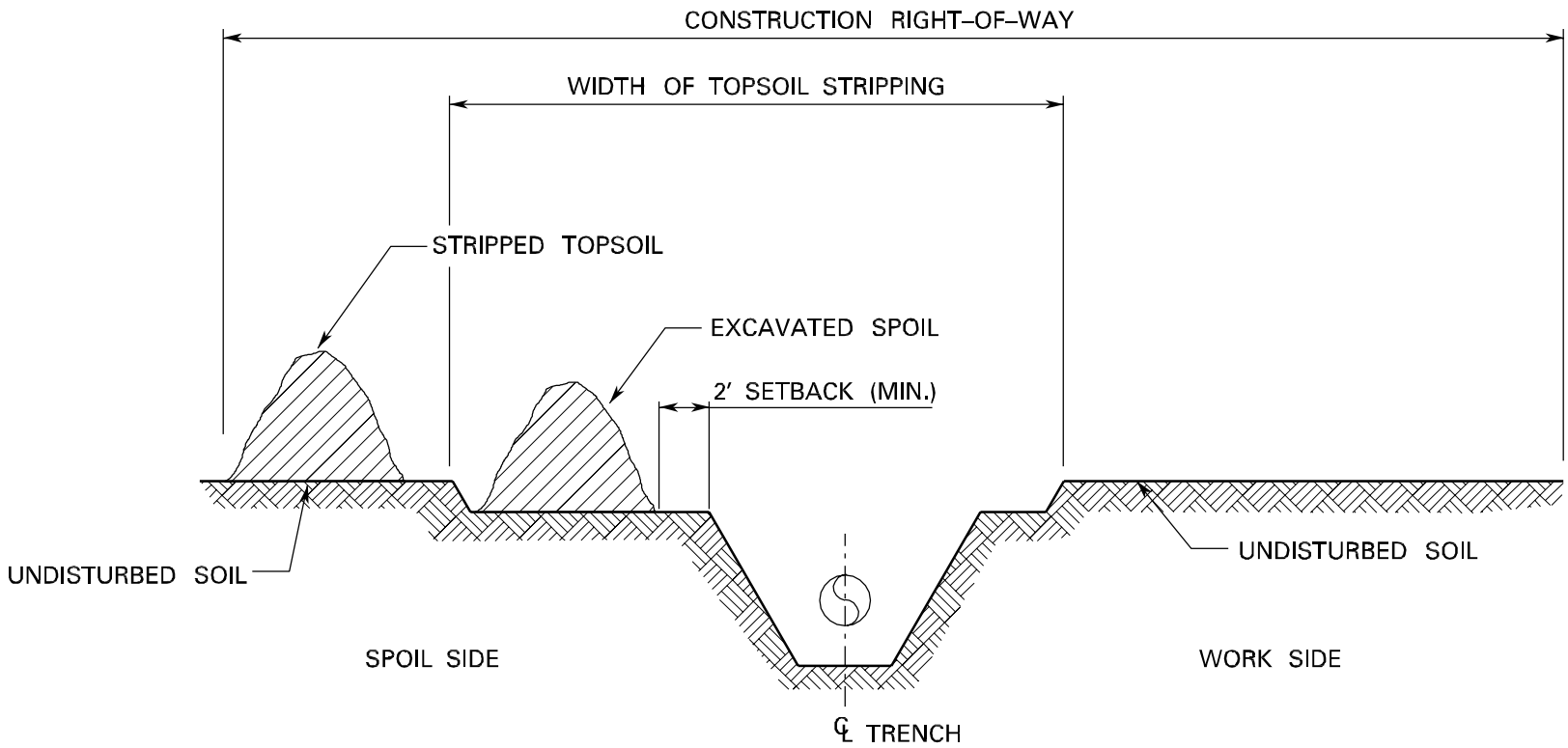
I.G. ESE0010.DGN

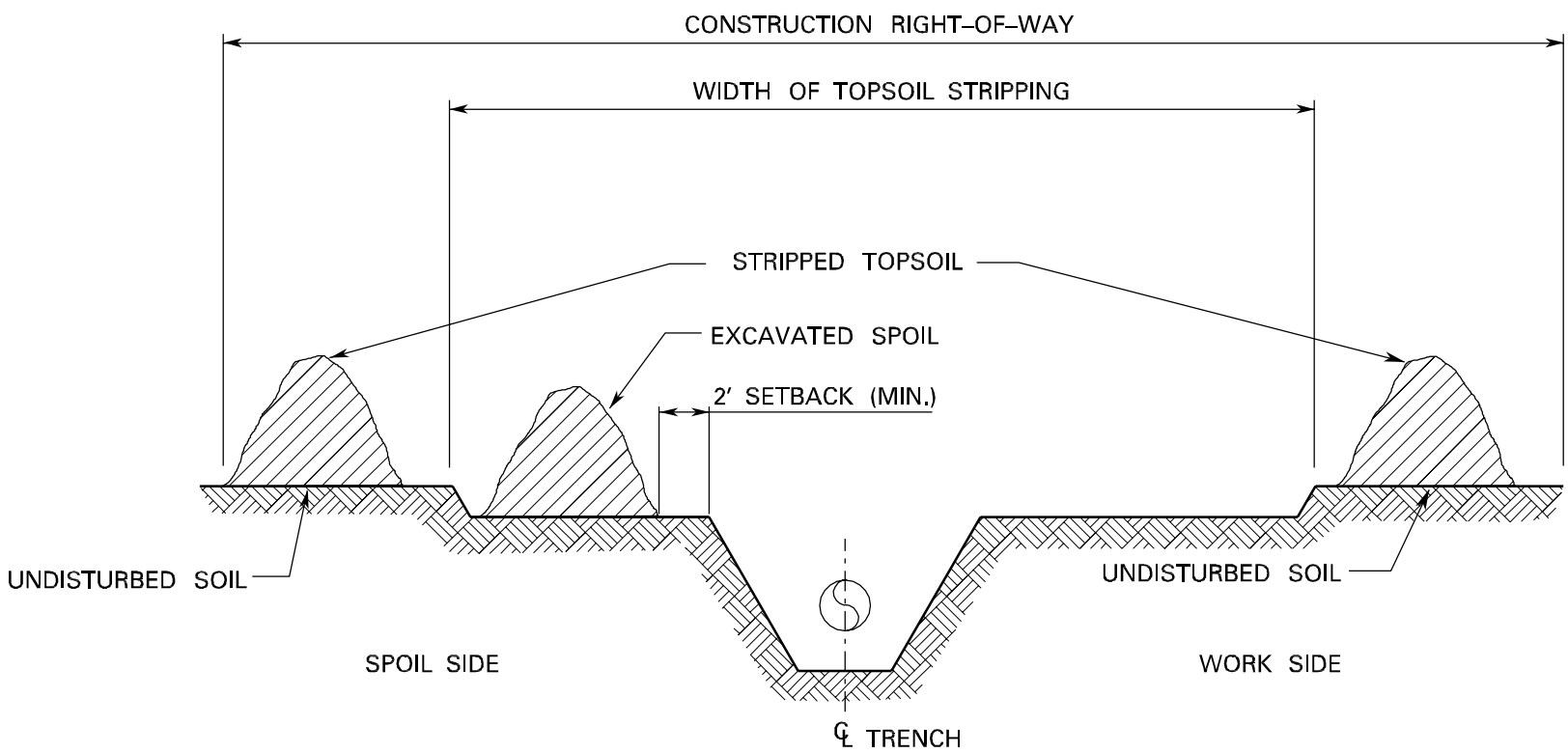
STORM DRAIN INLET PROTECTION

FIGURE #10

DWG. ES–0010 REV.



DITCH PLUS SPOILSIDE TOPSOIL SEGREGATION



FULL RIGHT-OF-WAY TOPSOIL STRIPPING

NOTES:

1. TOPSOIL MAY BE STORED IN LOCATIONS AS SHOWN ABOVE, OR AT OTHER COMPANY APPROVED LOCATIONS WITHIN THE CONSTRUCTION R.O.W.

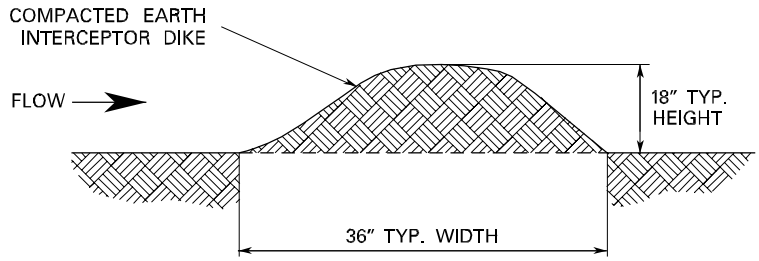
2. LEAVE GAPS IN SPOIL PILES FOR WATER RUN-OFF.

3. R.O.W. MAY BE EXPANDED UP TO 25' IN NON WETLAND AREAS FOR FULL R.O.W. TOPSOIL SALVAGE.

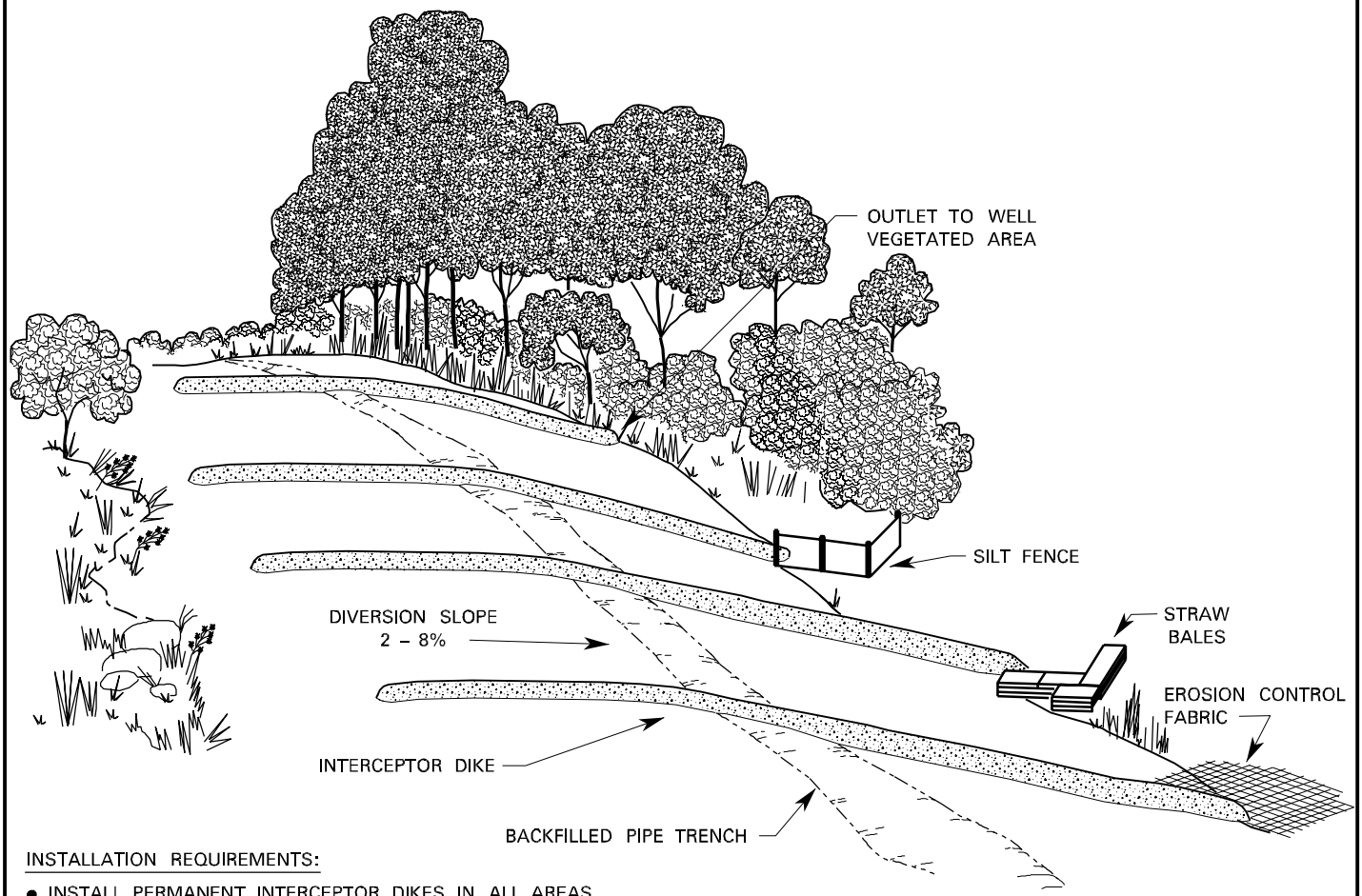
jwwhorley 01/22/2003

I.G. ESE0011.DGN

	R.O.W. TOPSOIL SEGREGATION TECHNIQUES	FIGURE #11
		DWG. ES-0011 REV.



CROSS SECTION



INSTALLATION REQUIREMENTS:

- INSTALL PERMANENT INTERCEPTOR DIKES IN ALL AREAS EXCEPT RESIDENTIAL OR AGRICULTURAL AS NECESSARY TO AVOID EXCESSIVE EROSION (UNLESS AUTHORIZED BY LANDOWNER OR LAND MANAGING AGENCY IN AGRICULTURAL OR RESIDENTIAL AREA).
- MUST BE INSTALLED ON SLOPES GREATER THAN 5% WHERE THE BASE OF THE SLOPE IS LESS THAN 50 FEET FROM A WATERBODY, WETLAND OR ROAD CROSSING AT THE FOLLOWING MINIMUM SPACING:

SLOPE (%)	SPACING (FT.)
5 – 15	300
>15 – 30	200
>30	100

- CONSTRUCT USING EARTH FILLED SACKS, STAKED STRAW BALES, SILT FENCE, OR SOIL FOR TEMPORARY OR COMPACTED EARTH AND ROCK FOR PERMANENT
- INSTALL WITH A 2 – 8% OUTFALL ANGLE.
- POSITION OUTFALL TO PREVENT SEDIMENT DISCHARGE INTO WETLANDS, WATERBODIES, OR OTHER SENSITIVE RESOURCES.
- FILTER RUN-OFF WATER BY CONSTRUCTING THE OUTLET IN A WELL VEGETATED STABLE AREA, OR BY USING AN ENERGY DISSIPATING DEVICE (SILT FENCE, STRAW BALES, EROSION CONTROL FABRIC), AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

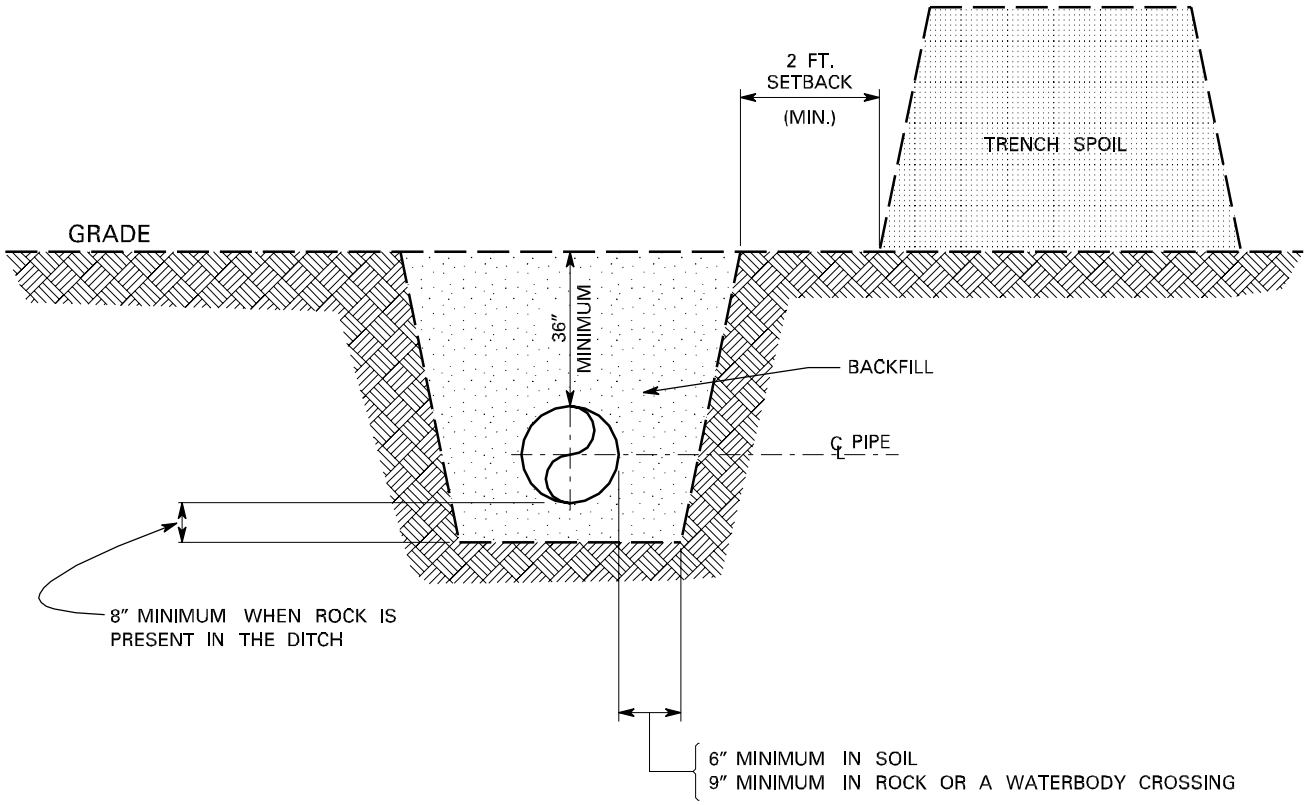
MAINTENANCE REQUIREMENTS:

- INSPECT DURING AND FOLLOWING CONSTRUCTION AND MAKE REPAIRS AS NEEDED.
- KEEP THE CHANNEL FREE OF DEBRIS AND OBSTRUCTIONS.
- SEED AND MULCH PERMANENT INTERCEPTOR DIKES FOLLOWING CONSTRUCTION.

tcsmith
02/18/2003

I.G. ESE0012.DGN

	INTERCEPTOR DIKE INSTALLATION AND MAINTENANCE	FIGURE #12
		DWG. ES–0012 REV.



CROSS–SECTION VIEW OF TYPICAL TRENCH

NOTES:

1. ALL ORIGINAL CONTOURS WILL BE RE–ESTABLISHED UPON COMPLETION OF PIPE INSTALLATION. EXCEPT IN WETLANDS, A CROWN MAY BE LEFT TO ACCOUNT FOR DITCH SETTLING, AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

2. IN COLD WATER FISHERY STREAMS, THE TOP 12" OF THE TRENCH WILL BE BACKFILLED WITH CLEAN GRAVEL OR NATIVE COBBLES.

	TYPICAL TRENCH DETAIL	FIGURE #13
		DWG. ES–0013 REV.

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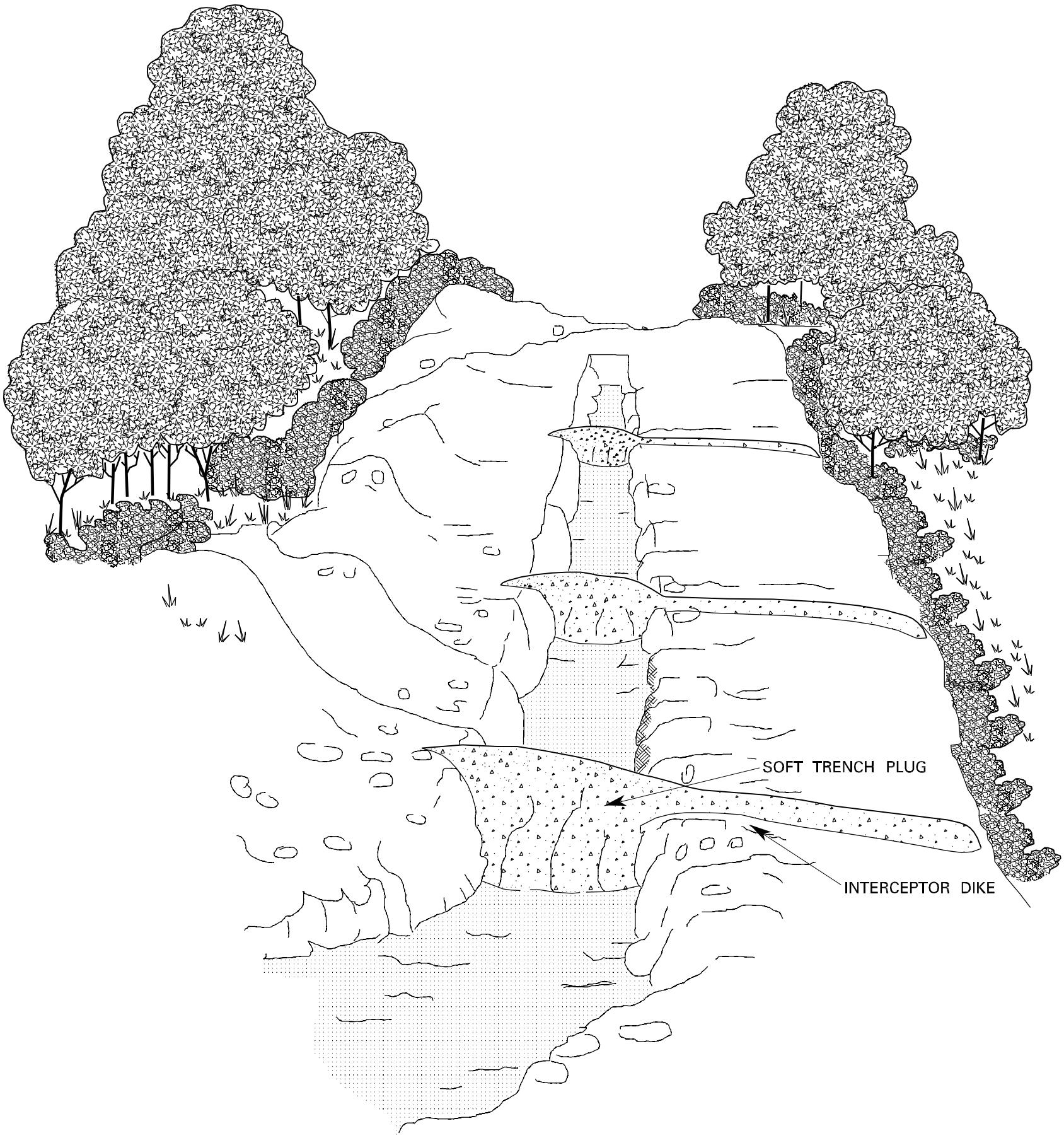
I.G. ESE0013.DGN



NOTES:

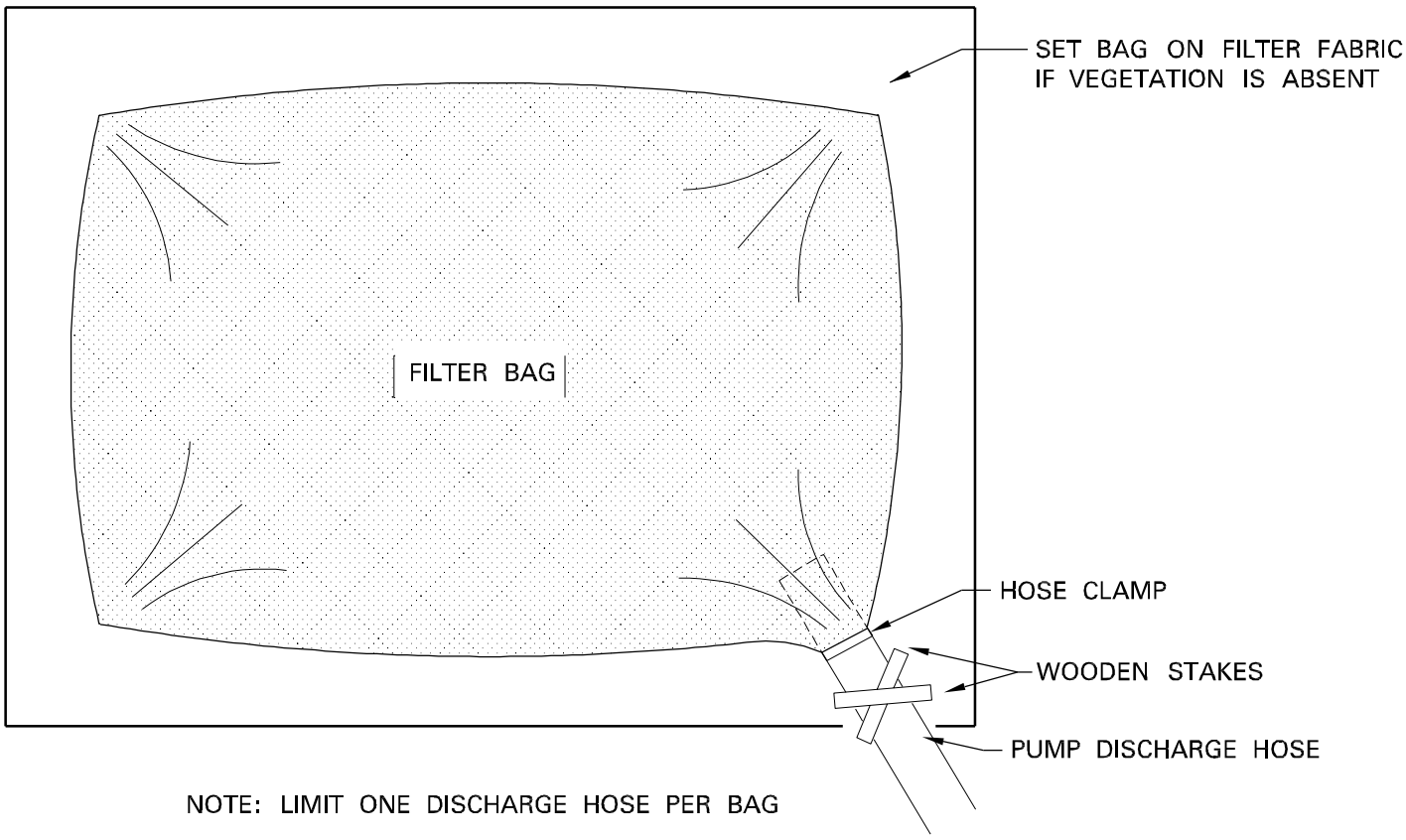
1. TEMPORARY TRENCH PLUGS MAY BE USED IN CONJUNCTION WITH INTERCEPTOR DIKES TO PREVENT WATER FROM OVERFLOWING INTO SENSITIVE RESOURCE AREAS.

2. DIVERT TRENCH OVERFLOW TO A WELL-VEGETATED OFF-R.O.W. LOCATION OR INSTALL APPROPRIATE ENERGY DISSIPATING DEVICE.

	TEMPORARY TRENCH PLUGS	FIGURE #14
		DWG. ES-0014 REV.

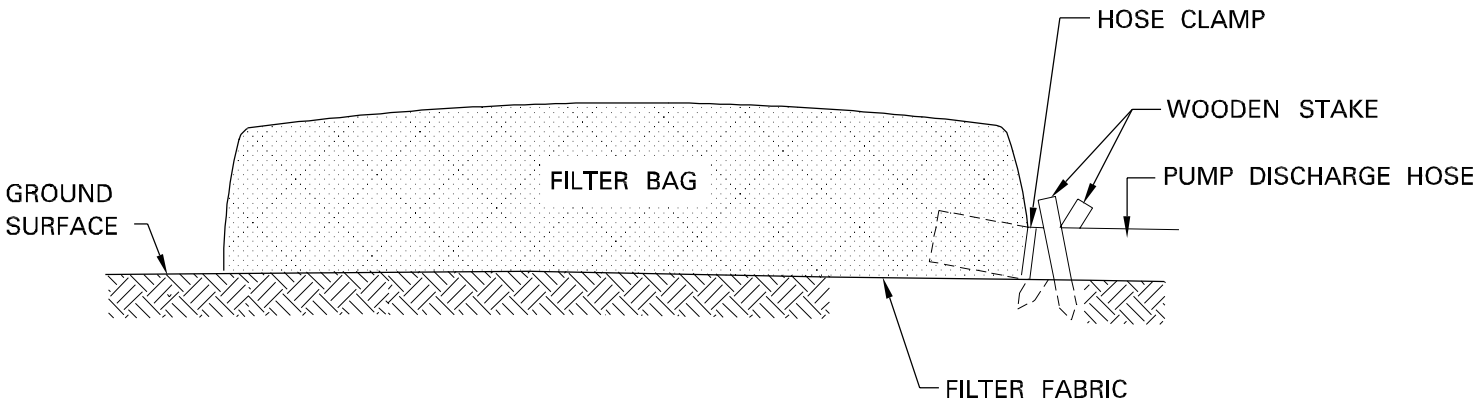
jwwhorley 01/22/2003

I.G. ESE0014.DGN



NOTE: LIMIT ONE DISCHARGE HOSE PER BAG

PLAN VIEW



CROSS-SECTION

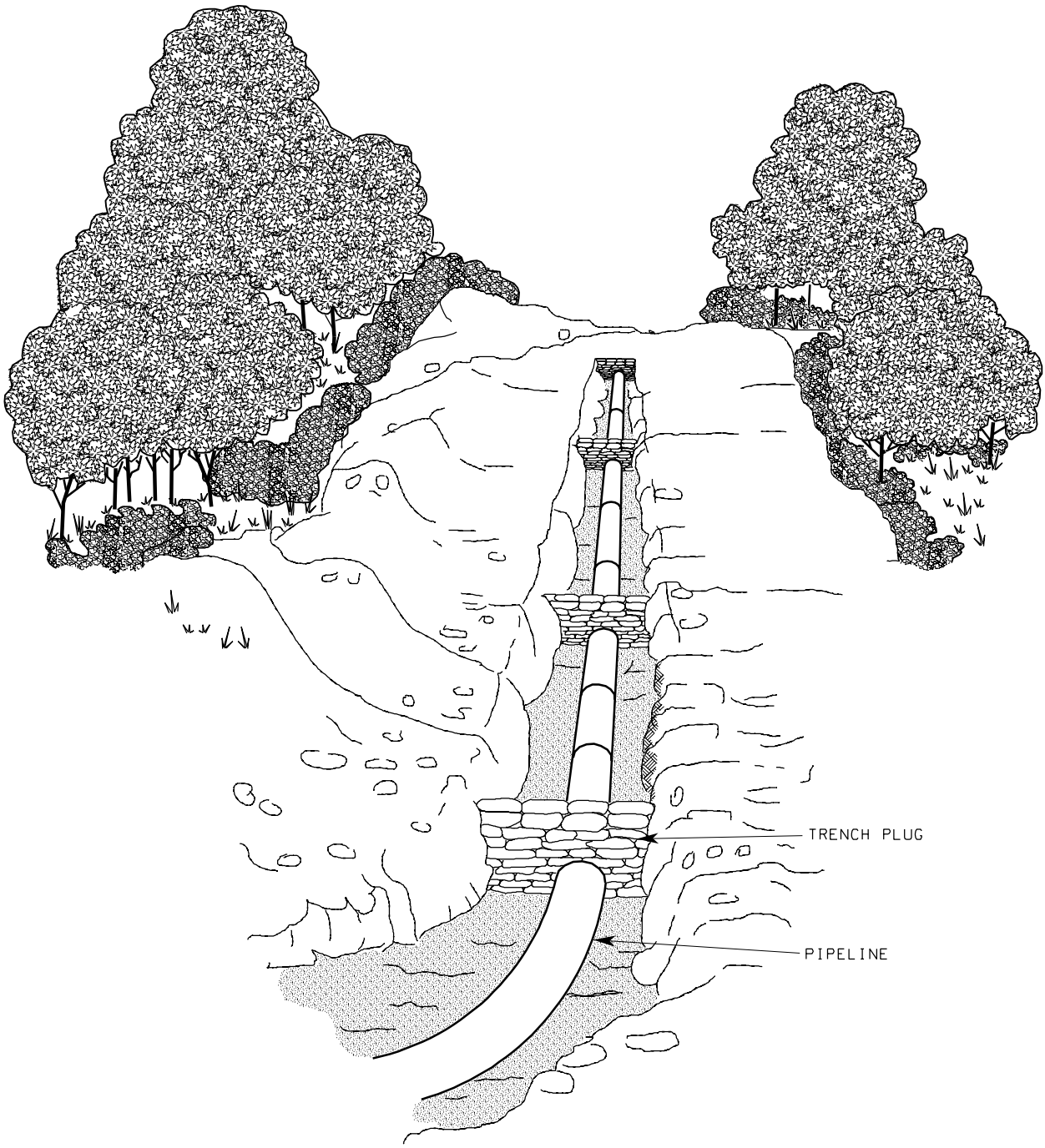
NOTES:

1. REMOVE DEWATERING STRUCTURE AS SOON AS POSSIBLE AFTER COMPLETION OF DEWATERING ACTIVITIES.

jwwhorley
01/22/2003

I.G. ESE0015.dgn

	FILTER BAG	FIGURE #15
		DWG. ES-0015 REV.



SLOPE (%)	SPACING (FT)
5–15	300
>15–30	200
>30	100

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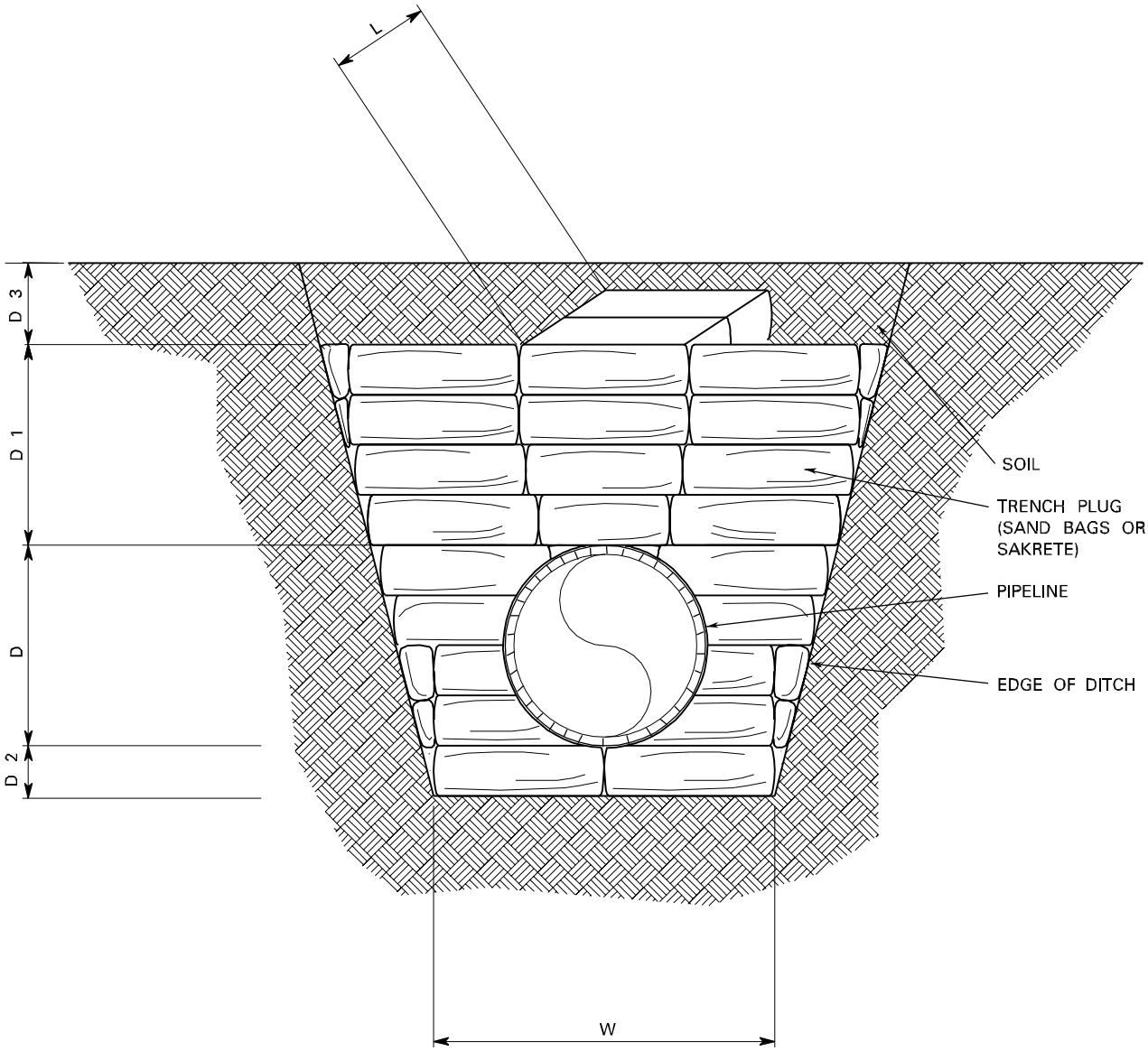
$$$$$$SYTIME$$$$$

I.G. ESE0016.DGN

PERMANENT TRENCH PLUGS

FIGURE #16

DWG. ES–0016 REV.



D = PIPE DIAMETER
D1 = APPROXIMATELY 24"
D2 = APPROXIMATELY 6" (8" MIN. IN ROCK)
D3 = APPROXIMATELY 12"
W = D + 2 to 4 FEET
L = APPROXIMATELY 18" – 24"
D1 + D3 = 36" MINIMUM

NOTE:

USE OF SAKRETE SHALL REQUIRE PRIOR COMPANY APPROVAL.

	TRENCH PLUG DETAIL	FIGURE #17
		DWG. ES–0017 REV.

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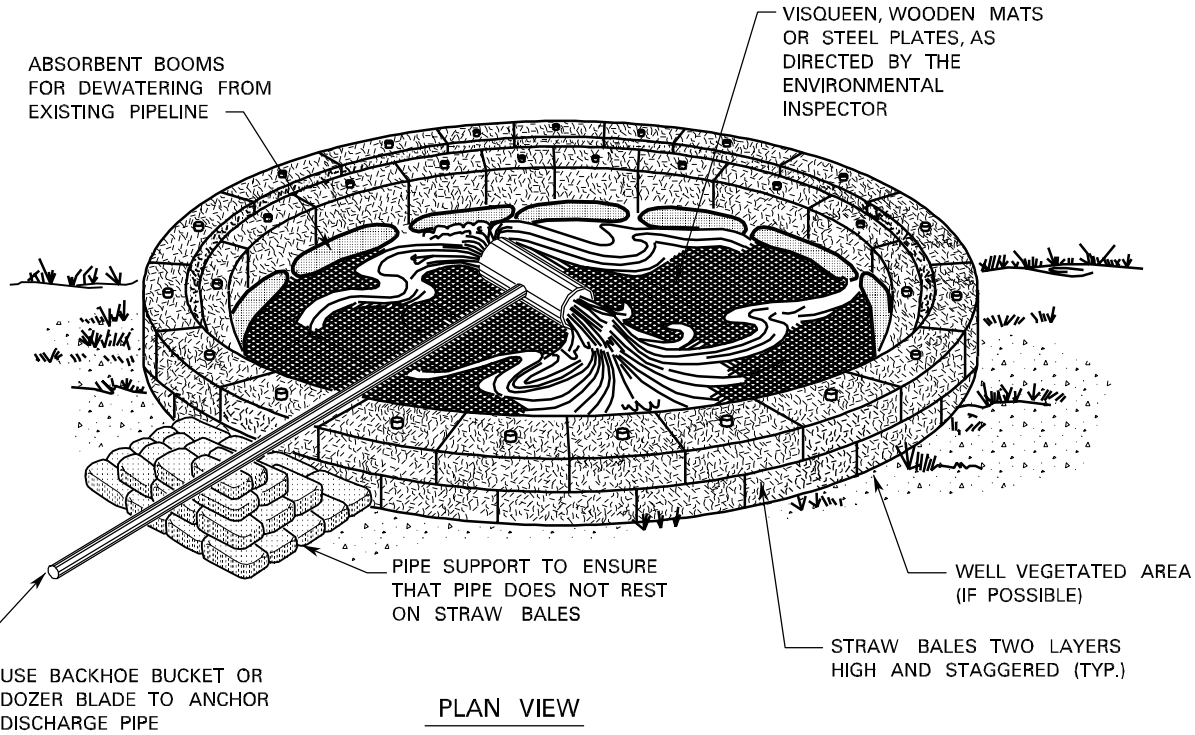
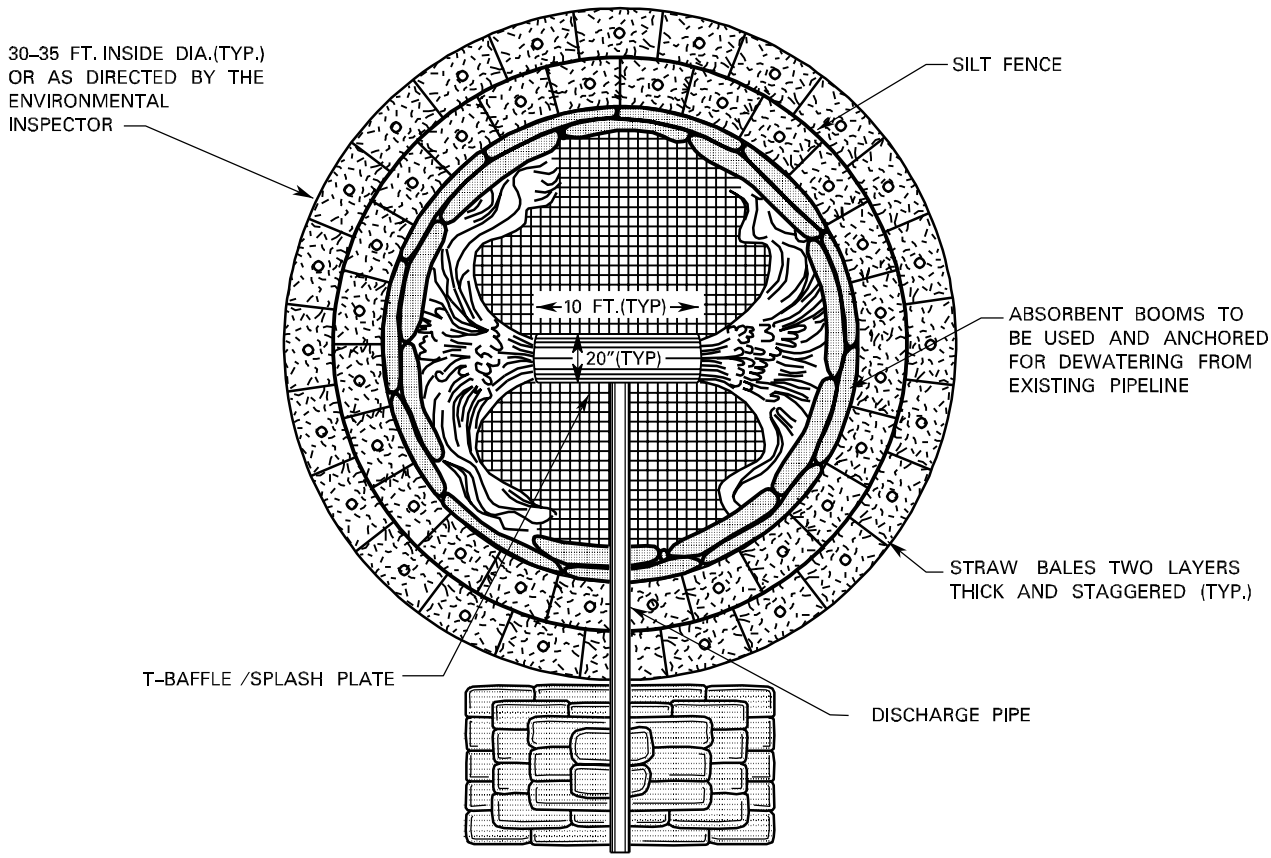
$$$$$$SYTIME$$$$$
I.G. ESE0017.DGN



PLAN VIEW

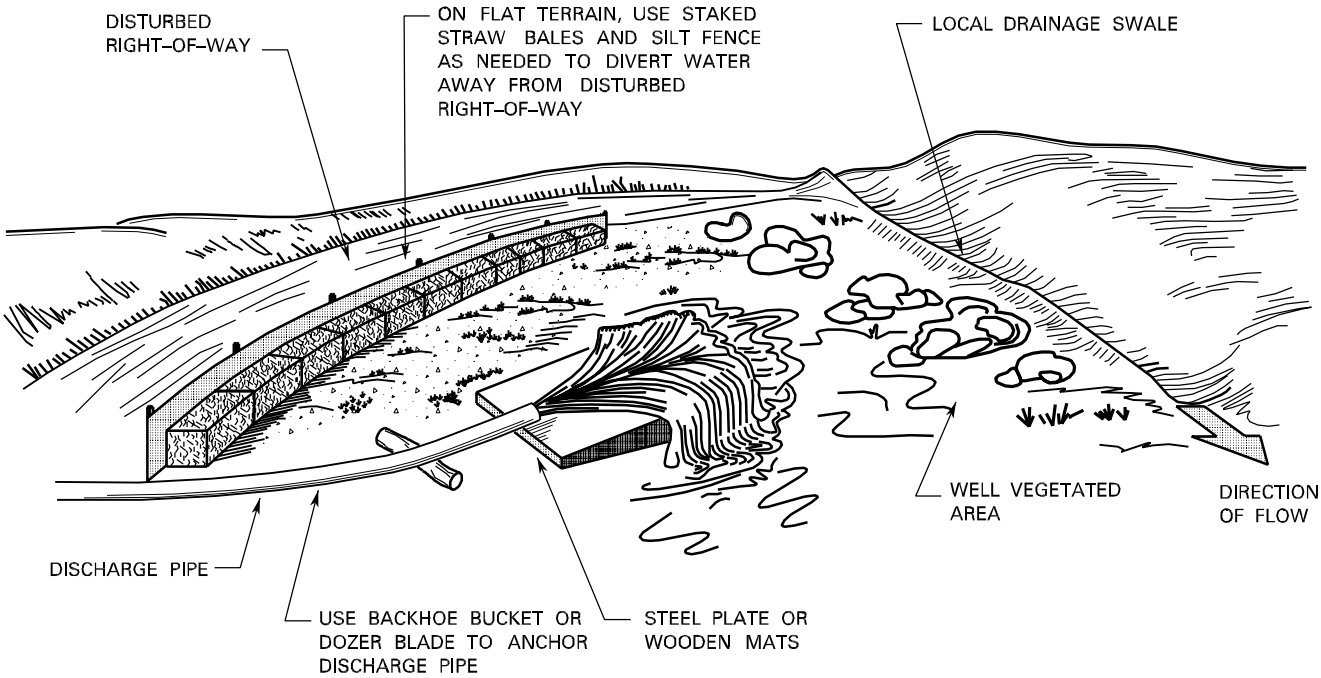


TOP VIEW

$$$$$USERNAME$$$$
$$$$$$SYTIME$$$$$

I.G. ESE0018.DGN

DEWATERING STRUCTURE FOR HYDROSTATIC TESTING	FIGURE #18	
	DWG. ES–0018	REV.



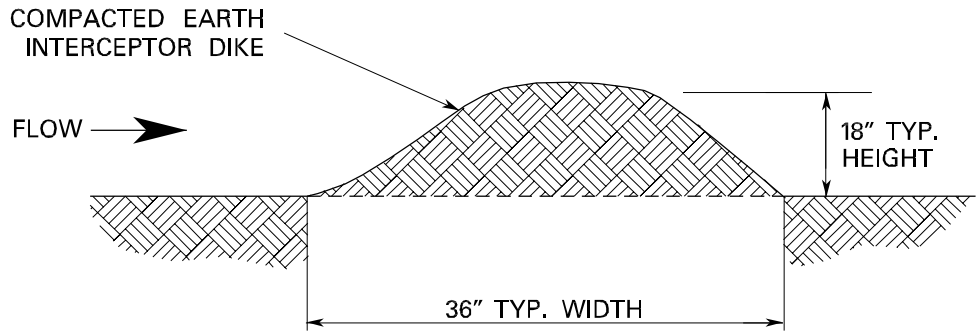
NOTE:

1. THIS DEWATERING STRUCTURE CAN ONLY BE USED FOR SMALL DISCHARGES FROM NEW PIPELINES WHEN A HYDROSTATIC TEST PACKAGE HAS NOT BEEN ISSUED. IT IS SUBJECT TO APPROVAL BY THE ENVIRONMENTAL INSPECTOR.

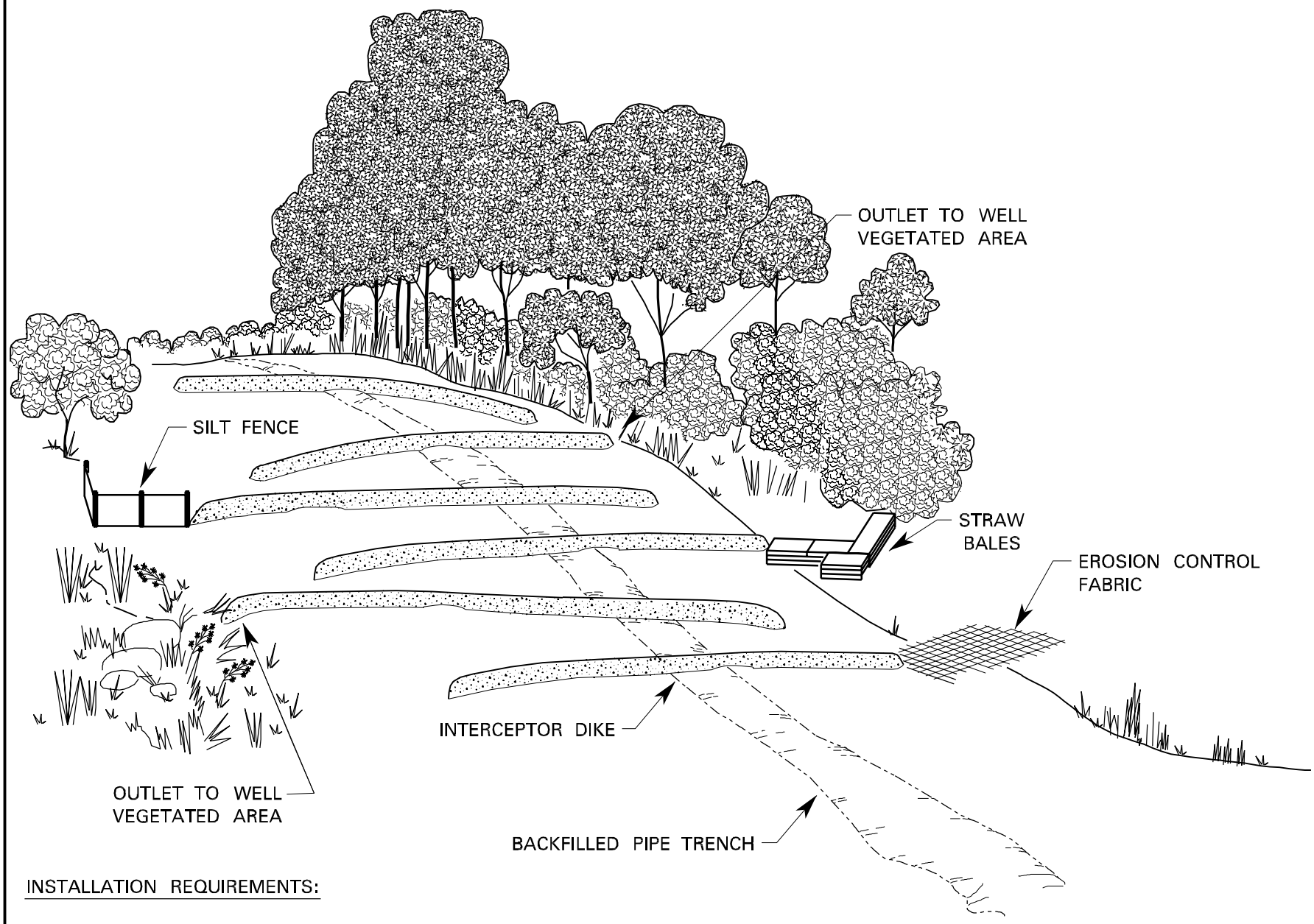
$$$$$USERNAME$$$$$
$$$$$$SYTIME$$$$$$

I.G. ESE0019.DGN

ALTERNATE DEWATERING STRUCTURE FOR HYDROSTATIC TESTING	FIGURE #19	
	DWG. ES–0019	REV.



CROSS SECTION



INSTALLATION REQUIREMENTS:

- INSTALL IN ALL AREAS EXCEPT RESIDENTIAL OR AGRICULTURAL (UNLESS AUTHORIZED BY LANDOWNER OR LAND MANAGING AGENCY).
- CONSTRUCT USING EARTH FILLED SACKS OR STAKED STRAW BALES FOR TEMPORARY OR COMPACTED EARTH AND ROCK FOR PERMANENT.
- INSTALL WITH A 2 – 8% OUTFALL ANGLE.
- FOR TEMPORARY CHEVRON INTERCEPTOR DIKES, POSITION OUTFALL TO PREVENT SEDIMENT DISCHARGE INTO WETLANDS, WATERBODIES, OR OTHER SENSITIVE RESOURCES.
- FILTER RUN–OFF WATER BY CONSTRUCTING AN OUTLET USING AN ENERGY DISSIPATING DEVICE (SILT FENCE, STRAW BALES, EROSION CONTROL FABRIC), AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

MAINTENANCE REQUIREMENTS:

- INSPECT DURING AND FOLLOWING CONSTRUCTION AND MAKE REPAIRS AS NEEDED.
- KEEP THE CHANNEL FREE OF DEBRIS AND OBSTRUCTIONS.
- SEED AND MULCH PERMANENT INTERCEPTOR DIKES FOLLOWING CONSTRUCTION.

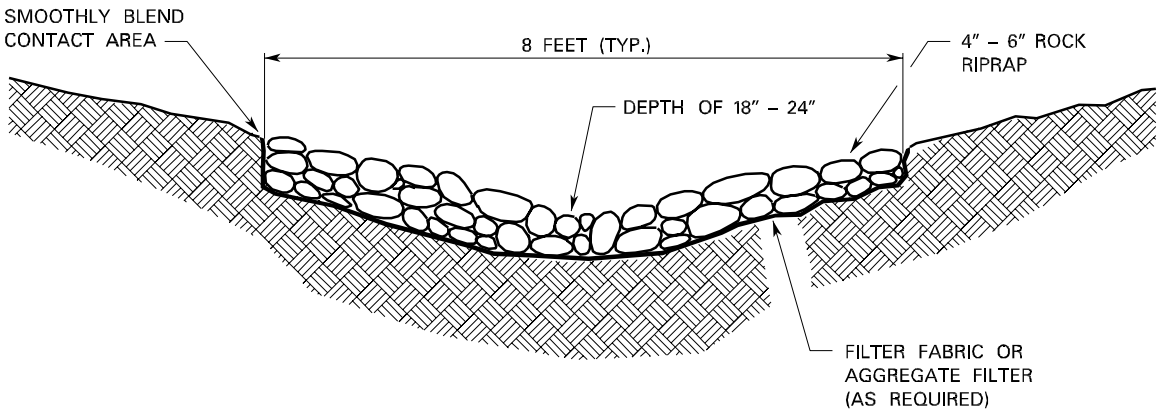
jwwhorley
01/22/2003

I.G. ESE0020.DGN

CHEVRON INTERCEPTOR DIKE
INSTALLATION AND MAINTENANCE

FIGURE #20

DWG. ES–0020 REV.



INSTALLATION REQUIREMENTS:

1. RIPRAP CHANNELS CAN BE CONSTRUCTED WITH GRASS–LINED SLOPES WHERE SITE CONDITIONS WARRANT.
2. STABILIZE CHANNEL INLET POINTS AND INSTALL OUTLET PROTECTION (AS NEEDED) DURING CHANNEL INSTALLATION.
3. INSTALL ENERGY DISSIPATING DEVICE (AS NEEDED) TO PREVENT SCOUR TO THE RECEIVING OUTLET.
4. REMOVE ALL TREES, BRUSH, AND OTHER OBJECTIONABLE MATERIAL FROM THE CHANNEL.
5. INSTALL FILTER FABRIC OR GRAVEL LAYER TO PREVENT PIPING (AS REQUIRED)

MAINTENANCE REQUIREMENTS:

1. INSPECT CHANNEL DURING AND FOLLOWING CONSTRUCTION AND MAKE REPAIRS AS NEEDED.
2. KEEP THE CHANNEL FREE OF DEBRIS AND OBSTRUCTIONS.

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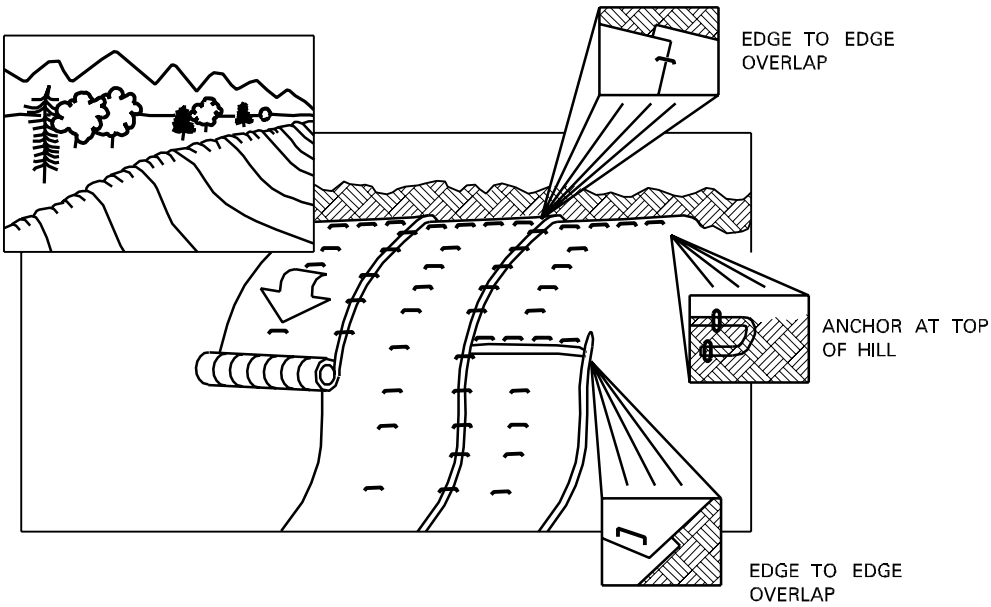
I.G. ESE0021.DGN

ROCK LINED DRAINAGE SWALE
INSTALLATION AND MAINTENANCE

FIGURE #21

DWG. ES–0021 REV.



NOTES:

1. EROSION CONTROL MATTING (BLANKETS) SHALL BE USED AT LOCATIONS IDENTIFIED IN THE PLAN AND/OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

2. EROSION CONTROL MATTING SHALL MEET THE REQUIREMENTS SPECIFIED IN THE PLAN AND/OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

3. STAPLES SHALL BE MADE OF 11 GAUGE WIRE, U-SHAPED WITH 6" LEGS AND A 1" CROWN. STAPLES SHALL BE DRIVEN INTO THE GROUND FOR THE FULL LENGTH OF THE STAPLE LEGS.

4. MATTING SHALL BE INSTALLED ACCORDING TO MANUFACTURER SPECIFICATIONS OR AS STATED BELOW:

   - EXTEND TOP OF BLANKET 3 FEET PAST THE UPPER EDGE OF THE SLOPE.
   - ANCHOR ("KEY") THE UPPER EDGE OF THE BLANKET INTO THE SLOPE USING A 6" DEEP TRENCH AND ROLL THE BLANKET DOWN THE HILL. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING TRENCH.
   - AVOID STRETCHING EROSION CONTROL MATTING (LOOSELY) DURING INSTALLATION.
   - BRING MAT ROLL BACK OVER THE TOP OF THE TRENCH AND CONTINUE TO ROLL DOWN SLOPE. STAPLE EVERY 12" WHERE MAT EXITS THE TRENCH AT THE TOP OF THE SLOPE.
   - WHEN BLANKETS ARE SPLICED DOWN-SLOPE TO ADJOINING MATS (SLOPE OR STREAM BANK MATS), THE UPPER BLANKET SHALL BE PLACED OVER THE LOWER MAT (SHINGLE STYLE) WITH APPROXIMATELY 6" OF OVERLAP. STAPLE THROUGH THE OVERLAPPED AREA EVERY 12".
   - OVERLAP ADJACENT BLANKETS 6". STAPLE EDGES OF BLANKETS AND CENTER EVERY 36".

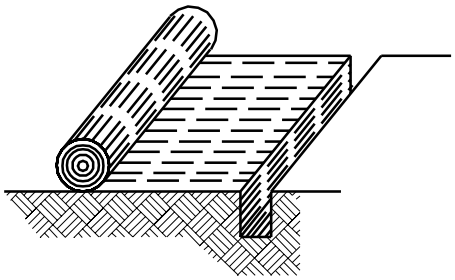
5. IN LIVESTOCK AREAS WHERE EROSION CONTROL MATTING IS APPLIED TO THE SLOPES, FENCING WILL BE USED IF NECESSARY TO EXCLUDE LIVESTOCK, WITH PERMISSION OF THE LANDOWNER.

6. MONITOR WASHOUTS, STAPLE INTEGRITY OR MAT MOVEMENT. REPLACE OR REPAIR AS NECESSARY.

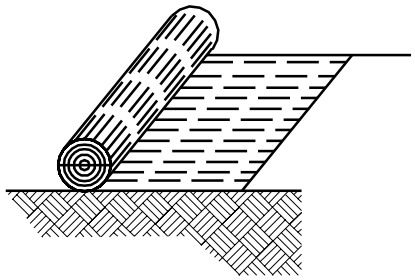
$$$$$USERNAME$$$$
$$$$$$SYTIME$$$$$$
I.G. ESE0022.DGN

TYPICAL MATTING ON SLOPES	FIGURE #22	
	DWG. ES-0022	REV.

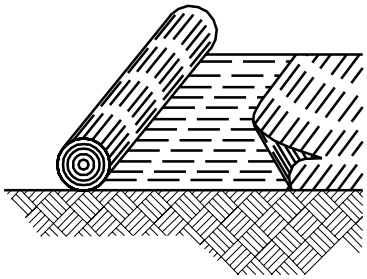
A. BURY THE TOP END OF THE JUTE STRIPS IN A 6" TRENCH (TYPICAL)



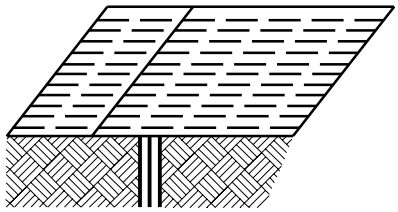
B. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING.

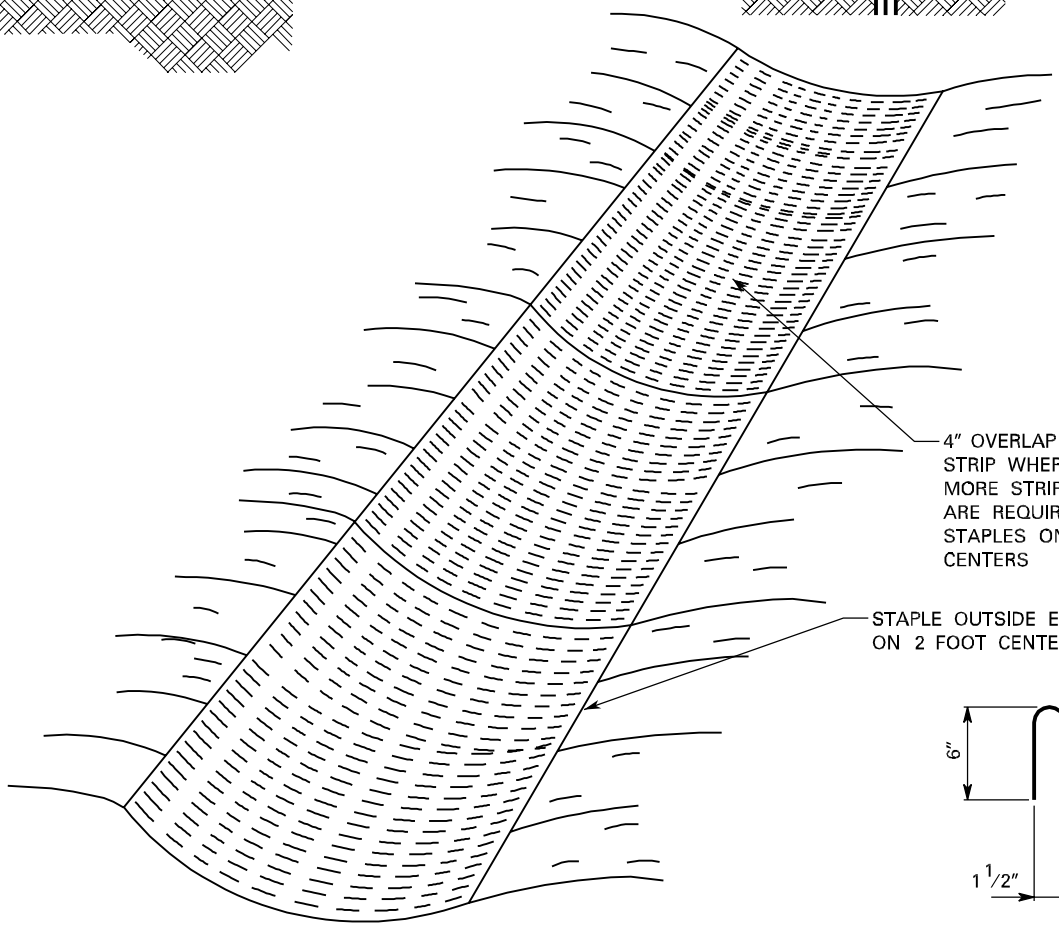


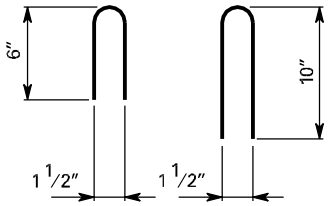
C. BURY AND TAMP UPPER END OF LOWER STRIP AS IN "A" AND "B". OVERLAP END OF TOP STRIP 4" AND STAPLE.



D. WHERE FABRIC STOPS, FOLD, BURY, AND TAMP JUTE STRIPS IN SLIT TRENCH. PROVIDE DOUBLE ROW OF STAPLES







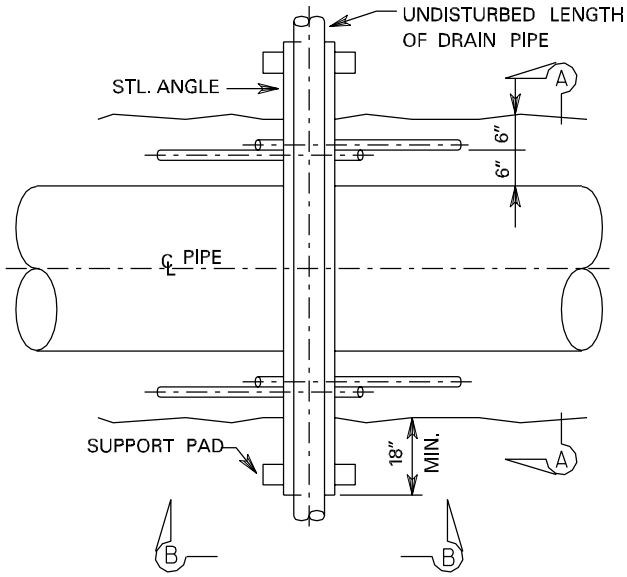
TYPICAL STAPLES

NO. 11 GAUGE WIRE

$$$$$USERNAME$$$$$
$$$$$$SYTIME$$$$$

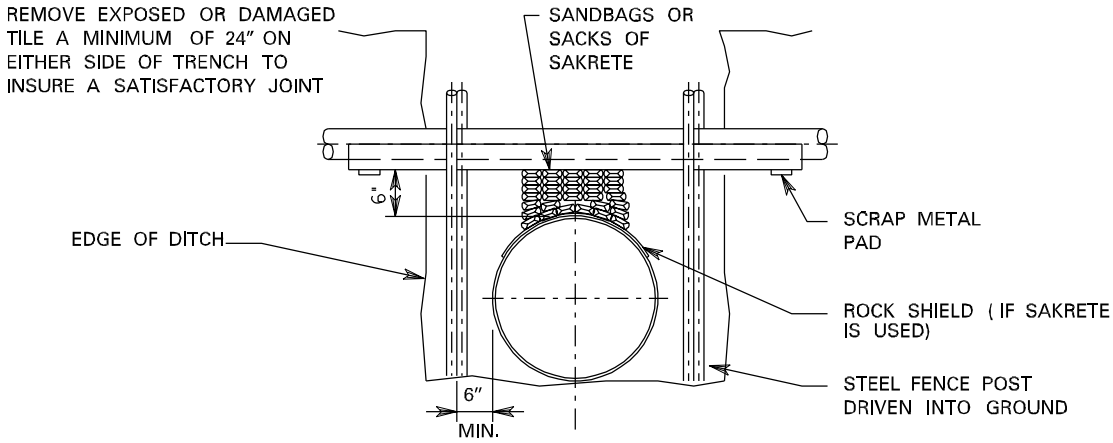
I.G. ESE0023.DGN

	EROSION CONTROL FABRIC INSTALLATION	FIGURE #23
		DWG. ES–0023 REV.



PLAN VIEW

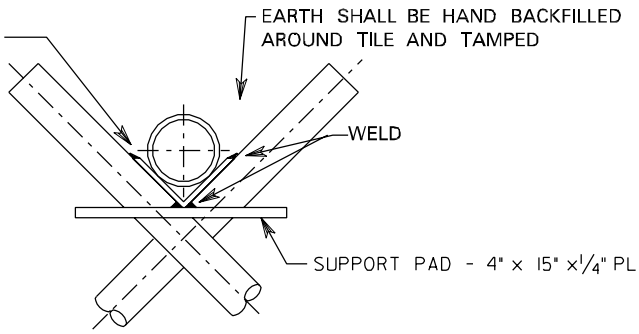
N.T.S.



SECTION "A–A"

N.T.S.

TO SUPPORT 4" & 6" TILE USE 4" x 1/4" ANGLE
" 8" " 6" x 7/16" "
" 10" " 6" x 7/16" "
" 12" " 8" x 1/2" "
" 16" " 8" x 1/2" "



SECTION "B–B"

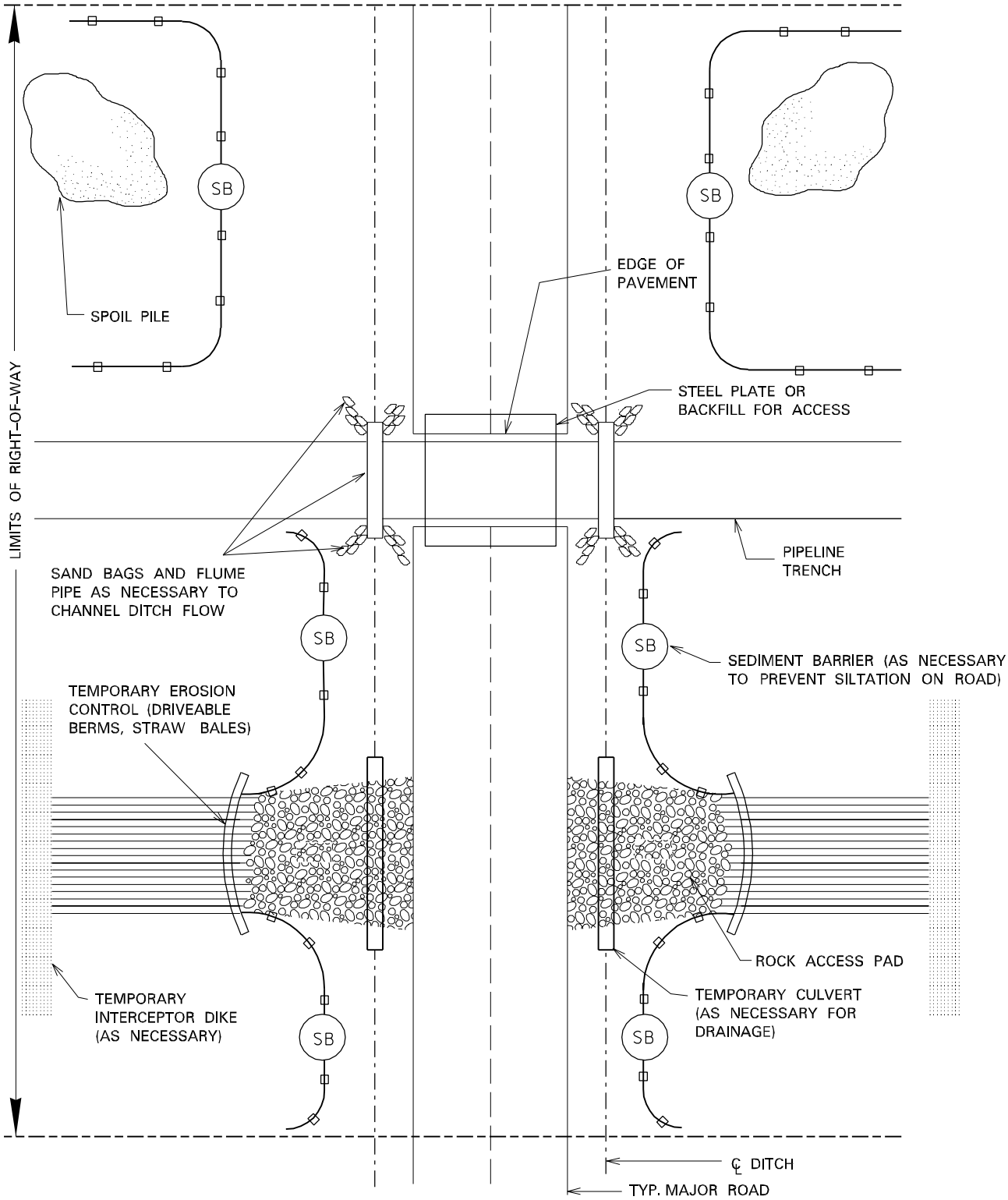
N.T.S.

NOTE:
USE OF SAKRETE SHALL REQUIRE PRIOR
COMPANY APPROVAL.

$$$$$USERNAME$$$$$
$$$$$$$SYTIME$$$$$$

I.G. ESE0024.DGN

	DRAIN TILE REPAIR PROCEDURE	FIGURE #24
		DWG. ES–0024 REV.



(SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND /OR STRAW BALES

	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (OPEN CUT)	FIGURE #25
		DWG. ES–0025 REV.

I.G. ESE0025.DGN

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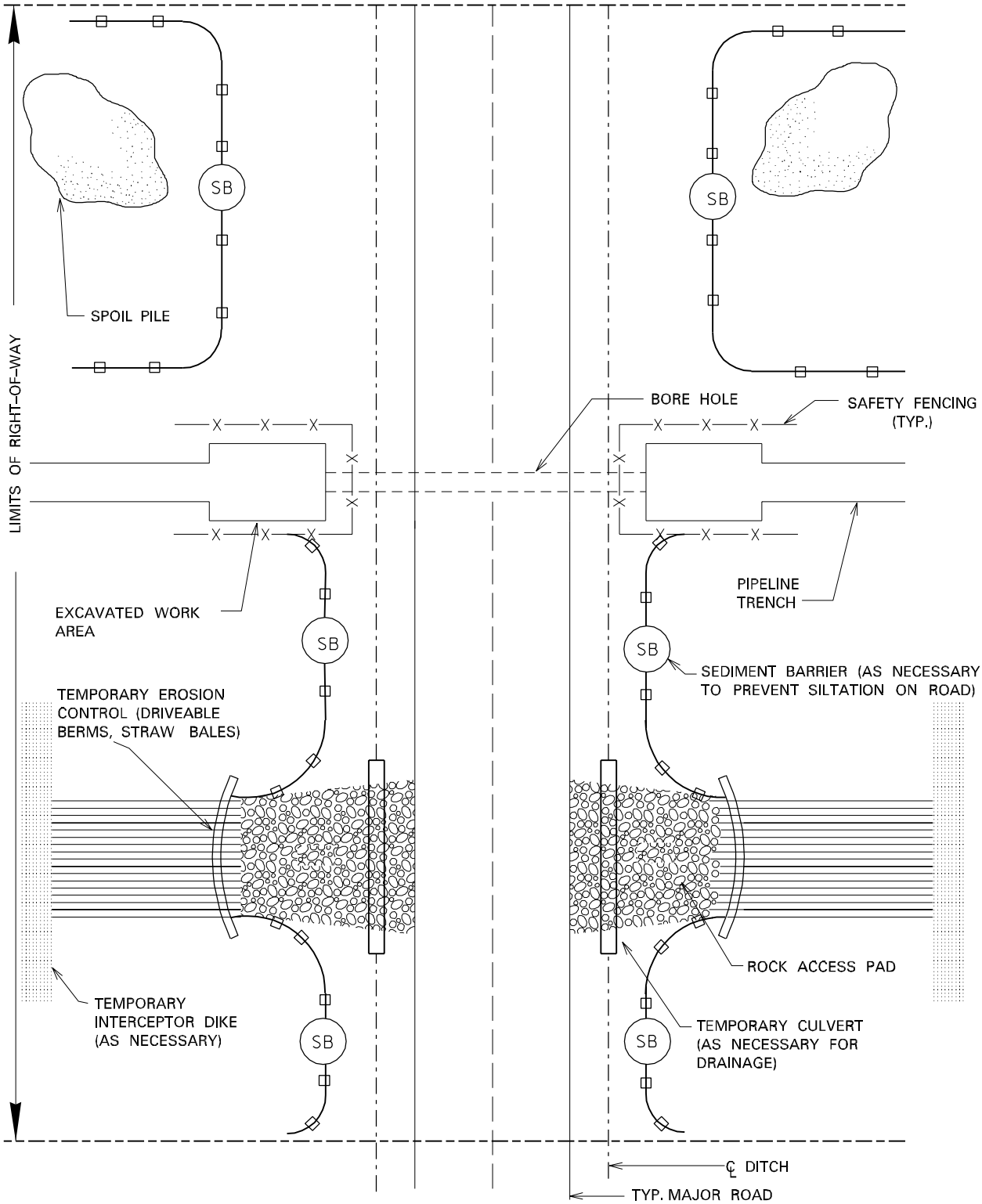
$$$$$$SYTIME$$$$$



(SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND /OR STRAW BALES

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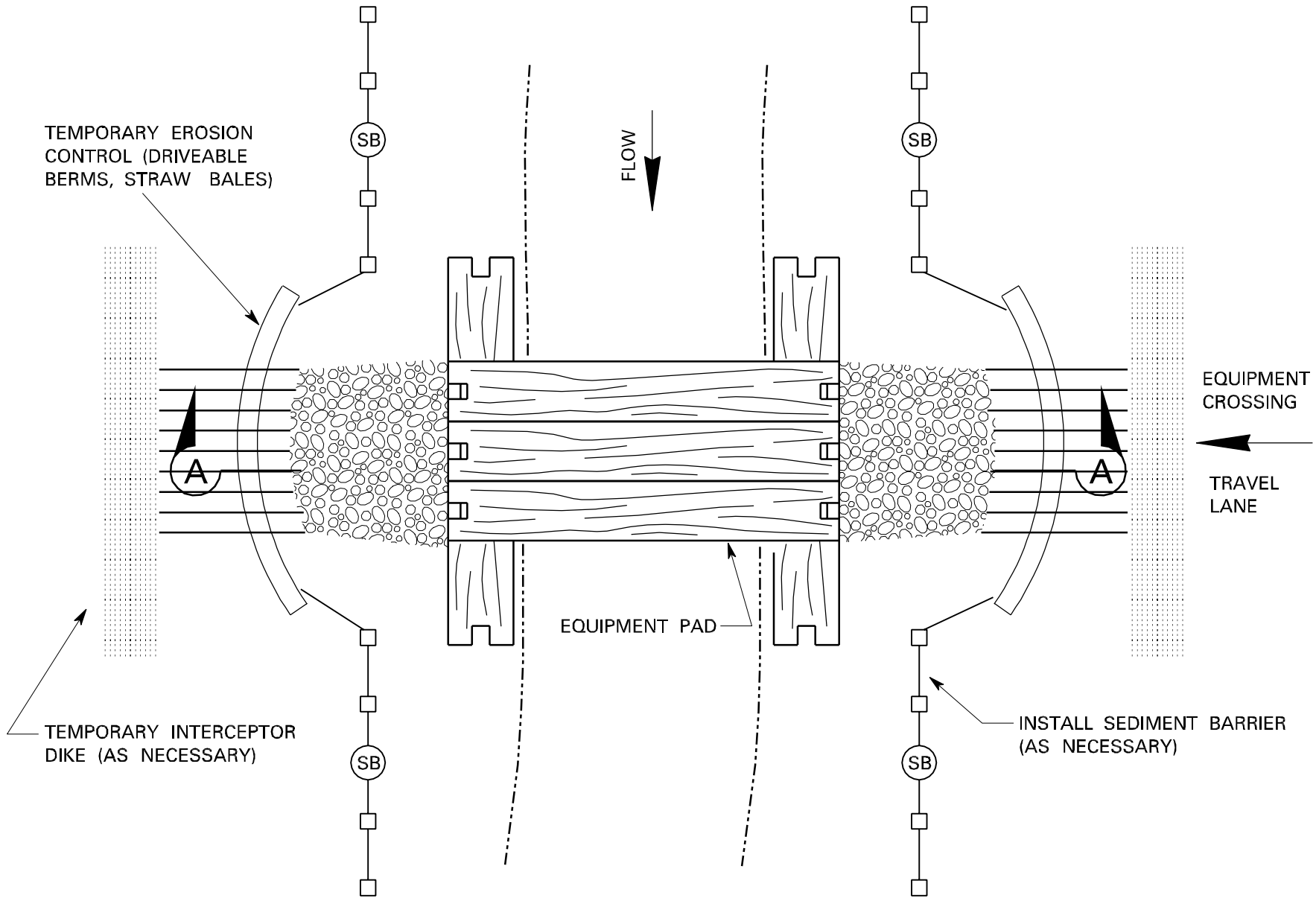
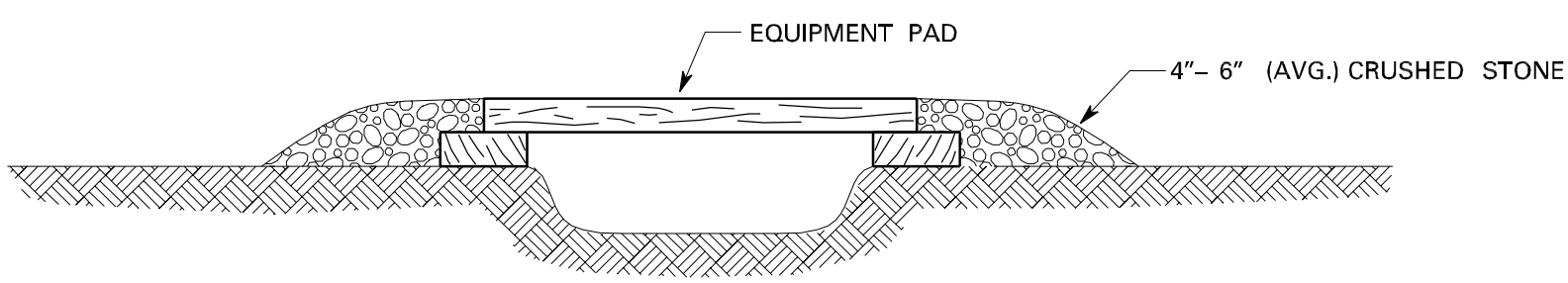
$$$$$$$$SYTIME$$$$$

I.G. ESE0026.DGN

	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (BORED)	FIGURE #26
		DWG. ES-0026 REV.



PLAN VIEW



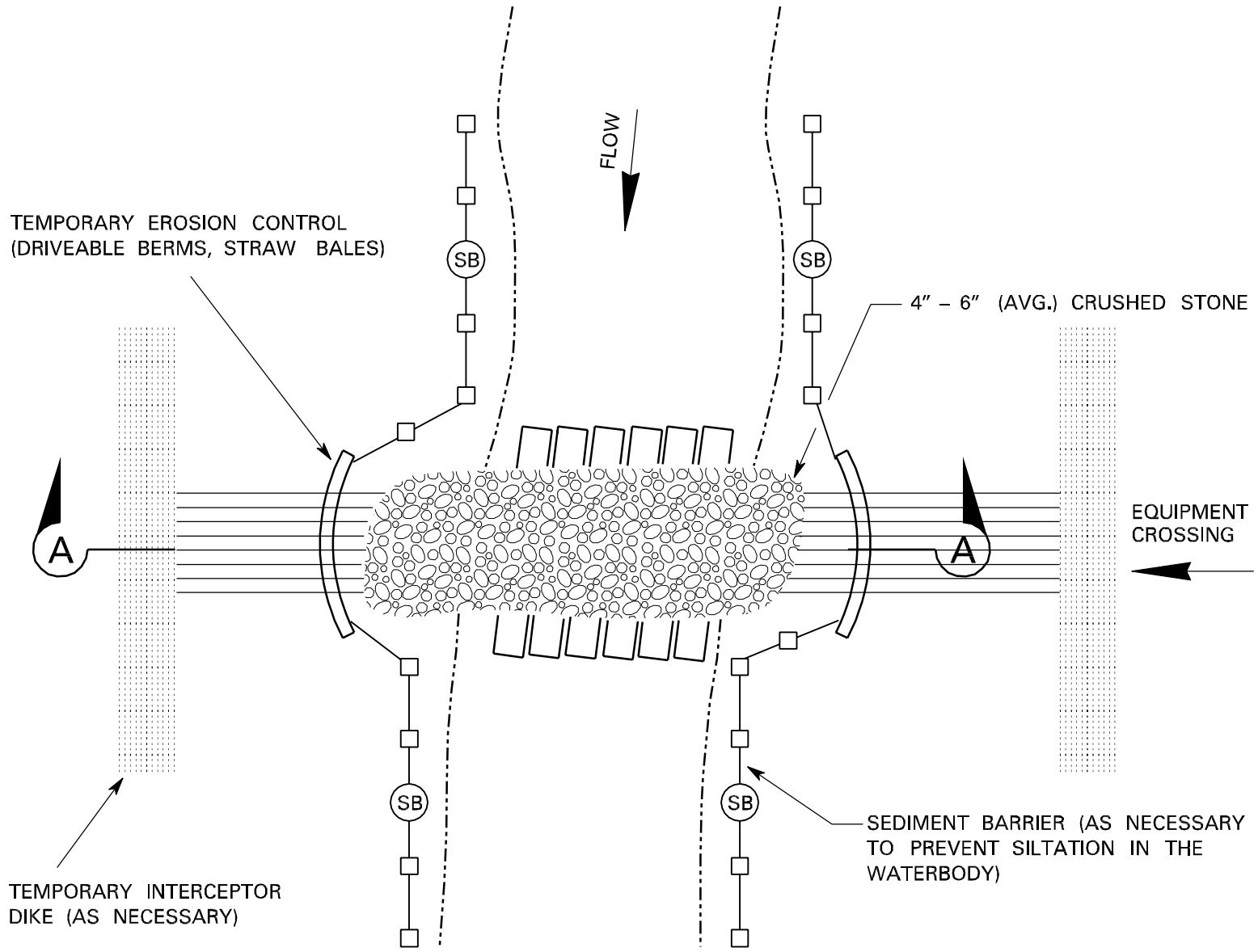
SECTION "A–A"

NOTES:

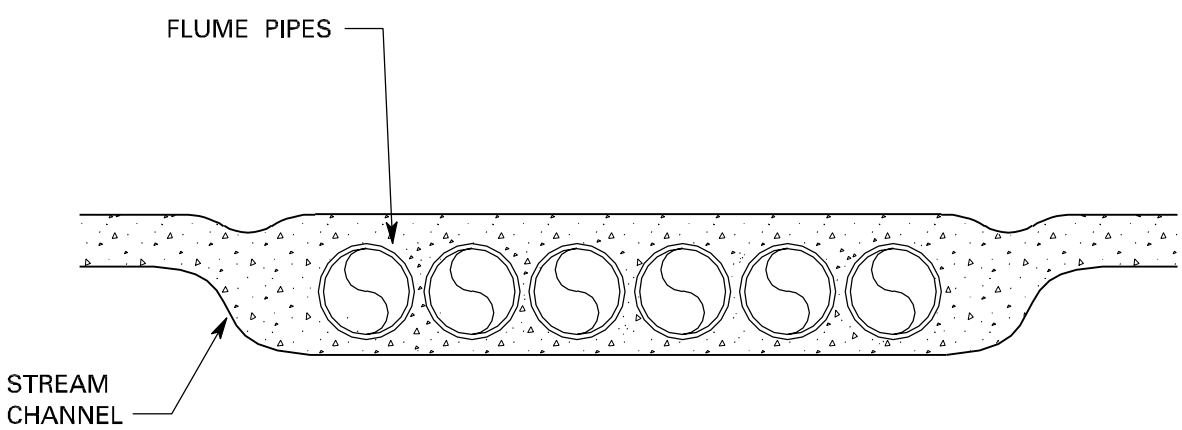
1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIAL.
2. ADDITIONAL EQUIPMENT PADS CAN BE PUT SIDE BY SIDE IF EXTRA WIDTH IS REQUIRED.
3. EQUIPMENT PAD TYPICALLY CONSTRUCTED OF HARDWOOD; MUST ACCOMMODATE THE LARGEST EQUIPMENT USED.
4. CRUSHED STONE MUST EXTEND A MINIMUM OF 10 FEET FROM THE TOP OF THE BANK.
5. CONSTRUCT BRIDGE TO PREVENT SOIL FROM ENTERING WATERBODY.

	TEMPORARY EQUIPMENT BRIDGE (EQUIPMENT PADS AND CULVERTS)	FIGURE #27
		DWG. ES–0027 REV.

I.G. ESE0027.DGN jwwhorley 01/22/2003



PLAN VIEW



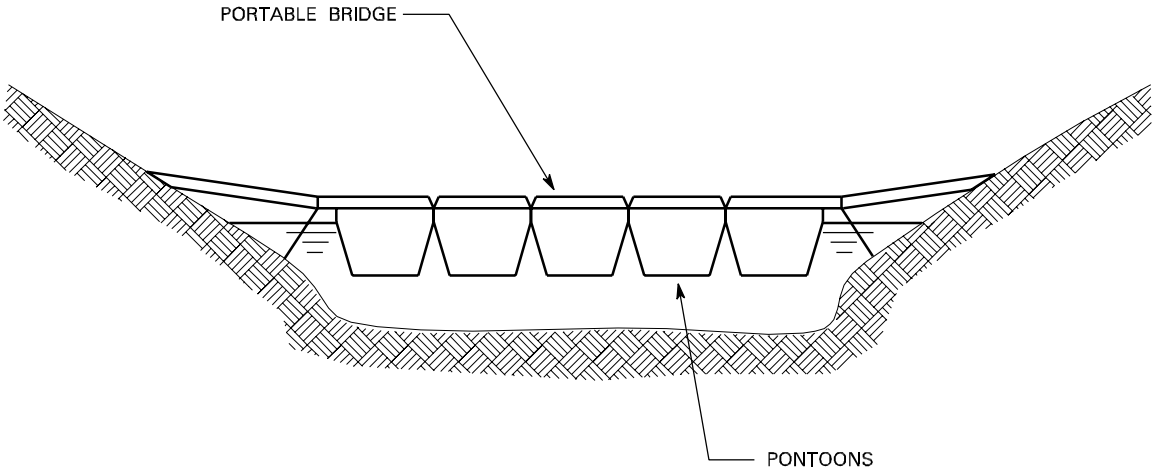
SECTION "A–A"

NOTES:

1. ALIGN FLUME PIPES TO PREVENT EROSION AND STREAMBED SCOUR.
2. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCES AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIALS.

	TEMPORARY EQUIPMENT BRIDGE (CRUSHED STONE AND CULVERTS)	FIGURE #28
		DWG. ES–0028 REV.

I.G. ESE0028.DGN
jwwhorley 01/22/2003



NOTES:

1. STABILIZE EDGES WITH SANDBAGS OR STONE.

2. REMOVE BRIDGE DURING CLEANUP.

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$$$$$$SYTIME$$$$$

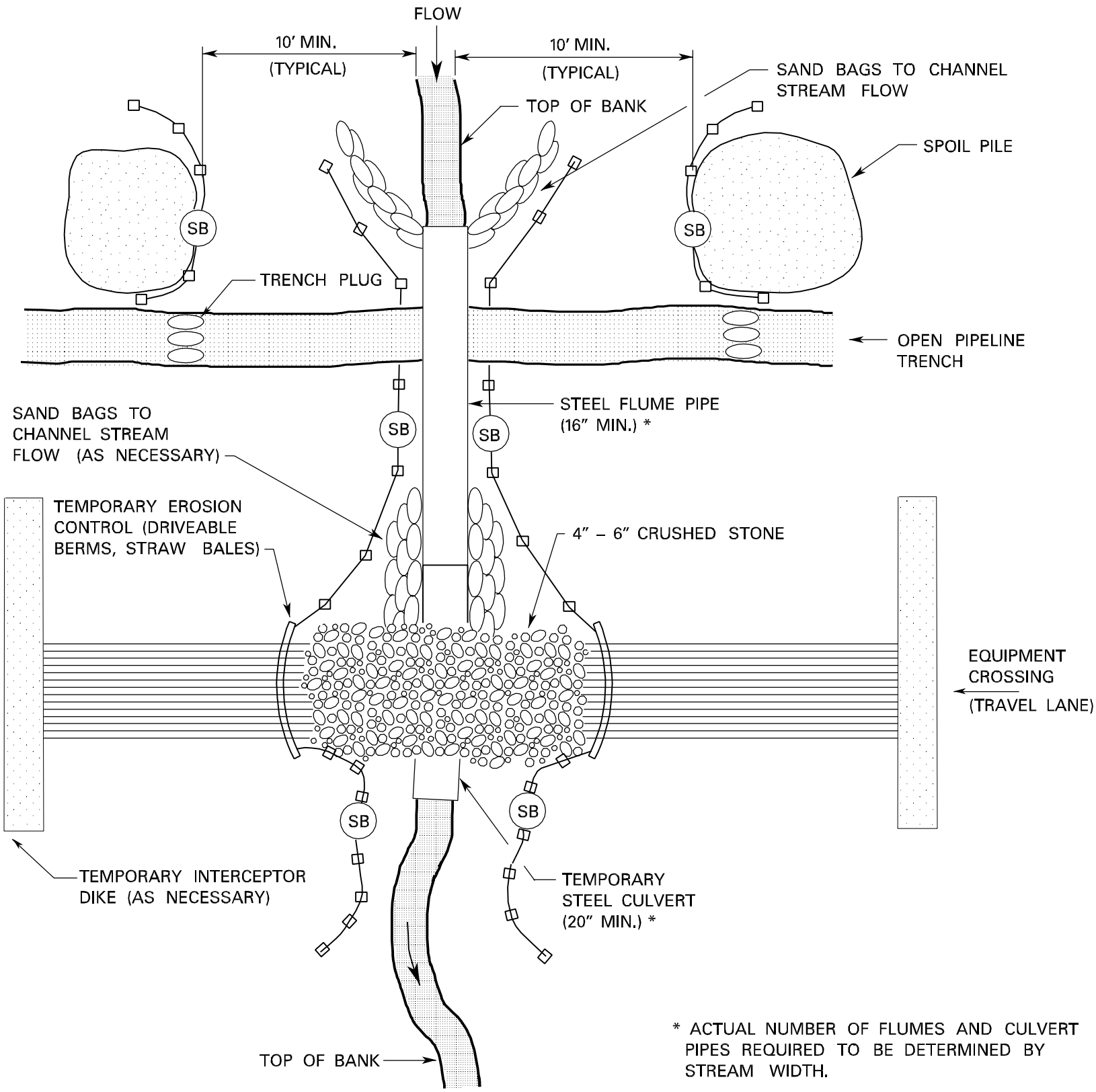
I.G. ESE0029.DGN

TEMPORARY EQUIPMENT BRIDGE
(FLEXI–FLOAT OR PORTABLE)

FIGURE #29

DWG. ES–0029

REV.



* ACTUAL NUMBER OF FLUMES AND CULVERT PIPES REQUIRED TO BE DETERMINED BY STREAM WIDTH.

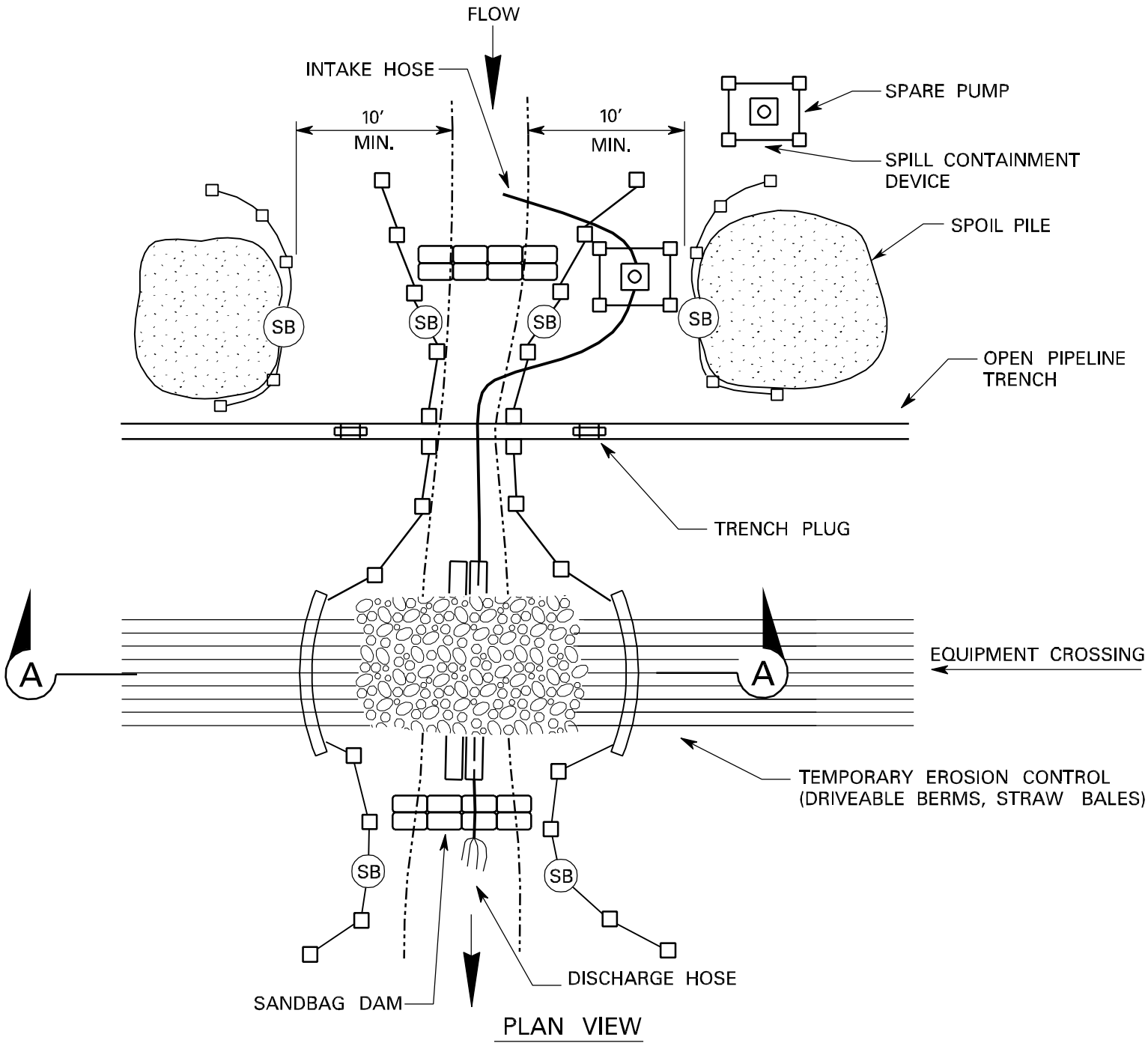
NOTES:

1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIALS.
2. SAND BAGS MUST BE FILLED WITH SAND FREE OF SILT, ORGANICS, AND OTHER MATERIAL.
3. ALIGN FLUME(S) TO PREVENT BANK EROSION AND STREAM SCOUR.
4. CONDUCT ALL IN-STREAM ACTIVITY (EXCEPT BLASTING OR OTHER ROCK BREAKING MEASURES) WITH THE FLUME(S) IN PLACE. FLUME PIPE(S) MAY NOT BE REMOVED FOR LOWERING IN OR INITIAL STREAMBED RESTORATION EFFORTS.
5. THE ENDS OF THE FLUME AND CULVERT MUST EXTEND TO AN UNDISTURBED AREA.

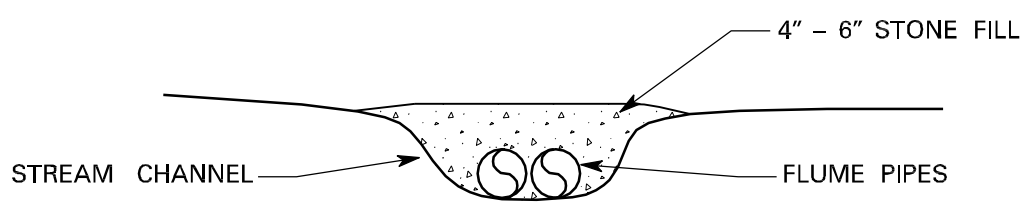
jwwhorley
01/22/2003

I.G. ESE0030.DGN

	TYPICAL FLUMED CROSSING	FIGURE #30
		DWG. ES–0030 REV.



PLAN VIEW



SECTION "A–A"

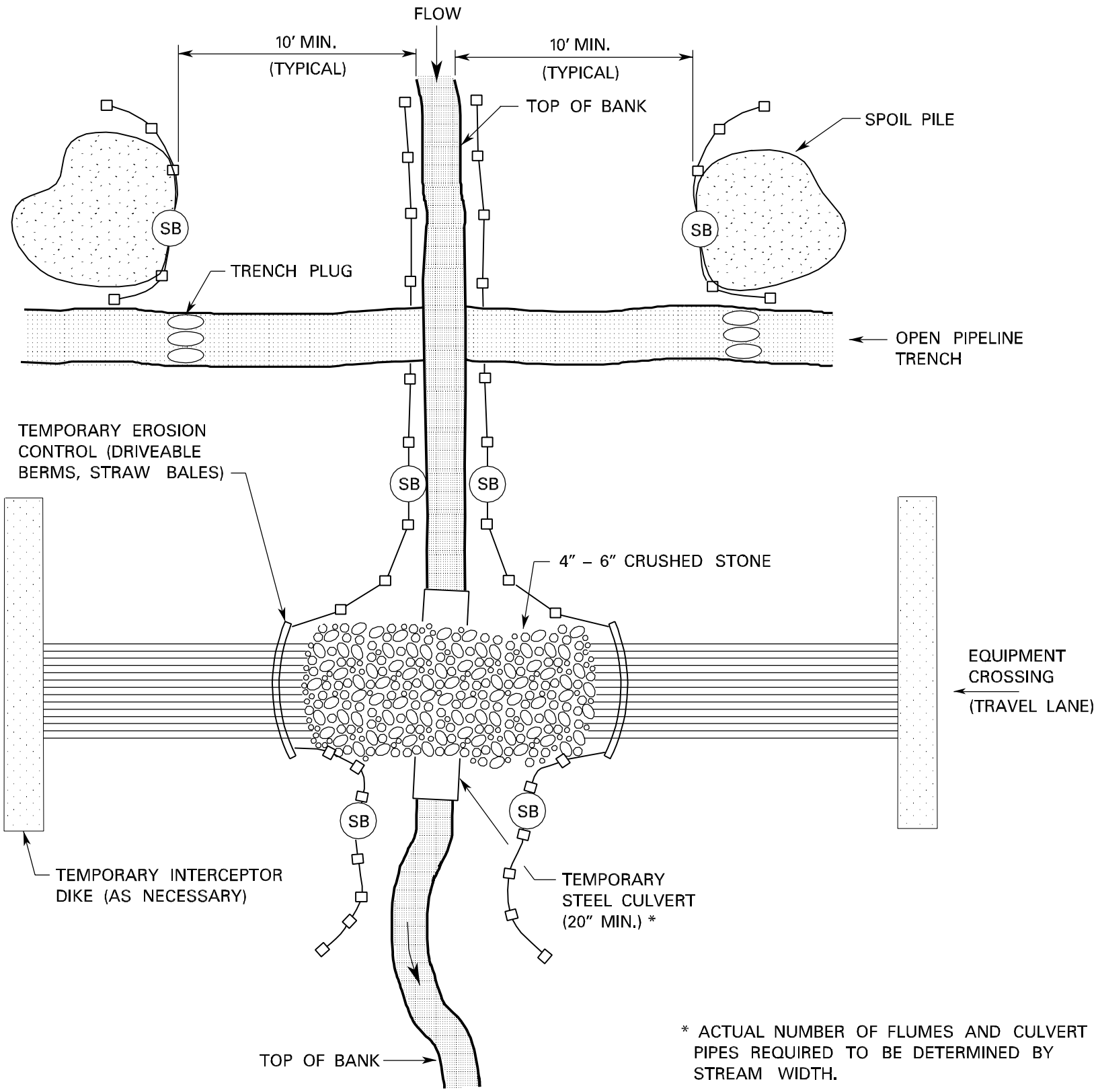
NOTES:

1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIALS
2. INSTALL AND SEAL SANDBAGS UPSTREAM AND DOWNSTREAM OF THE CROSSING.
3. CREATE AN UPSTREAM SUMP USING SANDBAGS IF NATURAL SUMP IS UNAVAILABLE FOR THE INTAKE HOSE.
4. EXCAVATE ACROSS STREAM CHANNEL FOLLOWING WATER REROUTING.
5. DO NOT REFUEL OR STORE FUEL WITHIN 100 FEET OF THE WATERBODY, WHERE FEASIBLE.
6. MONITOR PUMPS AT ALL TIMES DURING STREAM CROSSING PROCEDURE.
7. USE SUFFICIENT PUMPS, INCLUDING ONSITE BACKUP PUMPS, TO MAINTAIN DOWNSTREAM FLOW.
8. SCREEN PUMP INTAKES.
9. NUMBER OF FLUME PIPES FOR EQUIPMENT BRIDGE WILL VARY DEPENDING ON SITE CONDITIONS.

	TYPICAL DAM AND PUMP CROSSING	FIGURE #31
		DWG. ES–0031 REV.

jwwhorley 01/22/2003

I.G. ESE0031.DGN



* ACTUAL NUMBER OF FLUMES AND CULVERT PIPES REQUIRED TO BE DETERMINED BY STREAM WIDTH.

NOTES:

1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR APPROPRIATE MATERIALS.

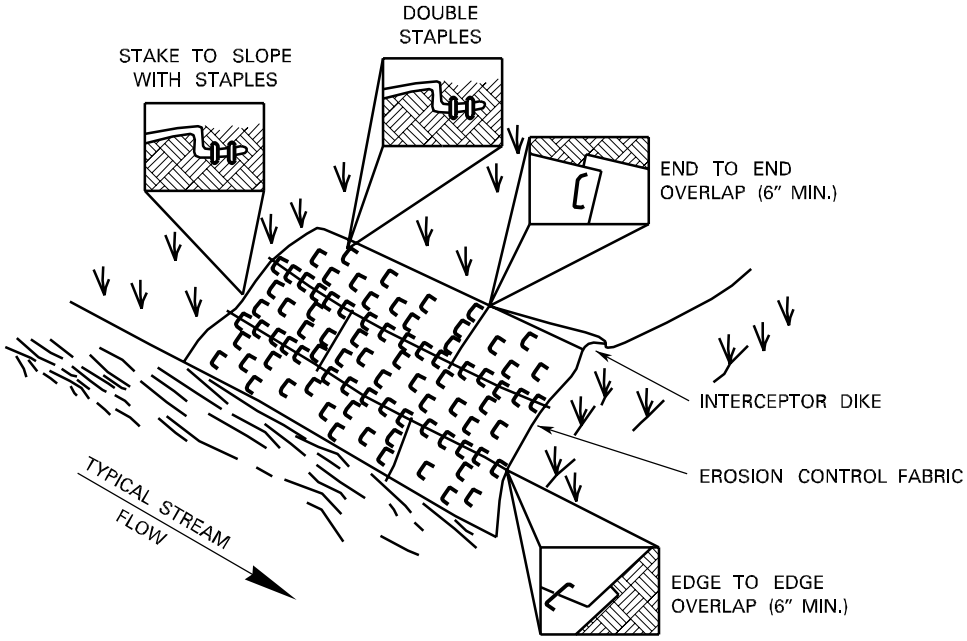
2. FOR MINOR WATERBODIES, COMPLETE TRENCHING AND BACKFILLING IN THE WATERBODY (NOT INCLUDING BLASTING OR OTHER ROCK BREAKING MEASURES) WITHIN 24 CONTINUOUS HOURS. IF A FLUME IS INSTALLED WITHIN THE WATERBODY DURING MAINLINE ACTIVITIES, IT CAN BE REMOVED JUST PRIOR TO LOWERING IN THE PIPELINE. THE 24–HOUR TIMEFRAME STARTS AS SOON AS THE FLUME IS REMOVED.

3. FOR INTERMEDIATE WATERBODIES, COMPLETE TRENCHING AND BACKFILLING IN THE WATERBODY (NOT INCLUDING BLASTING OR OTHER ROCK BREAKING MEASURES) WITHIN 48 CONTINUOUS HOURS, IF FEASIBLE.

jwwhorley
01/22/2003

I.G. ESE0032.DGN

	TYPICAL WET CROSSING	FIGURE #32
		DWG. ES–0032 REV.



NOTES:

1. EROSION CONTROL MATTING SHALL BE PLACE ON THE BANKS OF FLOWING STREAMS WHERE VEGETATION HAS BEEN REMOVED OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

2. EROSION CONTROL MATTING SHALL MEET THE REQUIREMENTS SPECIFIED IN THE PLAN AND/OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

3. STAPLES SHALL BE MADE OF 11 GAUGE WIRE, U-SHAPED WITH 6" LEGS AND A 1" CROWN. STAPLES SHALL BE DRIVEN INTO THE GROUND FOR THE FULL LENGTH OF THE STAPLE LEGS. ALTERNATELY 1" WOODEN PEGS 6" LONG AND BEVELED TO SECURE MATTING.

4. MATTING SHALL BE INSTALLED ACCORDING TO MANUFACTURER SPECIFICATIONS OR AS STATED BELOW:

   - EXTEND TOP OF BLANKET 2 FEET PAST THE UPPER EDGE OF THE HIGH WATER MARK. IF AN INTERCEPTOR DIKE IS PRESENT ON THE APPROACH SLOPE, BEGIN THE BLANKET ON THE UPHILL SIDE OF THE INTERCEPTOR DIKE.

   - INSTALL BLANKET(S) ACROSS THE SLOPE IN THE DIRECTION OF THE WATER FLOW.

   - ANCHOR ("KEY") THE UPSTREAM EDGE OF THE BLANKET(S) INTO THE SLOPE USING A 6" DEEP TRENCH. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING TRENCH

   - ANCHOR (KEY") THE UPPER EDGE OF THE BLANKET INTO THE SLOPE USING A 6" DEEP TRENCH. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING TRENCH.

   - OVERLAP THE EDGES OF PARALLEL BLANKETS A MINIMUM OF 6". PLACE THE UPPER BLANKET OVER THE LOWER BLANKET (SHINGLE STYLE) AND STAPLE EVERY 12" ALONG THE LENGTH OF THE EDGE.

   - WHEN BLANKET ENDS ARE ADJOINED, PLACE THE UPSTREAM BLANKET OVER THE DOWNSTREAM BLANKET (SHINGLE STYLE) WITH APPROXIMATELY 6" OF OVERLAP AND STAPLE THROUGH THE OVERLAPPED AREA EVERY 12".

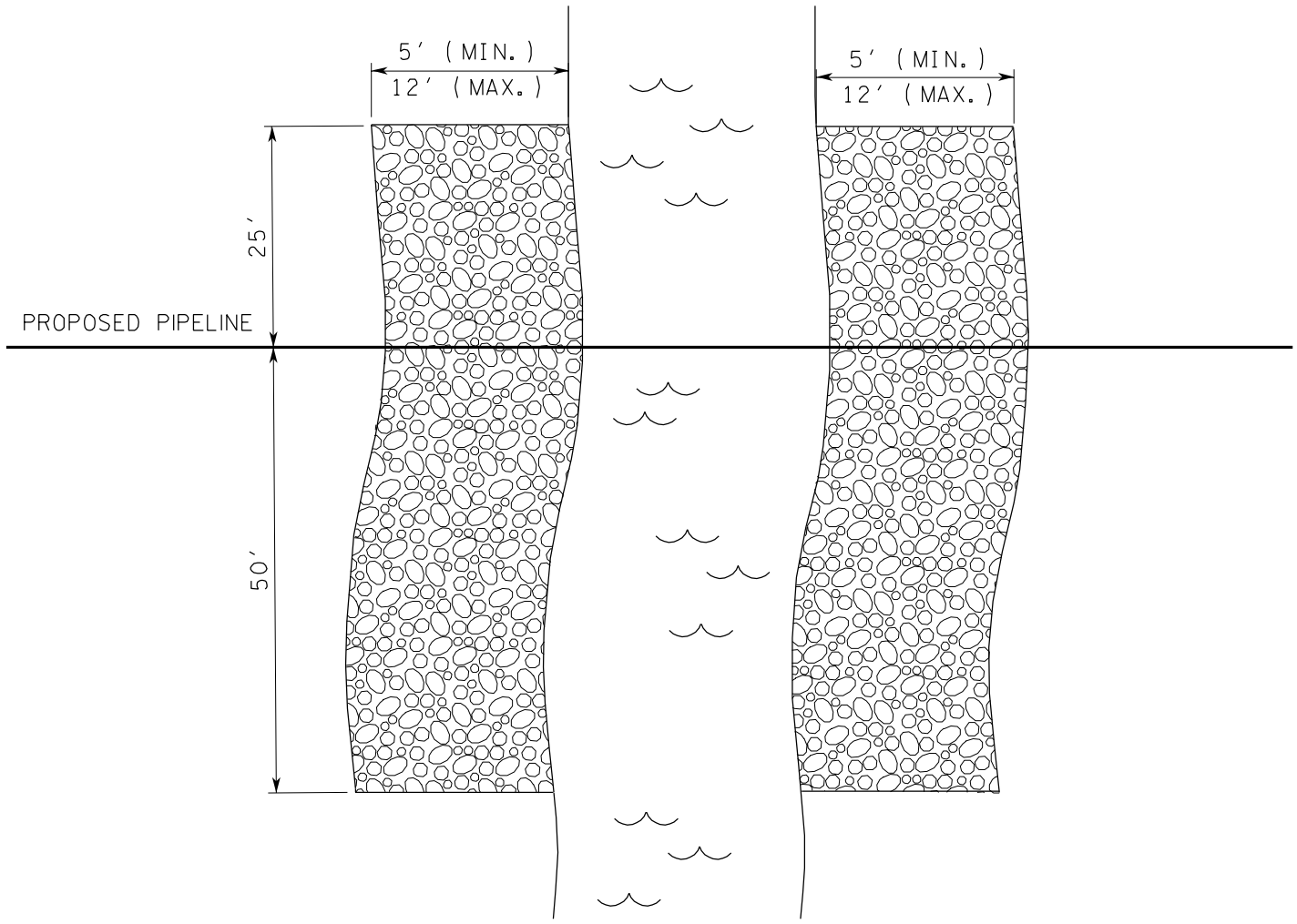
   - STAPLE DOWN THE CENTER OF THE BLANKET(S), THREE STAPLES IN EVERY SQUARE YARD.

5. IN LIVESTOCK AREAS WHERE EROSION CONTROL MATTING IS APPLIED TO THE STREAMBANKS, FENCING WILL BE USED IF NECESSARY TO EXCLUDE LIVESTOCK, WITH PERMISSION OF THE LANDOWNER.

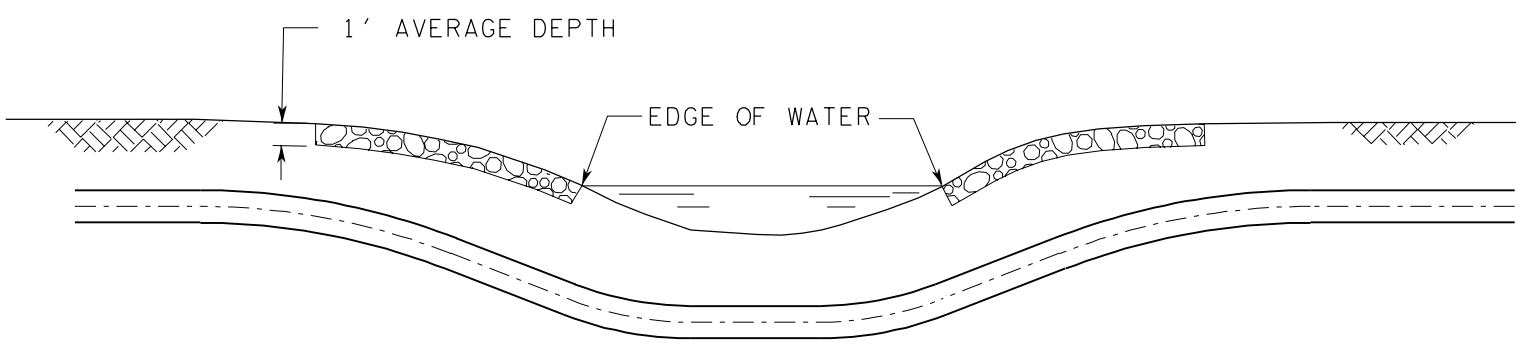
6. MONITOR WASHOUTS, STAPLE INTEGRITY OR MAT MOVEMENT. REPLACE OR REPAIR AS NECESSARY.

TYPICAL MATTING OF STREAMBANKS	FIGURE #33	
	DWG. ES–0033	REV.

$$$$$USERNAME$$$$
$$$$$SYTIME$$$$
I.G. ESE0033.DGN



PLAN



SECTION

NOTES:

1. RIP-RAP IS LESS THAN 500 FEET IN LENGTH.
2. RIP-RAP WILL NOT EXCEED AN AVERAGE OF ONE CUBIC YARD PER RUNNING FOOT.
3. RIP-RAP INSTALLATION SHALL BE IN COMPLIANCE WITH ALL APPLICABLE PERMITS.

jwwhorley 01/23/2003

I.G. ese0034. dgn

	RIP–RAP PLACEMENT (TYPICAL)	FIGURE #34
		DWG. ES–0034 REV.

APPENDIX B

SEED MIX RECOMMENDATIONS

SEED MIX RECOMMENDATIONS

"NORTHERN ZONE"[1]

UPLAND AREAS

Lime	4.0 tons/acre
Fertilizer	1000 lbs./acre (10-20-20)
Mulch (Wheat Straw)	3.0 tons/acre

1. **Upland Seed Mix** — 75 lbs./acre Pure Live Seed (PLS)

Kentucky Bluegrass	20%
Red Fescue[2]	20%
Kentucky 31 Tall Fescue[2]	15%
Redtop	10%
Perennial ryegrass	20%
White clover	5%
Birdsfoot Trefoil (Minimum 20% hard seed)	10%

2. **Pasture Mix** — 20 lbs./acre PLS

(For use only in disturbed managed pasture areas with landowner's permission.)

Kentucky Bluegrass	31%
Medium Red clover	26%
Norcen Trefoil	17%
Poly Perennial Rye	26%

3. **Recommended Seeding Dates:**

(For the establishment of temporary or permanent vegetation.)

Spring:	March 15 - May 30
Fall:	August 1 - October 15

WINTER STABILIZATION

If restoration can not occur prior to October 15, seed the ROW with 1.5 bushels per acre of winter rye or similar variety of rye as requested by the landowner. Mulch ROW at 3.0 tons per acre with wheat straw, including areas adjacent to streams and wetland crossings. Seed segregated topsoil piles with winter rye and mulch at a rate of 3.0 tons per acre.

WETLAND AREAS

DO NOT USE LIME OR FERTILIZER !!!

Mulch (Wheat Straw)	3.0 tons/acre

1. **Wetland Seed Mix**

Annual Ryegrass	40 lbs./acre PLS

[1] The Northern Zone is generally defined as extending north from the Northern borders of Arkansas and Tennessee.

[2] Fescue must be endophyte-free.

SEED MIX RECOMMENDATIONS

"SOUTHERN ZONE"[1]

UPLAND AREAS

Lime (agricultural limestone)	2.5 tons/acre
Fertilizer (6-12-12)	950 lbs./acre
Mulch (Oats,Wheat or Bermudagrass Straw)	3.0 tons/acre

1. **Seed Mixture**[2]

Sorghum, Sudangrass, or Sudangrass Hybrids[3]	40 lbs/acre Pure Live Seed (PLS)
Kentucky 31 Tall Fescue[4]	10 lbs/acre PLS
Big Bluestem	10 lbs/acre PLS
Indiangrass	10 lbs/acre PLS
Bermudagrass	10 lbs/acre PLS
Sericea Lespedeza[5]	10 lbs/acre PLS
White Clover[5]	5 lbs/acre PLS
Birdsfoot Trefoil[5]	10 lbs/acre PLS

2. **Recommended seeding dates:**

(For establishment of temporary or permanent vegetation.)

Spring:	March 15 - May 30
Fall:	August 1 - October 15

WINTER STABILIZATION

If restoration cannot occur prior to October 15, seed the ROW with 1.5 bushels per acre of winter rye or similar variety of rye as requested by the landowner. Mulch ROW at 3.0 tons per acre with wheat straw, including areas adjacent to stream and wetland crossings. Seed segregated topsoil piles with winter rye and mulch at a rate of 3.0 tons per acre.

WETLAND AREAS

DO NOT USE LIME OR FERTILIZER !!!

Mulch (Oats, Wheat, or Bermudagrass Straw)	3.0 tons/acre

1. **Wetland Seed Mix**:

Annual Ryegrass	40 lbs/acre PLS

[1] The Southern Zone is generally defined as extending south from the Northern borders of Arkansas and Tennessee.

[2] An alternative seed mixture may be requested by the landowner(s).

[3] These species may be sold under the following trade names: DeKalb SX17 , Greentreat II, Greentreat III, Tastemaker DR, Tastemaker III, FFR202, or Sordan 79.

[4] Fescue must be endophyte-free.

[5] Legumes should be treated with a species specific inoculate prior to seeding. Legume seed and soil should be scarified.

SPILL PREVENTION CONTROL AND COUNTERMEASURE (SPCC) PLAN &

PREPAREDNESS, PREVENTION, AND CONTINGENCY (PPC) PLAN for CONSTRUCTION PROJECTS

Project: ALGONQUIN INCREMENTAL MARKET PROJECT ("AIM Project")

Prepared By:

Spectra Energy Partners, LP
Environmental Construction Permitting
5400 Westheimer Court
Houston, TX 77056-5310

Effective February 18, 2003

Updated: February 2014

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ABBREVIATIONS AND DEFINITIONS

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CI	Chief Inspector (Company employee or Contractor Employee performing the duties of the onsite Construction Manager or Engineer)
Company	Spectra Energy Transmission, LLC
Company SC	Company Spill Coordinator (The Environmental Inspector or the Chief Inspector)
Contractor	Third party service provider performing construction activities for the Company on property owned or under the control of the Company. This role may be filled by the Company on small projects constructed by Company personnel and equipment.
Contractor SC	Contractor Spill Coordinator
CWA	Clean Water Act
DOT	U. S. Department of Transportation
E&C	Engineering & Construction
ECP	Environmental Construction Permitting
EHS, EH&S	Environmental Health and Safety
EI	Environmental Inspector (Company employee or Contractor Employee performing the duties of onsite environmental specialist overseeing Contractor compliance with environmental permit conditions, laws and regulations)
E&SCP	Erosion & Sedimentation Control Plan
FERC	Federal Energy Regulatory Commission
FWPC	Federal Water Pollution Control Act
HDD	Horizontal Directional Drill
JSA	Job Safety Analysis
MSDS	Material Safety Data Sheets
ppm	Parts per Million
Environmental Lead	Environmental Construction Permitting specialist assigned to the project
OPA	Oil Pollution Act
RCRA	Resource Conservation and Recovery Act
SPCC Plan or Plan	Spill Prevention, Control and Countermeasure Plan
TSCA	Toxic Substances Control Act

1.0 PURPOSE/PLAN OBJECTIVE

Spectra Energy Transmission, LLC ("Company") has prepared this Spill Prevention, Control and Countermeasure ("SPCC") Plan ("Plan") for construction projects in the United States. The purpose of this Plan is to reduce the probability and risk of a potential spill or release of oil or hazardous materials by the Company or Contractor during construction-related activities, by providing training to the Company and Contractor and expediting spill response and cleanup. This plan is not intended to meet the requirements of existing facility operations.

The Plan's specific objectives are to identify and address:

- The type and quantity of material handled, stored, or used on site during construction;
- The measures to be taken for spill preparedness and prevention;
- Emergency response procedures;
- Spill incident reporting/notification procedures; and
- Local emergency response team arrangements.

This plan has been prepared to meet the requirements of the Federal Energy Regulatory Commission's ("FERC's") *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures), the Oil Pollution Act ("OPA"), the Federal Water Pollution Control Act ("FWPC"), the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") of 1980, the Resource Conservation and Recovery Act ("RCRA"), the Toxic Substances Control Act ("TSCA") and the Clean Water Act ("CWA").

The Company Environmental Construction Permitting ("ECP") group is responsible for the development and maintenance of this Plan. The Plan will be distributed to the Company Engineering & Construction ("E&C") Department's teams and associated Company personnel and will be included in the construction contract. It is the responsibility of the E&C teams to distribute to any necessary Contractors for implementation.

This Plan outlines both Company and Contractor responsibilities by topic. The Contractor is responsible for implementation of the Plan. In the absence of a Contractor, the Company will be responsible for both Company and Contractor responsibilities as they are laid out in this Plan.

A copy of the Plan must be on site during active construction and should also be maintained at the closest construction field office.

2.0 TRAINING

The Company requires all Contractor and Company personnel engaged in any construction activity to receive training in the implementation of the Plan prior to the commencement of on-site construction related activities.

Site visitors are to be given a brief review of the Plan as part of their orientation on safety and emergency procedures prior to the start of any on-site activities.

Contractor Responsibility

The Contractor will be responsible for the following:

- Keep training records
- Perform training briefings through ongoing meetings like tailgates and the daily project Job Safety Analysis ("JSA") that include:
  - Precautionary measures to prevent spills;
  - Potential sources of spills, including equipment failure or malfunction;
  - Standard operating procedures in the event of a spill;
  - Applicable notification requirements;
  - Equipment, materials and supplies available for clean-up of a spill;
  - Hazardous waste identification procedures;
  - Generation and proper handling of all non-hazardous waste, hazardous waste, and other toxic substances;
  - Proper storage, labeling, transportation and disposal of non hazardous and hazardous waste; and
  - Sample collection procedures.

Company Responsibility

The Company Chief Inspector ("CI"), Environmental Inspector ("EI"), or their designate will perform the following:

- Teach awareness-level training at the initial project environmental training session;
- Ensure further training is available for other new project personnel; and
- Audit training records kept by the Contractor as necessary.

3.0 PRE-PLANNING - MATERIAL INVENTORY AND DOCUMENTATION

Contractor Responsibility

The Contractor will be responsible for the following **prior** to the start of construction:

- Develop an inventory of all oil/hazardous material stored or used during construction;
- Complete Tables I, II, IV, V and VI (see Appendix A);
- Obtain material safety data sheets ("MSDS") (Appendix B) for all hazardous and non-hazardous substances listed in Table I (see Appendix A);
- Prepare a basic facility diagram or sketch for any storage areas, including pipe yards and temporary storage areas. The diagram should include locations of oil-filled containers, direction of run-off, emergency evacuation routes and assembly areas (see Appendix E); and
- Submit the required Tables, MSDS, and signature pages to the ECP's Environmental Lead for review and approval.

Company Responsibility

- Complete Tables III (see Appendix A);
- Review the Tables, MSDS, and signature pages submitted by the Contractor for approval; and
- Distribute approved Tables, MSDS, and signature pages to include in Plan as Appendices A, B and D.
- Fill out any signature pages or forms (see Appendix D)
    - Management Approval and Cleanup Commitment
    - Certificate of Determination of Substantial Harm Criteria

4.0 SPILL AND LEAK PREPAREDNESS AND PREVENTION

4.1 Prevention and Preparedness

Contractor Responsibility

- Complete Appendix A, Table I, Material and Waste Storage Inventory, and Table VI, Areas for Potential Leaks and Spills, prior to construction;
- Provide spill prevention, containment, and clean up equipment, and keep it available on-site;
- Perform daily inspections of all equipment, storage tanks, and/or container storage areas;
- Repair all leaking equipment, machinery or tools immediately. If items cannot be repaired, remove them immediately from the project site;
- Maintain a minimal spill kit (absorbent diapers, plastic bags, gloves, etc.) for each piece of hydraulically operated equipment and personnel vehicles within the project area;
- Store materials as indicated in the storage facility diagram or sketch provided by the Contractor in Appendix E;
- Submit a secondary containment plan for any hazardous material storage within the project area to the Company for approval **prior** to storage; and
- Obtain written approval from the project CI or EI for hazardous material storage within 100 feet of a wetland or waterbody.

Company Responsibility

- Review any secondary containment or storage plans submitted by the Contractor for approval.

4.1.1 Secondary Containment

Contractor Responsibility

- Single wall tanks shall be provided with temporary secondary containment that will hold at least 110% of the tank capacity of the largest tank inside the containment area;
  - This includes pumps, generators, compressors or other petroleum powered equipment used on site for dewatering and other activities during construction.
- PCB (50 parts per million ("ppm") or greater) storage tanks shall be double-walled or have secondary containment that will hold 200 percent of the tank capacity;
- All containers with a storage capacity greater than 55 gallons shall have temporary containment (see Appendix A, Table I for type of temporary containment); and
- All pumps and other portable fuel burning equipment used during construction will be sited in secondary containment.

4.1.2 Storage/Inspection (Tanks/Containers)

Contractor Responsibility

- Operate only those tanks for fuel and material storage that meet the approval of the Company;
- Elevate tanks a maximum of two feet above grade;
- Inspect vehicle-mounted tanks to ensure all are equipped with flame/spark arrestors on all vents to prevent self-ignition;

- Locate tank storage in areas that are at least 100 feet from all waterbodies, wetlands, and designated municipal watershed areas, with certain exceptions as approved by ECP and listed in Appendix A, Table IV;
- Complete Appendix A, Table IV, Tank and Container Storage Exception Areas, and submit to the Company for approval prior to construction;
- Inspect all tanks daily for leaks and deterioration. The results of all inspections shall be made available to the Company upon request;
- Do not store incompatible materials in sequence in tanks prior to decontamination (A general list of potentially incompatible materials that may be used during construction are included in Appendix A, Table I);
- Store small cans of gasoline, diesel, solvents, etc., within the temporary secondary containment or within secured trailers or vehicles when not in use;
- Replace leaking and/or deteriorated containers as soon as the condition is first detected; and
- Ensure that all container storage and containment areas being used to store hazardous materials or wastes are in compliance with applicable local, state and federal requirements.

4.1.3 Loading/Unloading Areas

Contractor Responsibility

- Transfer liquids and refuel only in pre-designated and pre-approved locations that are at least 100 feet from all waterbodies and wetlands, with certain exceptions as approved by the EI and listed in Appendix A;
- Inspect the area beneath loading/unloading location for spills before and after each use;
- Utilize drip pans at all hose connections while loading/unloading liquids. If a leak or spill occurs, the loading/unloading operation will be stopped and the spill will be contained, cleaned up and collected prior to continuing the operation;
- Inspect all outlets of the tank trucks prior to leaving the loading and unloading area to prevent possible leakage from the truck while in transit;
- Equip any service vehicle used to transport lubricants and fuel with an emergency response spill kit. At a minimum, this kit must include:
  - 25 lbs of granular oil absorbent
  - 10, 48" x 3" oil socks
  - 5, 17" x 17" oil pillows
  - 1, 10" x 4" oil boom
  - 20, 24" x 24" x 3/8" oil mats
  - Garden size, 6 mil, polyethylene bags
  - 10 pair of latex gloves
  - 1, 55-gallon polyethylene open-head drum;
- Equip any service vehicle used to transport lubricants and fuel with a chemical response kit. At a minimum, this kit must include:
  - 1 bag of loose chemical pulp
  - 2 to 3, 17" x 17" chemical pillows
  - 2, 48" x 3" chemical socks
  - 5, 18" x 18" x 3/8" adsorbent mats
  - garden-size, 6 mil, polyethylene bags
  - 10 pair of latex gloves
  - 1, 30-gallon polyethylene open-head drum
  - hazardous waste labels

Company Responsibility

- Personnel shall be present during loading and unloading activities.

5.0 CONTINGENCY PLAN AND EMERGENCY PROCEDURES

All Company and Contractor personnel have responsibilities for spill prevention, control, and countermeasure.

Contractor Responsibility

- Maintain adequate manpower and equipment at the pipe yard or contractor ware yard necessary to divert any spill from reaching waterbodies and wetland areas; and
- Complete Appendix A, Table I, Emergency Response and Personal Protective Equipment, with a list of emergency equipment and storage location.

Company Responsibility

- Complete Appendix A, Table III, Key Emergency Contacts, prior to construction, and update as necessary.

First Responder Responsibility

The first responder is the person who first observes a spill or release of oil or other hazardous materials to the environment.

This person will take the following steps:

- Assess the situation to determine if the situation poses an immediate threat to human health or the environment;
- Identify hazardous material involved, if any;
- Report the spill to the Company Spill Coordinator ("Company SC") and Contractor Spill Coordinator ("Contractor SC") immediately; and
- Standby at a safe distance and keep others away.

Contractor SC Responsibility

- Coordinate the response to all spills which occur as a result of Contractor operations;
- Report the spill to the Company;
- Coordinate with the Company SC; and
- Conduct subsequent site investigations and associated incident reports unless otherwise directed by the Company.

The Contractor SC may be removed by the Company SC as spill response coordinator at the discretion of the Company.

The Contractor SC will direct Contractor personnel to:

- Shut off source of spill or leak as quickly as possible;
- Minimize affected area with appropriate containment or dike/berm;
- Assemble required spill response equipment as required (protective clothing, gear, heavy equipment, pumps, absorbent material, empty drums, etc.);
- Ensure that spilled material is placed in appropriate containers, in accordance with the best management practices and applicable laws and regulations;

- Properly label and store containers in accordance with applicable requirements; and
- Ensure that all spill response equipment is fully functional. Any equipment that cannot be reused shall be replaced.

Company SC Responsibility

The Company SC will be responsible for overseeing the Contractor SC's clean up of all spills of oil or hazardous materials.

Upon notification, the Company SC shall:

- Assess situation for potential threat to human health, environment and the neighboring community;
- Implement evacuation, if necessary;
- Activate emergency shutdown, if necessary;
- Control source as conditions warrant;
- Ensure that incompatible materials are kept away from the impacted area;
- Keep any potential ignition source away from the impact area, if spilled material is flammable;
- Coordinate sampling, disposal and equipment decontamination with Environmental Health and Safety ("EHS") in Houston, if necessary;
- For spills of PCBs, contact EHS for special spill response requirements related to PCB spills;
- Assist with the coordination of cleanup and disposal activities;
- If necessary, contact outside remediation services, in coordination with EHS, to assist with clean up;
- Notify EHS of all quantities and description of wastes to be handled by EHS;
- Complete the *EH&S Incident Investigation Form* (see Appendix C) and distribute accordingly;
- For unanticipated release of hydrostatic test waters, notify state contact if required by state permit, in accordance with timeframes required by state permit;
- Review permits to determine if immediate water sampling of test water is required and arrange if necessary; and
- Determine if local Right of Way agent will notify public officials (e.g. township manager and/or mayor).

6.0 SPILL CLEAN-UP/WASTE DISPOSAL PROCEDURES OF HYDROSTATIC TEST WATER

6.1 Oil/Fuel and Hazardous Material Spills and Unanticipated Releases

Contractor Responsibility

- Ensure no immediate threat to surrounding landowners or environment;
- Identify/verify the material and quantity released;
- Review MSDS to determine the proper handling;
- Ensure that Personal Protective Equipment and containers are compatible with the substance;
- Remediate small spills and leaks as soon as feasible. Use adsorbent pads whenever possible to reduce the amount of contaminated articles;
- Restrict the spill by stopping or diverting flow to the oil/fuel tank;
- If the release exceeds the containment system capacity, immediately construct additional containment using sandbags or fill material. Every effort must be made to prevent the seepage of oil into soils, wetlands and surface waters;
- Block off drains and containment areas to limit the extent of the spill. For chemical spills, never wash down a spill with water;
- If a release occurs into a storm drain or stream, immediately pump any floating layer into drums. For high velocity streams, place oil booms or hay bales between the release area and the site boundary and downstream of affected area. As soon as possible, excavate contaminated soils and sediments within approved work areas;
- Collect and reclaim as much of the spill as possible using a hand pump or similar device. Containerize contaminated soils in an appropriate Department of Transportation ("DOT") container in accordance with applicable requirements. Never place incompatible materials in the same drum;
- For larger quantities of soils, construct temporary waste piles using plastic liners placing the contaminated soils on top of the plastic and covered by plastic. Plastic-lined roll-off bins should be leased for storing this material as soon as feasible;
- Properly label any drums, containers or storage piles in accordance with applicable requirements;
- Move drum to secure staging or storage area;
- Decontaminate all equipment in a contained area and collect fluids in drums;
- Document and report cleanup activities to the Company SC as soon as feasible; and
- If environmentally sensitive resources (wetlands, waterbodies) exist in the area, ensure that Best Management Practices as described in Company's Erosion &Sedimentation Control Plan ("E&SCP") are utilized to minimize impact to these resources.

Company Responsibility

- If necessary, arrange for sampling the substance for analysis and waste profiling, according to instructions from the Company Standard Operating Procedures, and/ or EHS;
- Document and report activities to EHS as soon as feasible.

6.2 Disposal of Contaminated Materials/Soils

For Company and Contractor protocol on the disposal of contaminated materials, soils, or any other waste materials, please see the Company Waste Management Plan.

6.3 Notification

Company Responsibility

- The Company SC shall notify the Emergency Spill Hotline at (800) 735-6364 and those listed in Appendix A, Table III, immediately for spills that meet any of the following criteria:
  - one pound or more of a solid material (excluding Horizontal Directional Drill ("HDD") mud) spilled on land;
  - five gallons or more of a liquid spilled on land;
  - creates a sheen on water; or
  - unanticipated release of hydrostatic test water.
- If necessary, notify the local fire department, law enforcement authority, or health authority as appropriate. The following information should be provided:
  - the name of the caller and callback number;
  - the exact location and nature of the incident;
  - the extent of personnel injuries and damage;
  - the extent of release; and
  - the material involved and appropriate safety information.
- An incident report form should be filled out following containment and cleanup of the spill or release. Incident data should be gathered using the *EH&S Incident Investigation Form* (see Appendix C) and should be sent to the appropriate ECP project manager for records retention and entry into the EPASS/ILP database.

7.0 HOUSEKEEPING PROGRAM

7.1 Construction Area

Contractor Responsibility

- Maintain construction area in neat and orderly manner; and
- Routinely collect and properly dispose of all trash off-site.

7.2 Contractor Yards/Ware Yards

Contractor Responsibility

- Produce a "site specific" plan to address storage, spill prevention and overall yard organization for all contractor yards and ware yards. Contractor yard "site specific" plans should include the following:
  - facility name;
  - physical address;
  - longitude and latitude coordinates;
  - directions to facility (including road names);
  - date of first oil and hazardous material storage;
  - location of oil and hazardous material containers greater than 55 gallons;
  - loading/unloading areas;
  - direction of drainage flow; and
  - primary and secondary evacuation routes.
- Provide adequate aisle spacing to allow unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment as necessary in storage areas;
- Ensure similar housekeeping practices enforced in construction areas are also implemented in storage areas; and
- Any facility with an aggregate aboveground oil storage capacity greater than 1,320 US gallons but less than 10,000 gallons must have the plan self-certified by the owner or operator of the qualified facility or a licensed Professional Engineer. Any facility with an aggregate aboveground oil storage capacity greater than 10,000 gallons must have the plan reviewed and certified by a licensed Professional Engineer.

7.3 Security

Contractor Responsibility

- Hazardous wastes and waste containing PCBs greater than 50 ppm will be stored in a secured location (i.e. fenced, locked, etc.). Fuel storage areas will be located to minimize, as much as possible, tampering by unauthorized personnel during non-operational hours.
- Complete Table V, Waste Storage Security Information, in Appendix A, prior to construction.

Company Responsibility

- Review Table V, Waste Storage Security Information in Appendix A, that has been prepared by the Contractor prior to construction.

Project Signatures:

Company Spill Coordinator:

Print Name

Signature Date

Contractor Spill Coordinator

Print Name

Signature Date

APPENDIX A - TABLES

TABLE I – MATERIAL AND WASTE INVENTORY

Oil and Fuel to be used or stored on site during construction:

STORAGE CAPACITY OF OIL FILLED-CONTAINERS

Container Number[a/]	Storage capacity (volume)	Location

[a/] The reference container numbers should correspond to the facility diagram in Appendix E.

Commercial Chemicals to be used or stored on site during construction:

Hazardous and Non-Hazardous Wastes to be used or stored on site during construction:

Incompatible Materials to be used or stored on site during construction:

Type of Temporary Containment containers to be used:

TABLE I TO BE COMPLETED BY CONTRACTOR Prior to the Start of Construction and updated as necessary

TABLE II – EMERGENCY RESPONSE AND PERSONAL PROTECTIVE EQUIPMENT

Spill Response:

Equipment	Quantity	Location

Fire Protection:

Equipment	Quantity	Location

Personnel Protection:

Equipment	Quantity	Location

TABLE II TO BE COMPLETED BY CONTRACTOR
Prior to the Start of Construction and updated as necessary

TABLE III – KEY EMERGENCY CONTACTS

The list of key personnel who will be contacted in the event of an emergency or spill incident include:

1. ***Company Emergency Contacts*** Contact Name Phone Number

Company Spill Coordinator & Environmental Inspector (within 15 minutes identifying of incident)

24-hour Emergency Spill Hotline -- 1-800-735-6364
(within 15 minutes of identifying incident)

Regional Environmental Coordinator
(within 15 minutes of identifying incident)

ECP's Project Environmental Lead / PM
(notify within 60 minutes of incident & submit Spill Report Form within 24 hours to ECP PM)

Company Project Manager

Company Environmental Coordinator

Field Construction
Company Construction Coordinator

2. ***Contractor Emergency Contact***

Contractor Spill Coordinator

3. ***Local Authorities*** – As necessary

Emergency contact for Police, Fire & Medical assistance ***Dial 911***

Non-Emergency Local Authorities or Contacts		
Location	**Contact**	**Phone Number**

4. Environmental Agencies

Notification to be made by Regional Environmental Coordinator and ECP's PM

5. Potential Environmental Remedial Service Contractors

Clean Harbors Environmental Services, Inc.	Howard Alexander	(800) 782-8805
Safety-Kleen (FS), Inc	Edward A. Mitchell	(281) 478-7700
U.S.A. Environment	Cesar Garcia	(713) 425-6925 or (832) 473-5354
WRS Infrastructure and Environment Inc	Steve Maxwell	(281) 731-0886

TABLE III TO BE COMPLETED BY COMPANY
Prior to the Start of Construction and updated as necessary

TABLE IV – TANK AND CONTAINER STORAGE EXCEPTION AREAS

Tank and container storage shall be located in areas that are at least 100 feet from all waterbodies and wetlands.

The below exceptions have been approved by ECP and EHS:

1.

2.

3.

4.

TABLE IV TO BE COMPLETED BY CONTRACTOR
Prior to the Start of Construction and updated as necessary

TABLE V – WASTE STORAGE SECURITY INFORMATION

TABLE V TO BE COMPLETED BY CONTRACTOR
Prior to the Start of Construction and updated as necessary

TABLE VI–AREAS FOR POTENTIAL LEAKS AND SPILLS

1.

2.

3.

4.

TABLE VI TO BE COMPLETED BY CONTRACTOR Prior to the Start of Construction and updated as necessary

APPENDIX B - MSDS

APPENDIX-B

ATTACHMENT

MSDS SHEETS/ANALYSIS "SUPER GEL-X"

Water Well Drilling &
Mineral Exploration Products

AMERICAN Colloid Company
Water/Mineral Division

Super Gel-X
High Yield Bentonite

DESCRIPTION:

- Super Gel-X is a 200 mesh, high viscosity 200-bbl yield, sodium bentonite for use in all freshwater drilling conditions.

RECOMMENDED USE:

- May be used for all types of freshwater mud rotary drilling.

CHARACTERISTICS:

- Highly concentrated for maximum yield.
- Fast and easy mixing.
- Reduces solids and increases lifting power.
- Removes cuttings.
- Cools and lubricates bit.
- Stabilizes bore holes.

MIXING AND APPLICATION:

- Mixing ratios are based on 200-bbl yield material using freshwater. Level of water purity will affect bentonite performance.

- Super Gel-X mixing ratio in lbs. per 100 gallons of water:

  Normal conditions …… 15 to 25 lbs.
  Sand and gravel …….. 25 to 35 lbs.
  Fluid loss controls …… 35 to 40 lbs.

PACKAGING:

- 50 pound, multi-wall, non-tear, waterproof bags, 48 bags per pallet, and all pallets are stretch-wrapped.

1500 W. Shure Drive **Arlington Heights, IL 60004** **1434-(3112) 392-4600**

The information and data contained herein are believed to be accurate and reliable. American Colloid Company makes no warranty of any kind and accepts no responsibility for the results obtained through this application of this information.

MATERIAL SAFETY DATA SHEET

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200.
Standard must be consulted for specific requirements.

PRODUCT NAME: SUPER GEL-X™

Section I MANUFACTURER'S INFORMATION

MANUFACTURER'S NAME & ADDRESS:

CETCO – *Drilling Products Group*
1500 West Shure Drive
Arlington Heights, IL 60004

Date Prepared: June 1, 2002

Telephone Number: 847-392-5800 Fax 847-506.6150
EMERGENCY CONTACT: CHEMTREC 800-424-9300
E-mail: www.cetco.com

Section II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

HAZARDOUS COMPONENTS: (Specific Chemical Identity: Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Crystalline Quartz: CAS# 14808-60-7			*	< 6%
Respirable Crystalline Quartz:			NIOSH	< 2%
Present (TWA)	0.1 mg/m^3	0.1 mg/m^3	50 ug/m^3	
Proposed (TWA)		50.0 ug/m^3		
Nuisance Dust:				
Respirable	5 mg/m^3	5 mg/m^3		
Total Dust	15 mg/m^3	10 mg/m^3		

*** WARNING:** This product contains a small amount of crystalline silica, which may cause delayed respiratory disease if inhaled over a prolonged period of time. Avoid breathing dust. Use NIOSH/MSHA approved respirator where TLV for crystalline silica (Quartz) may be exceeded. IARC Monographs on the evaluation of the Carcinogenic Risk of Chemicals to Humans (volume 68, 1997) concludes that crystalline silica is carcinogenic to humans in the form of quartz. IARC classification 1.

The small quantities of crystalline silica (quartz) found in this product are, under normal conditions, naturally coated with an unremovable layer of amorphous silica and/or bentonite clay. IARC (vol. 68, 1997, pg. 191-192) has stated that crystalline silica (quartz) can differ in toxicity depending on the minerals with which it is combined, citing studies in IARC (vol. 42, 1987, p. 86) which stated that the toxic effect of crystalline silica (quartz) is reduced by the "protective effect...due mainly to clay minerals..."

National Institute for Occupational Safety and Health (NIOSH) has recommended that the permissible exposure limit be changed to 50 micrograms respirable free silica per cubic meter of air (0.05 mg/ m^3) as determined by a full shift sample up to a 10 hour working day, 40 hours per week. *See*: 1974 NIOSH criteria for a recommended Standard for Occupational Exposure to Crystalline Silica should be consulted for more detailed information.

PEL - OSHA Permissible Exposure Limit.

TLV - American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value.

TWA - 8 hour time weighted average

Note: The Permissible Exposure Limits (PEL) reported above are the pre - 1989 limits that were reinstated by OSHA June 30, 1993 following a decision by the United States Circuit Court of Appeals for the 11th Circuit. Federal OSHA is now enforcing these PELs. More restrictive exposure limits may be enforced by some other jurisdictions.

PRODUCT IDENTIFICATION:

Chemical Name: Dry Mixture of Inorganic Mineral Compounds.
NFPA/HMIS: Health - 2, Fire - 0, Reactivity - 0, Specific Hazard - *See Section VI.*
Shipping Class: Not Regulated (DOT / 49CFR, IMDG, ICAO / IATA).

Section III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: Not Applicable.
Vapor Pressure (mm Hg.)**:** Not Applicable.
Vapor Density (AIR = 1)**:** Not Applicable.
Solubility in Water: Negligible.
Specific Gravity (H_2O = 1)**:** 2.5
Melting Point: 1400°F
Evaporation Rate (Butyl Acetate = 1)**:** Not Applicable.
Appearance and Odor: Tan or beige to light gray colored powder to fine granules, odorless.

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PRODUCT NAME: SUPER GEL-X™

Section IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (*Method Used*)**:** Not Available. **Flammable Limits:** Not Available. **LEL** - NA. **UEL** - NA.
Extinguishing Media: Not Applicable. **Special Fire Fighting Procedure:** Not Applicable.
Unusual Fire/Explosion Hazards: Product may pose possible dust explosion under *extremely rare* circumstances or conditions.

Section V REACTIVITY DATA

Stability: Stable **Conditions to Avoid** - None Known.
Incompatibility (*Materials to Avoid*)**:** Powerful oxidizing agents such as fluorine, chlorine trifluoride, manganese trioxide, etc.
Hazardous Decomposition or By-products: Silica will dissolve in hydrofluoric acid producing a corrosive gas, silicon tetrafluoride.
Hazardous Polymerization: Will Not Occur **Conditions to Avoid** - None Known.

Section VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes Skin? No Ingestion? No
Health Hazards (Acute and Chronic):

Inhalation: Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may have the following serious chronic health effects:
Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness and reduced pulmonary function. Smoking exacerbates this disease. Individuals with silicosis are predisposed to develop tuberculosis.
Cancer Status: The International Agency for Research on Cancer has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1 - carcinogenic to humans). Refer to *IARC Monograph 68, Silica, Some Silicates and Organic Fibers* (published in June 1997) in conjunction with the use of these
materials. The National Toxicology Program classifies respirable crystalline silica as "reasonably anticipated to be a carcinogen". For further information *See*: "Adverse effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, page 761-765, 1997.

Other Data with Possible Relevance to Human Health: The small quantities of crystalline silica (quartz) found in this product are, under normal conditions, naturally coated with an unremovable layer of amorphous silica and/or bentonite clay. IARC (Vol. 68, 1997, pg. 191-192) has stated that crystalline silica (quartz) can differ in toxicity depending on the minerals with which it is combined, citing studies in IARC (Vol. 42, 1987 pg. 86) which stated that the toxic effect of crystalline silica (quartz) is reduced by the "protective effect....due mainly to clay minerals..."

Carcinogenicity: NTP? No IARC Monographs? Yes OSHA Regulated? No

Signs and Symptoms of Exposure: Excessive inhalation of generated dust may result in shortness of breath and reduced pulmonary function.

Medical Conditions Generally Aggravated by Exposure: Individuals with respiratory disease, including but not limited to, asthma and bronchitis, or subject to eye irritation should not be exposed to respirable crystalline silica (quartz) dust.

Emergency and First Aid Procedures:
Eyes & Skin: Flush with water.
Gross Inhalation of Dust: Remove to fresh air; give oxygen or artificial respiration if necessary; seek medical attention.
Ingestion: If large amounts are swallowed, get immediate medical attention.

Section VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled: Vacuum if possible to avoid generating airborne dust. Avoid breathing dust. Wear an approved respirator. Avoid adding water; product will become slippery when wet.
Waste Disposal Method: Bury in an approved sanitary landfill, in accordance with federal, state and local regulations.
Precautions to Be Taken in Handling and Storing: Avoid breathing dust, use NIOSH/MSHA approved respirator where TLV limits for Crystalline Silica may be exceeded.
Other Precautions: Slippery when wet.

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PRODUCT NAME: SUPER GEL-X™

Section VIII CONTROL MEASURES

Respiratory Protection: Use appropriate respiratory protection for respirable particulate based on consideration of airborne workplace concentration and duration of exposure arising from intended end use. Refer to the most recent standards of ANSI (z88.2) OSHA (29 CFR 1910.134), MSHA (30 CFR Parts 56 and 57) and NIOSH Respirator Decision Logic.

Ventilation: Use local exhaust as required to maintain exposures below applicable occupational exposure limits (*See Section II*). See also ACGIH "Industrial Ventilation – A Manual for Recommend Practice", (*current edition*).

Protective Gloves: Not Required. **Eye Protection:** Recommended.

Other Protective Clothing or Equipment: None. **Work/Hygienic Practices:** Use good housekeeping practices.

Section IX REGULATORY INFORMATION

SARA 311/312: Hazard Categories for SARA Section 311/312 Reporting: Chronic Health
SARA 313: This product contains the following chemicals subject to annual release reporting requirements under the SARA section 313 (40 CFR 372): None

CERCLA section 103 Reportable Quantity: None

California Proposition 65: *This product contains the following substances known to the state of California to cause cancer and/or reproductive harm: This product contains crystalline silica (respirable); however, the user should note that the small quantities of crystalline silica (quartz) found in this product are, under normal conditions, naturally coated with an unremovable layer of amorphous silica and/or bentonite clay. IARC (Vol. 68, 1997, pg. 191-192) has stated that crystalline silica (quartz) can differ in toxicity depending on the minerals with which it is combined. Citing studies in IARC (Vol. 42, 1987, p. 86) which stated that the toxic effect of crystalline silica (quartz) is reduced by the "protective effect....due mainly to clay minerals...".*

Toxic Substances Control Act: All of the components of this product are listed on the EPA TSCA Inventory or are exempt from notification requirements.

Canadian Environmental Protection Act: All the components of this product are listed on the Canadian Domestic Substances List or exempt from notification requirements.

European Inventory of Commercial Chemical Substances: All the components of this product are listed on the EINECS Inventory or exempt from notification requirements. (The EINECS number for Quartz: 231-545-5)
European Community Labeling Classification: Harmful (Xn)
European Community Risk and Safety Phrases: R40, R48, S22

Japan MITI: All the components of this product are existing chemical substances as defined in the Chemical Substance Control Law.

Australian Inventory of Chemical Substances: All the components of this product are listed on the AICS Inventory or exempt from notification requirements.

Canadian WHMIS Classification: Class D, Division 2, Subdivision A (Very Toxic Material causing other Toxic Effects)

NF-+PA Hazard Rating:	Health: 2	Fire: 0	Reactivity: 0
HMIS Hazard Rating:	Health: *	Fire: 0	Reactivity: 0

***Warning** - Chronic health effect possible - inhalation of silica dust may cause lung injury/disease (silicosis). Take appropriate measures to avoid breathing dust. *See Section II*.

REFERENCES:

Registry for Toxic Effects of Chemical Substances (RTECS), 1995.

Patty's Industrial Hygiene and Toxicology.

NTP Seventh Annual Report on Carcinogens, 1994.

IARC Monograph Volume 68, Silica, Some Silicates and Organic Fibers, 1997.

The information herein has been compiled from sources believed to be reliable and is accurate to the best of our knowledge. However, CETCO cannot give any guarantees regarding information from other sources, and expressly does not make any warranties, nor assumes any liability, for its use.

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APPENDIX-B

ATTACHMENT

MSDS SHEETS/ANALYSIS "MAX GEL"

MAX GEL ™

Certified to ANSI/NSF 60

MAX GEL viscosifier is a premium Wyoming bentonite blended with special extenders producing a viscosifier that will yield more than twice as much viscosity as regular Wyoming bentonite. MAX GEL is a high-yielding, easily mixed, superior mud making bentonite in fresh water.

APPLICATIONS

MAX GEL is used in the following applications to rapidly build mud viscosity and provide superior hole cleaning, as well as to help control lost circulation, formation sloughing and promote hole stability in unconsolidated formations.

- Potable water wells
- Mineral exploration (coring and rotary drilling)
- Horizontal directional drilling
- Blast holes
- Shaft drilling
- Monitor / observation wells
- Gel-foam air drilling applications

ADVANTAGES

- Yields more quickly than API-standard bentonite
- Non-toxic and proven suitable for use in drilling potable water wells
- Increased penetration rates are exhibited due to lower solids content than regular bentonite systems
- Transportation and storage costs are reduced due to lower treatment requirements as compared to bentonite

TYPICAL AMOUNTS OF MAX GEL ADDITIONS ADDED TO FRESH WATER

Drilling Application/Desired Results	lb/100gal	lb/bbl	kg/m3
Normal drilling	15 - 25	6 - 11	15 - 30
In gravel or other poorly consolidated formation	25 - 40	12 - 18	35 - 50
Lost circulation control	35 - 45	15 - 20	40 - 45
Added to freshwater mud to improve hole cleaning properties, increase hole stability and develop filter cakes	5 - 10	2 - 5	6 - 14

LIMITATIONS

- Loses effectiveness in water containing >7500 mg/l sodium chloride / 240 mg/l calcium
- If dispersants or thinners are to be used, they should be added sparingly, using 50% or less of the normal treatment

TYPICAL PHYSICAL PROPERTIES

Physical appearance..... Light tan / gray – green powder
Specific gravity ..... 2.3 - 2.5
Approximate yield..... 220 bbl/ton

TOXICITY AND HANDLING

Bioassay information available upon request. No special requirements are necessary for handling and storage. Avoid inhalation of dust. A dust respirator and goggles are recommended if mixing in an enclosed area.

PACKAGING AND STORAGE

MAX GEL is packaged in 50 lb. (22.7-kg), multi-wall, paper sacks and is available in bulk. Store in a dry location (slip hazard when wet) and minimize dust (use dust-less systems for handling, storage and cleanup).

This material is supplied solely for informational purposes and M-I L.L.C. makes no guarantees or warranties, either expressed or implied, with respect to the accuracy or use of this data. All product warranties and guarantees shall be governed by the Standard Terms of Sale.

MATERIAL SAFETY DATA SHEET
MAX GEL

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: MAX GEL

OTHER NAME: Bentonite

CHEMICAL CLASS: Naturally occuring mineral.

APPLICATIONS: Oil well drilling fluid additive. Viscosifier.

EMERGENCY TELEPHONE: 281-561-1600

SUPPLIER: Supplied by a Business Unit of
M-I L.L.C.
P.O. Box 42842, Houston, Texas 77242-2842
See cover sheet for local supplier.

TELEPHONE: 281-561-1509
FAX: 281-561-7240

CONTACT PERSON: Sam Hoskin - Manager, Occupational Health

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Silica, crystalline, quartz	14808-60-7	2-15 %		
Bentonite	1302-78-9	70-95 %		
Silica, crystalline, Cristobalite	14464-46-1	2-12 %		
Silica, crystalline, Tridymite	15468-32-3	1-5 %		
Gypsum	13397-24-5	0-1 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

This product is a/an gray to tan powder. Slippery when wet. No significant immediate hazards for emergency response personnel are known.

ACUTE EFFECTS:
HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:
CARCINOGENICITY:
IARC: Not listed. NTP: Not listed. OSHA: Not regulated.

ATTENTION! CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC classification Group 1.

ROUTE OF ENTRY:
Inhalation. Skin and/or eye contact.

TARGET ORGANS:
Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (?F): N/D
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:
This material is not combustible. Use extinguishing media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES:
No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:
No unusual fire or explosion hazards noted.

HAZARDOUS COMBUSTION PRODUCTS:
Not relevant.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:

Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Flush the area with water. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Silica, crystalline, quartz	14808-60-7	*		0.1				mg/m3 resp.dust
Bentonite	1302-78-9	5		3				mg/m3 resp.dust
Silica, crystalline, Cristobalite	14464-46-1	*		0.05				mg/m3 resp.dust
Silica, crystalline, Tridymite	15468-32-3	*		0.05				mg/m3 resp.dust
Gypsum	13397-24-5	15						mg/m3 total dust

INGREDIENT COMMENTS:

* OSHA PELs for Mineral Dusts containing crystalline silica are 10 mg/m3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator. For exposures exceeding 10 x PEL use a NIOSH-approved N100 Particulate Respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:
Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.
COLOR:	Grey. to Tan.
ODOR:	Odorless or no characteristic odor.
SOLUBILITY DESCRIPTION:	Insoluble in water.
DENSITY/SPECIFIC GRAVITY (g/ml):	2.3-2.6 TEMPERATURE (?F): 68
BULK DENSITY:	67 lb/ft3; 1068 kg/m3
VAPOR DENSITY (air=1):	N/A
VAPOR PRESSURE:	N/A TEMPERATURE (?F):

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
N/A.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
N/A

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:
No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION:
Contact M-I Environmental Affairs for ecological information.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

DISPOSAL METHODS:

Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ: N/A

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Silica, crystalline, quartz	14808-60-7	Yes	No	No	No	Yes
Bentonite	1302-78-9	Yes	No	No	No	Yes
Silica, crystalline, Cristobalite	14464-46-1	Yes	No	No	No	Yes
Silica, crystalline, Tridymite	15468-32-3	Yes	No	No	No	Yes
Gypsum	13397-24-5	Yes	No	No	No	Yes

US FEDERAL REGULATIONS:
WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.
2. Delayed (Chronic) Health Effects.

The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
DSL (Canada)
EINECS (Europe)

STATE REGULATIONS:

STATE REGULATORY STATUS:

This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

PROPOSITION 65: This product contains the following chemical(s) considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer or reproductive toxicity, and for which warnings are now required: Silica, crystalline

CANADIAN REGULATIONS:
LABELS FOR SUPPLY:

REGULATORY STATUS:

This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: D2A - Other Toxic Effects: Very Toxic Material

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: * 1 Slight Hazard
FLAMMABILITY: 0 Minimal Hazard
REACTIVITY: 0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX: E - Safety Glasses, Gloves, Dust Respirator

USER NOTES:

N/A = Not applicable N/D = Not determined

INFORMATION SOURCES:

OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants.

ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition).

Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997).

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Silica, Some Silicates, Coal Dust, and para-Aramid Fibrils, Vol. 68, World Health Organization, Lyon, France, 1997.
Product information provided by the commercial vendor(s).

PREPARED BY: Sam Hoskin/bb

REVISION No.: 0

MSDS STATUS: Approved.

DATE: June 1, 1999

DISCLAIMER:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

APPENDIX-B

ATTACHMENT

MSDS SHEETS/ANALYSIS "BARA-KADE"

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BARA-KADE® BENTONITE**

Revision Date: 31-Mar-2005

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BARA-KADE® BENTONITE
Synonyms: None
Chemical Family: Mineral
Application: Additive

Manufacturer/Supplier
BPM Minerals LLC
3000 N Sam Houston Parkway East
Houston, TX 77032

Telephone: (281) 871-7900
Fax: (281) 871-7940
Emergency Telephone: (800) 666-9260 or (713) 753-3000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Crystalline silica, cristobalite	14464-46-1	0 - 1%	0.05 mg/m^3	1/2 x $\frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, tridymite	15468-32-3	0 - 1%	0.05 mg/m^3	1/2 x $\frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, quartz	14808-60-7	1 - 5%	0.05 mg/m^3	$\frac{10\ mg/m^3}{\%SiO2 + 2}$
Bentonite	1302-78-9	60 - 100%	Not applicable	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

3. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media All standard firefighting media.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Flammability 0, Reactivity 0, Health 0*

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Various
Odor:	Odorless
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	50-70
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data: Stable

Hazardous Polymerization: Will Not Occur

Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye or skin contact, inhalation.

Inhalation

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Skin Contact May cause mechanical skin irritation.

Eye Contact May cause eye irritation.

Ingestion None known

Aggravated Medical Conditions Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: TLM96: 10000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity For This Product	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	D2A Very Toxic Materials (Crystalline silica)

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

APPENDIX-B

ATTACHMENT

POTENTIAL ADDITIVES MSDS PRODUCT SHEETS

MATERIAL SAFETY DATA SHEET
POLYPAC R

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME:	POLYPAC R
CHEMICAL CLASS:	Polyanionic cellulose polymer.
APPLICATIONS:	Oil well drilling fluid additive. Fluid Loss reducer
EMERGENCY TELEPHONE:	281-561-1600
SUPPLIER:	Supplied by a Business Unit of M-I L.L.C. P.O. Box 42842, Houston, Texas 77242-2842 See cover sheet for local supplier.
TELEPHONE:	281-561-1509
FAX:	281-561-7240
CONTACT PERSON:	Sam Hoskin - Manager, Occupational Health

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Carboxymethylcellulose sodium salt	9004-32-4	100 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.
This product is a/an white powder. May form explosive dust-air mixtures. Slippery when wet. A nuisance dust.

ACUTE EFFECTS:
HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:
CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ROUTE OF ENTRY:
Inhalation. Skin and/or eye contact.

TARGET ORGANS:
Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (°F): N/D
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:
Carbon dioxide (CO_2). Dry chemicals. Foam. Water spray, fog or mist.

SPECIAL FIRE FIGHTING PROCEDURES:
No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:
Dust in high concentrations may form explosive mixtures with air.

HAZARDOUS COMBUSTION PRODUCTS:
Irritating gases/vapors/fumes. Oxides of: Carbon.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:
Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Flush the area with water. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:
Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:
Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

INGREDIENT NAME:	CAS No.:	OSHA PEL: TWA:	OSHA PEL: STEL:	ACGIH TLV: TWA:	ACGIH TLV: STEL:	OTHER: TWA:	OTHER: STEL:	UNITS:
Carboxymethylcellulose sodium salt	9004-32-4							No std.

INGREDIENT COMMENTS:
This product is regulated as nuisance particulates (dust/mist/aerosol). TLV: 3 mg/m3 resp. dust; PEL: 5 mg/m3 resp. dust.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:
Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator.

PROTECTIVE GLOVES:
Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:
Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:
Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:
Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE: Powder, dust.
COLOR: White.
ODOR: Odorless or no characteristic odor.
SOLUBILITY DESCRIPTION: Soluble in water.
DENSITY/SPECIFIC GRAVITY (g/ml): 1.5-1.6 TEMPERATURE (°F): 68
BULK DENSITY: 548 kg/m3
VAPOR DENSITY (air=1): N/A
VAPOR PRESSURE: N/A TEMPERATURE (°F):
pH-VALUE, DILUTED SOLUTION: 6.5-8.0 CONCENTRATION (%,M): 1%

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
Avoid heat.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXIC DOSE - LD 50: 27000 mg/kg (oral rat)

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION:
No ecological information is available for this product.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.
Empty containers retain residues. All labeled precautions must be observed.

DISPOSAL METHODS:
Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ: N/A

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Carboxymethylcellulose sodium salt	9004-32-4	Yes	No	No	No	Yes

US FEDERAL REGULATIONS:

WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.

The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
DSL (Canada)

STATE REGULATIONS:

STATE REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

CANADIAN REGULATIONS:

REGULATORY STATUS: This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: Not a Controlled Product.

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: 1 Slight Hazard
FLAMMABILITY: 1 Slight Hazard
REACTIVITY: 0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX: E - Safety Glasses, Gloves, Dust Respirator

USER NOTES: N/A = Not applicable N/D = Not determined

INFORMATION SOURCES: OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants.

ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition).

Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997).
Product information provided by the commercial vendor(s).

PREPARED BY:	Sam Hoskin/bb
REVISION No./Repl. MSDS of:	2/November 4, 1997
MSDS STATUS:	Approved.
DATE:	August 30, 1999

DISCLAIMER:
MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET
POLY-PLUS (LIQUID)

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME:	POLY-PLUS (LIQUID)
CHEMICAL CLASS:	Anionic polyacrylamide
APPLICATIONS:	Oil well drilling fluid additive. Shale control agent.
EMERGENCY TELEPHONE:	281-561-1600
SUPPLIER:	Supplied by a Business Unit of M-I L.L.C. P.O. Box 42842, Houston, Texas 77242-2842 See cover sheet for local supplier.
TELEPHONE:	281-561-1509
FAX:	281-561-7240
CONTACT PERSON:	Sam Hoskin - Manager, Occupational Health

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Petroleum distillates, hydrotreated light	64742-47-8	20-40 %		
Anionic polyacrylamide		60-80 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

This product is a/an white liquid. Dike and contain spills. Keep out of sewers and waterways. Slippery when wet.

ACUTE EFFECTS:

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:

CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ROUTE OF ENTRY:

Inhalation. Skin and/or eye contact.

TARGET ORGANS:
Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

FLASH POINT (°F):	>201	METHOD: PM Closed cup.
AUTO IGNITION TEMP. (°F):	N/D	
FLAMMABILITY LIMIT - LOWER(%):	N/D	
FLAMMABILITY LIMIT - UPPER(%):	N/D	

EXTINGUISHING MEDIA:
Carbon dioxide (CO_2). Dry chemicals. Foam. Water spray, fog or mist.

SPECIAL FIRE FIGHTING PROCEDURES:
Wear positive-pressure, self-contained breathing apparatus (SCBA) and protective fire fighting clothing (including fire fighting helmet, coat, pants, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

UNUSUAL FIRE & EXPLOSION HAZARDS:
No unusual fire or explosion hazards noted.

HAZARDOUS COMBUSTION PRODUCTS:
Irritating gases/vapors/fumes. Oxides of: Carbon. Nitrous gases (NO_x). and Hydrogen chloride (HCl).

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:
Absorb in vermiculite, dry sand or earth and place into containers. Rinse area with water. Dike far ahead of larger spills for later disposal. Do not contaminate drainage or waterways.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:
Ventilate well, avoid breathing vapors. Use approved respirator if air contamination is above accepted level. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed.

STORAGE PRECAUTIONS:
Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Petroleum distillates, hydrotreated light	64742-47-8	5 *		5 *	10 *	2000 **		mg/m3
Anionic polyacrylamide								No std.

INGREDIENT COMMENTS:
* Exposure limits are for Oil mist, mineral. ** OSHA PEL for Petroleum Distillates, naphtha.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:
Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: If exposed to particulates/aerosols:
Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator.
If exposed to organic vapors:
Use a NIOSH/MSHA-approved organic vapor respirator.

PROTECTIVE GLOVES:
Chemical resistant gloves required for prolonged or repeated contact. Use protective gloves made of: Impermeable material. Such as, Neoprene, nitrile, polyethylene or PVC.

EYE PROTECTION:
Wear chemical safety goggles where eye exposure is reasonably probable.

PROTECTIVE CLOTHING:
Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:
Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Liquid.	
COLOR:	White.	
ODOR:	Hydrocarbon.	
SOLUBILITY DESCRIPTION:	Slightly soluble in water.	
SOLUBILITY VALUE (g/100g H2O 68°F):	5	
BOILING POINT (°F, interval):	212	PRESSURE: 760mmHg
MELT./FREEZ. POINT (°F, interval):	32	
DENSITY/SPECIFIC GRAVITY (g/ml):	1.00- - 1.05	TEMPERATURE (°F): 68
VAPOR DENSITY (air=1):	N/D	
VAPOR PRESSURE:	>0.13	TEMPERATURE (°F): 68
EVAPORATION RATE:	N/D	REFERENCE:
pH-VALUE, DILUTED SOLUTION:	8.7	CONCENTRATION (%,M): 1%

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
Avoid heat.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:
No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

ACUTE AQUATIC TOXICITY:
This product passes the mysid shrimp toxicity test required by the U.S. Environmental Protection Agency (EPA) Region VI (Gulf of Mexico) NPDES Permit, which regulates offshore discharge of drilling fluids, when tested in a standard drilling fluid. Contact M-I's Environmental Affairs Department for more information.

This product is approved for use under the U.S. Environmental Protection Agency (EPA) Region IX (California) General NPDES Permit which regulates offshore discharges of drilling fluids. Contact M-I's Environmental Affairs Department for more information.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.
Empty containers retain residues. All labeled precautions must be observed.

DISPOSAL METHODS:
Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

GENERAL: RQ = N/A

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Petroleum distillates, hydrotreated light	64742-47-8	Yes	No	No	No	Yes
Anionic polyacrylamide		Yes	No	No	No	Yes

US FEDERAL REGULATIONS:
WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.
SARA 311 Categories:
1: Immediate (Acute) Health Effects.

The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
PROPOSITION 65: This product does not contain chemicals considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer or reproductive toxicity, and for which warnings are now required.

STATE REGULATIONS:
STATE REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

CANADIAN REGULATIONS:
REGULATORY STATUS: This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: Not a Controlled Product.

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: 1 Slight Hazard
FLAMMABILITY: 1 Slight Hazard
REACTIVITY: 1 Slight Hazard

NPCA HMIS PERS. PROTECT. INDEX:	J - Splash Goggles, Gloves, Synthetic Apron, Dust and Vapor Respirator.
USER NOTES:	N/A = Not applicable N/D = Not determined
PREPARED BY:	Sam Hoskin
REVISION No./Repl. MSDS of:	2/June 3, 1998
MSDS STATUS:	Approved.
DATE:	June 27, 2001

DISCLAIMER:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET
DUOVIS

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: DUOVIS

CHEMICAL CLASS: Biopolymer.

APPLICATIONS: Oil well drilling fluid additive. Viscosifier

EMERGENCY TELEPHONE: 281-561-1600

SUPPLIER: Supplied by a Business Unit of
M-I L.L.C.
P.O. Box 42842, Houston, Texas 77242-2842
See cover sheet for local supplier.

TELEPHONE: 281-561-1509
FAX: 281-561-7240

CONTACT PERSON: Sam Hoskin

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Xanthan gum	11138-66-2	100 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. Do not take internally.

This product is a/an white to tan powder. May form explosive dust-air mixtures. Slippery when wet. No significant immediate hazards for emergency response personnel are known.

ACUTE EFFECTS:

HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:

CARCINOGENICITY:
IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ROUTE OF ENTRY:
Inhalation. Skin and/or eye contact.

TARGET ORGANS:
Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (°F): >392
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:
Carbon dioxide (CO_2). Dry chemicals. Foam. Water spray, fog or mist.

SPECIAL FIRE FIGHTING PROCEDURES:
No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:
Dust in high concentrations may form explosive mixtures with air.

HAZARDOUS COMBUSTION PRODUCTS:
Irritating gases/vapors/fumes. Oxides of: Carbon.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:
Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Xanthan gum	11138-66-2	15		10				mg/m3 total dust

INGREDIENT COMMENTS:

Exposure limits are for Particulates Not Otherwise Classified (PNOC).

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:

Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.
COLOR:	White. to Tan.
ODOR:	Slight.
SOLUBILITY DESCRIPTION:	Soluble in water.
DENSITY/SPECIFIC GRAVITY (g/ml):	N/D TEMPERATURE (°F):
BULK DENSITY:	50 lb/cu. ft.; 805 kg/m3
VAPOR DENSITY (air=1):	N/A
VAPOR PRESSURE:	N/A TEMPERATURE (°F):
pH-VALUE, DILUTED SOLUTION:	5.4 - 8.6 CONCENTRATION (%,M): 1%

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
Avoid heat.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

Komponent: **Xanthan gum**

TOXIC DOSE - LD 50: >5000 mg/kg (oral rat)

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION:
No ecological information is available for this product.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.

DISPOSAL METHODS:
Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Xanthan gum	11138-66-2	Yes	No	No	No	Yes

US FEDERAL REGULATIONS:

WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.

The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
DSL (Canada)
EINECS (Europe)

STATE REGULATIONS:

STATE REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

CANADIAN REGULATIONS:

REGULATORY STATUS: This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: Not a Controlled Product.

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: 1 Slight Hazard
FLAMMABILITY: 1 Slight Hazard
REACTIVITY: 0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX: E - Safety Glasses, Gloves, Dust Respirator

USER NOTES: N/A = Not applicable N/D = Not determined

INFORMATION SOURCES:

OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants.

ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition).

Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997). Product information provided by the commercial vendor(s).

PREPARED BY: Sam Hoskin

REVISION No./Repl. MSDS of: 1 / September 9, 1994

MSDS STATUS: Approved.

DATE: January 22, 1998

DISCLAIMER:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET
SUPER-VIS

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: SUPER-VIS

CHEMICAL CLASS: Biopolymer.

APPLICATIONS: Oil well drilling fluid additive. Viscosifier

EMERGENCY TELEPHONE: 281-561-1600

SUPPLIER: Supplied by a Business Unit of
M-I L.L.C.
P.O. Box 42842, Houston, Texas 77242-2842
See cover sheet for local supplier.

TELEPHONE: 281-561-1509
FAX: 281-561-7240

CONTACT PERSON: Sam Hoskin - Manager, Occupational Health

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Xanthan gum	11138-66-2	100 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

This product is a/an white tan transparent powder. May form explosive dust-air mixtures. Slippery when wet. A nuisance dust.

ACUTE EFFECTS:
HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:

CARCINOGENICITY:
IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ROUTE OF ENTRY:
Inhalation. Skin and/or eye contact.

TARGET ORGANS:
Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (°F): >392
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:
Carbon dioxide (CO_2). Dry chemicals. Foam. Water spray, fog or mist.

SPECIAL FIRE FIGHTING PROCEDURES:
No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:
Dust in high concentrations may form explosive mixtures with air.

HAZARDOUS COMBUSTION PRODUCTS:
Irritating gases/vapors/fumes. Oxides of: Carbon.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:
Carefully sweep up and put in closed containers. Avoid making dust. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Xanthan gum	11138-66-2	5		3				mg/m3 resp.dus

INGREDIENT COMMENTS:

Exposure limits are for Particulates Not Otherwise Classified (PNOC).

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:

Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.
COLOR:	White. to Tan.
ODOR:	Slight.
SOLUBILITY DESCRIPTION:	Soluble in water.

DENSITY/SPECIFIC GRAVITY (g/ml): N/D TEMPERATURE (°F):
BULK DENSITY: 50 lb/cu. ft.; 805 kg/m3
VAPOR DENSITY (air=1): N/A
VAPOR PRESSURE: N/A TEMPERATURE (°F):
pH-VALUE, DILUTED SOLUTION: 5.4 - 8.6 CONCENTRATION (%,M): 1%

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
Avoid heat.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

Component: **Xanthan gum**

TOXIC DOSE - LD 50: >5000 mg/kg (oral rat)

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION:
No ecological information is available for this product.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.

DISPOSAL METHODS:
Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ: N/A

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Xanthan gum	11138-66-2	Yes	No	No	No	Yes

US FEDERAL REGULATIONS:
WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.

The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
DSL (Canada)
EINECS (Europe)

STATE REGULATIONS:
STATE REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

CANADIAN REGULATIONS:
REGULATORY STATUS: This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: Not a Controlled Product.

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: 1 Slight Hazard
FLAMMABILITY: 1 Slight Hazard
REACTIVITY: 0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX: E - Safety Glasses, Gloves, Dust Respirator

USER NOTES: N/A = Not applicable N/D = Not determined

INFORMATION SOURCES: OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants.

ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition).

Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997). Product information provided by the commercial vendor(s).

PREPARED BY: Sam Hoskin

REVISION No.: 0

MSDS STATUS: Approved.

DATE: August 26, 1998

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DRILPLEX HDD

A specialty product used to enhance MAX GEL. DRILPLEX HDD is an inorganic chemical viscosifier for water-based bentonite drilling fluids. DRILPLEX HDD is only slightly soluble in water.

ADVANTAGES

DRILPLEX HDD allows the formulation of fluids with exceptional shear-thinning properties. A uniquely novel type of drilling fluid is the result showing both excellent dynamic and static carrying capacity for solids. This is indicated by high yield point and low plastic viscosity readings. When not circulating, the mud reverses instantaneously to a gelled state and results in high suspending capacity indicated by high, non-progressive gel strength readings.

Benefits achievable with DRILPLEX HDD fluids include:

- High rate of penetration
- Optimum cuttings transport
- Excellent solids suspension
- Borehole stabilization
- Low drilling costs

APPLICATIONS

For 300 gallons of drilling fluid mix:

1. Add 1&1/2 sacks (75 pounds) Max Gel in fresh water and hydrate for 10 minutes. If higher rheological properties are desired then mix more gel. For every 7 lb. of additional gel added the yield point will rise approximately 20 points.
2. After the gel is hydrated add 6 pounds of DRILPLEX HDD (3 Vis cups). Mix for an additional 5-10 minutes.
3. For torque reduction add 1.5 gallons of Rod Ease.

LIMITATIONS

DRILPLEX HDD fluids are not compatible with anionic products. Do not add any polymers or thinners to this fluid. These materials will destroy the rheological properties of the fluid. It is important that the mixing tank is cleaned before mixing DRILPLEX HDD .

TYPICAL PHYSICAL PROPERTIES

Appearance:	Off-white powder
Odor:	None
Specific Gravity:	2.8-3.1
Solubility:	Slight

TOXICITY AND HANDLING

Bioassay information available upon request. No special requirements are necessary for handling and storage. Avoid inhalation of dust. A dust respirator and goggles are recommended if mixing in an enclosed area.

PACKAGING AND STORAGE

40 pound sack

How does DRILPLEX HDD work?

To understand how DRILPLEX HDD -based fluids can help you drill cleaner more trouble-free holes it is helpful to understand the chemistry behind the fluid. DRILPLEX HDD is not a polymer and unlike many polymers, the incorporation of DRILPLEX HDD in drilling fluid systems results in low solids shear thinning fluids that do not degrade at high shear rates. DRILPLEX HDD -based drilling fluids develop a gel structure capable of remarkable solids suspension, yet exhibit low viscosity flow characteristics.

Mixed compounds are insoluble, crystalline inorganic compounds containing two or more metals in a unique hydroxide lattice. Each DRILPLEX HDD crystal has a positive charge due to its crystalline structure.

DRILPLEX HDD crystals are sheet-like platelets that, when dispersed, are considerably smaller than an average particle of bentonite or attapulgite. The combination of small particle size and positive charge causes DRILPLEX HDD crystals to interact with clay particles via an ion exchange mechanism, resulting in a unique gel structure. When a positively charged DRILPLEX HDD particle reacts with a negatively charged clay particle, a new compound is formed which is capable of remarkable solids suspension.

The DRILPLEX HDD /clay complex exhibits unique behavior. At rest it behaves like an elastic solid. However, when force is applied, the structure is fractured and flow occurs along the fracture line. When the force is removed, the fracture heals instantly, restoring the structure to its elastic solid state. Results of experiments confirm that DRILPLEX HDD -based fluids behave initially like elastic solids. As greater strain is applied to the system, these fluids are transformed to viscous liquids.

The most important result of this inter-particle association is the unique ability of DRILPLEX HDD -based fluids to exhibit low viscosity at the drill bit, yet gel quickly as flow decreases, thereby carrying and suspending cuttings. Cuttings are suspended during bit/reamer trips, preventing hole fill and stuck pipe problems. If the drilling/reaming operation is halted for any reason, you can pick up right where you left off, at the bottom of the hole, without significant fill even after days.

Traditionally, high fluid viscosity or turbulent flow has been required to achieve good hole cleaning performance. Because of their unique rheology, DRILPLEX HDD -based systems carry and suspend solids better than high viscosity systems. And this is accomplished at very low flat rates. Outstanding hole cleaning coupled with low solids shear thinning allow DRILPLEX HDD -based systems to provide a high rate of penetration.

The rheology modifier meets all EPA requirements for toxicity and environmental safety:

The rheology modifier is low in toxicity and meets EPA requirements. In environmentally sensitive areas such as offshore waters this can mean decreased expenditures for cleanup and reduced handling precautions. Mycid shrimp test done on generic fluids Numbers 1 & 7 containing The rheology modifier showed no increase in toxicity when run by ENSR Laboratories using EPA protocol. All submitted rheology modifier-based fluids passed the required tests for drilling in Gulf of Mexico Federal Waters.

This material is supplied solely for informational purposes and M-I L.L.C. makes no guarantees or warranties, either expressed or implied, with respect to the accuracy or use of this data. All product warranties and guarantees shall be governed by the Standard Terms of Sale.

MATERIAL SAFETY DATA SHEET

Trade Name: DRILPLEX HDD **MSDS NO.** 12013

Revision Date: 10/30/2001

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name: **DRILPLEX HDD**

Synonyms:	None	**HMIS Rating**	
Chemical Family:	Not Determined	**Health:**	3
Product Use:	Rheology modifier for HDD fluids	**Flammability:**	1
UN/NA PIN No:	Not Regulated	**Reactivity:**	0
WHMIS Class:	D2B	**PPE:**	E

Emergency Telephone (24 hr.): 281-561-1600

Supplied by a Business Unit of:
M-I L.L.C.
5950 North Course Drive
Houston, TX 77072
Phone: (281) 561-1509
Fax: (281) 561-7240

Contact Person: Sam Hoskin - Manager, Occupational Health
Revision Date: 10/30/2001
Revision Number: 1
MSDS Status: Approved

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient/CAS	**Wt. %**
Metal oxides/hydroxide, alkali salts NONE	60-100
Calcium hydroxide 1305-62-0	1-5

Ingredient Comments: No comments.

3. HAZARDS IDENTIFICATION

Emergency Overview: WARNING! Harmful if swallowed. Can cause burns to eyes and moist skin. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. This product is a/an Off-white powder

Potential Health Effects:
Acute Effects

Eye Contact: Causes eye irritation.
Inhalation: Irritating to the respiratory tract if inhaled.
Ingestion: Harmful if swallowed.
Skin Contact: Causes severe skin irritation.
Chronic Effects

Sensitization: Not determined.

Carcinogenicity:

Cancer Comments: IARC: Not Listed; OSHA: Not regulated; NTP: Not listed

Principle Routes of Exposure: Inhalation. Dermal - skin. Eyes.

Target Organ Effects: Respiratory System. Lungs. Skin. Eyes.

Signs and Symptoms: Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

Medical Conditions Aggravated By Exposure:
Respiratory conditions.

Environmental Effects and Hazards:
Environmental effects have not been determined.

4. FIRST AID MEASURES

Eye Contact: In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion: Do not induce vomiting. Drink two glasses of water. Call a physician immediately.

Inhalation: Move person to fresh air. Perform artificial respiration if breathing has stopped. Get medical attention.

Skin Contact: Remove contaiminated clothing. wash skin with water, using soap if available. Get medical attention if any discomfort continues.

General Notes: Persons seeking medical attention should carry a copy of this MSDS with them.

Notes To Physician: None known.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: °F	Not Determined	**°C**	Not Determined
Flash Point Method:	Not Determined		
Flammable Limits in Air - Lower (%):	Not Determined		
Flammable Limits in Air - Upper (%):	Not Determined		
Autoignition Temperature: °F	Not Determined	**°C**	Not Determined

Flammability Class: Non-Combustible

Other Flammable Properties: Dusts at sufficient concentrations can form explosive mixtures with air.

Extinguishing Media: Use extinguishing media appropriate for surrounding fire. This material is not combustible.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: No specific fire fighting procedure given.
Hazardous Combustion Products: Irritating gases/vapors/fumes. Oxides of: Carbon.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protective equipment identified in Section 8.
Spill Procedures: Avoid the generation of dust.
Sweep, vacuum, or shovel and place into closable container for disposal. Cover and move the containers. Flush the area with water. Repackage or replace if possible.
Environmental Precautions: Do not allow to enter sewer or surface and subsurface waters.

7. HANDLING AND STORAGE

Handling: Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Wash thoroughly after handling. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.
Storage: Store at room temperature in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits

Ingredient/CAS	Wt. %	ACGIH TLV TWA	ACGIH TLV STEL	ACGIH TLV Ceiling:	ACGIH Skin	OSHA PEL TWA	OSHA PELs Ceiling:	OSHA PELs Skin	Notes
Metal oxides/hydroxide, alkali salts NONE	60-100	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	None
Calcium hydroxide 1305-62-0	1-5	5 mg/m3 TWA	Not Listed	Not Listed	Not Listed	5 mg/m3 (resp)	Not Listed	Not Listed	None

Engineering Controls: Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to ensure air contamination and keep workers exposure below the applicable limits.

Personal Protection Equipment

Eye/Face Protection: Wear dust resistant safely goggles where there is a danger of eye contact.

Skin Protection: Wear appropriate clothing to prevent repeat or prolonged skin contact.

Respiratory Protection: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol, use at least NIOSH-approved P95 half-mask disposable or reuseable particulate respirator. For exposure exceeding 10 x PEL use a NIOSH-approved N100

Particulate Respirator.

General Hygiene Considerations: Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possability of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Dust
Color: Off-white
Odor: Odorless
Physical State: Powder
pH Value, Conc. Sol.: Not Determined
pH Value Diluted Sol.: 11-12
Vapor Pressure: N/A
Vapor Density (Air=1): N/A
Boiling Point (°F): Not determined.
Melting/Freezing Point: Not determined.
Solubility in Water Description: Not Determined
Solubility: Moderately soluble
Density/Specific Gravity: Not Determined
Bulk Density at 20°C: 125 - 156 lb/cu ft; 2000 - 2500 kg/m3
Evaporation Rate: Not Determined
Odor Threshold Lower: NA
Odor Threshold Upper: Unknown

10. STABILITY AND REACTIVITY

Chemical Stability: Stable
Conditions to Avoid: High humidity conditions.
Materials to Avoid: Maleic anhydride. Nitroparaffins. Strong acids.
Hazardous Decomposition Products: None known
Hazardous Polymerization: Will not occur

11. TOXICOLOGICAL INFORMATION

Toxicological Data

Ingredient/CAS	Wt. %	Route	Species	Dose	Duration	Effect	Source
Metal oxides/hydroxide, alkali salts NONE	60-100	N/D	N/D				N/D
Calcium hydroxide 1305-62-0	1-5	N/D	N/D				N/D

Toxicological Information: No toxicological data is available for this product. Toxicological data for major components is listed.

12. ECOLOGICAL INFORMATION

Ecotoxicological Data

Ingredient/CAS	Wt. %	Species	Concentration	Duration	Source
Metal oxides/hydroxide, alkali salts NONE	60-100	N/D		N/D	N/D
Calcium hydroxide 1305-62-0	1-5	N/D		N/D	N/D

Chemical Fate Data

Biodegration: Not determined.
Bioaccumulation: Not determined
Octanol/Water Partition Coefficient: None Known

Ecological Information: No ecological information is available for this product.

13. DISPOSAL CONSIDERATIONS

Waste Classification: Not determined.
Waste Management: Not determined.
Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

Hazardous Materials Description: Not Regulated
U.S. DOT
- **Proper Shipping Name:** Not Regulated
- **Hazard Class:** None
- **Subsidiary Harzard:** None
- **UN/NA Number:** Not Regulated
- **DOT Packing Group:** None
- **Packaging Authorizations:** None
- **Product RQ:** Not determined.
- **Emergency Response Guide No.:** Not determined.

TDG (Canada):
- **Proper Shipping Name:** Not Regulated
- **Hazard Class:** Not regulated.
- **Subsidiary Hazard:** None
- **UN/NA PIN No:** Not Regulated
- **Packing Group:** None

IMDG:
- **Proper Shipping Name:** Not Regulated
- **Hazard Class:** Not regulated.
- **Subsidiary Hazard:** None
- **UN No.:** Not Regulated
- **Packing Group:** None

EMS No.: None
Marine Pollutant: None

ICAO/IATA:
Proper Shipping Name: Not Regulated
Hazard Class: Not regulated.
Subsidiary Hazard: None
UN No.: Not Regulated
Packing Group: None

15. REGULATORY INFORMATION

US Federal Regulations

SARA 311/312:

SARA 311/312 Hazard Catagories: Immediate (acute) health hazard;

Metal oxides/hydroxide, alkali salts 60-100 **NONE**

SARA 313	Not Listed
CERCLA	Not Listed
SARA 302 / TPQs	Not Listed

Calcium hydroxide 1-5 **1305-62-0**

SARA 313	Not Listed
CERCLA	Not Listed
SARA 302 / TPQs	Not Listed

State Regulations

State Comments: Proposition 65: This product does not contain chemicals considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer or reproductive toxicity, and for which warnings are now required.

Metal oxides/hydroxide, alkali salts 60-100 **NONE**

California Prop. 65 Cancer list	Not Listed
California Prop. 65 Developmental Toxicity	Not Listed
California Prop. 65 Reproductive Female	Not Listed
California Prop. 65 Reproductive Male	Not Listed

Calcium hydroxide 1-5 **1305-62-0**

California Prop. 65 Cancer list	Not Listed
California Prop. 65 Developmental Toxicity	Not Listed
California Prop. 65 Reproductive Female	Not Listed
California Prop. 65 Reproductive Male	Not Listed

International Inventories

TSCA - Sect. 8(b) Inventory	This product complies with TSCA.
Canada - Domestic Substances Inventory	This product complies with Canadian DSL.
Canada - Non-Domestic Substances Inventory	This product does not comply with Canadian NDSL.

Canadian Regulations

Controlled Products Regulations Statement:	This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.
WHMIS Class:	D2B

16. OTHER INFORMATION

Notes: N/D = Not Determined; N/A = Not Applicable

Information Sources:

OSHA Permissible Exposure Limits, 29 CRF 1910, Subpart Z, Sections 1910.1000, Air Contaminates.
ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (Latest edition).
Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr.,(ed), VNR, New York, New York,(1997).
IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Silica, Some Silicates, Coal Dust, and para-Aramid Fibrils, Vol. 68, World Health Organization, Lyon, France, 1997.
Product information provided by the commercial vendor(s).

The following has been revised since the last issue of this MSDS:
Nothing has been revised.

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Certified to ANSI/NSF 60

SODA ASH

SODA ASH is used in water-base mud as a source of carbonate ions to precipitate calcium, increase pH, or flocculate spud mud. SODA ASH is the common name for sodium carbonate (Na_2CO_3). It is a weak base which is soluble in water and dissociates into sodium (Na) and carbonate (CO_3) ions in solution.

APPLICATIONS

SODA ASH is primarily used to reduce soluble calcium in water-based drilling muds and make-up waters. Other uses include increasing pH and flocculating spud muds.. Calcium is present in many make-up waters and formations. It can cause flocculation of the mud resulting in increased rheology, gel strengths and fluid loss. High filtrate calcium will cause precipitation of calcium-sensitive additives such as the acrylic polymers POLY-PLUS® (PHPA) and RINGFREE®, which are the most sensitive. Cellulosic polymers POLYPAC® (PAC) and CMC are only slightly calcium-sensitive and tolerate moderate levels of filtrate calcium. Typical treatments of SODA ASH range from 0.25 to 2 lb/bbl (0.7 to 5.7 kg/m^3), dependent on the calcium level and water chemistry of the drilling fluid. One pound (0.45 kg) of SODA ASH will remove the calcium from 1.283 pounds (0.58 kg) calcium sulfate (anhydrite). Treatments should be made on an incremental basis to prevent over-treatment which results in carbonate contamination.

In pure water, SODA ASH forms highly buffered solutions which range between a pH of 10.9 to 11.6 at concentrations of 0.21 to 30 lb/bbl (0.6 to 86 kg/m^3) AT CONCENTRATIONS OF 0.21 TO 30 lb/bbl. (0.6 to 86 kg/m^3). Carbonate ions begin being converted into bicarbonate (HCO_3) ions when the pH decreased below 11.3.

ADVANTAGES

- Widely available and an economic source of carbonate ions to precipitate calcium while increase pH
- Concentrate chemical; effectively removes calcium in most drilling fluids at small treatment levels
- Effective flocculant for spud muds

LIMITATIONS

- Increases pH and should not be used to treat cement contamination or higher pH fluids; less soluble at high pH
- Over-treatment results in carbonate contamination; even minor amounts of excess carbonate ions can cause large increases in yield point, gel strengths and fluid loss

TYPICAL PHYSICAL PROPERTIES

Physical appearance---------- White powder
Specific gravity ---------- 2.51
pH (1% solution) ---------- 11.4
Solubility ---------- Soluble in water (51 g/100 ml at 86°F/30°C)

TOXICITY AND HANDLING

Bioassay information is available upon request. Handle as an industrial chemical, wearing protective equipment and observing the precautions as described on the Transportation and Material Safety Data Sheets (MSDS). SODA ASH is an alkaline material which may cause irritation to eyes, skin or respiratory tract. SODA ASH should be added slowly to the mud system either by mixing through the hopper or chemical barrel. Do not mix SODA ASH with other chemicals, especially caustic soda or lime. When using a chemical barrel, mix SODA ASH into a full barrel of fresh water and provide adequate agitation.

PACKAGING AND STORAGE

SODA ASH is packaged in 100-lb (45.4-kg) and 50 lb (22.7-kg), multi-wall, paper sacks. SODA ASH is a globally available commercial chemical. Store in a dry area away from water or acids

This material is supplied solely for informational purposes and M-I L.L.C. makes no guarantees or warranties, either expressed or implied, with respect to the accuracy or use of this data. All product warranties and guarantees shall be governed by the Standard Terms of Sale.

MATERIAL SAFETY DATA SHEET
SODA ASH

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: SODA ASH

CHEMICAL CLASS: Sodium carbonate

APPLICATIONS: Oil well drilling fluid additive. Calcium precipitation

EMERGENCY TELEPHONE: 281-561-1600

SUPPLIER: Supplied by a Business Unit of
M-I L.L.C.
P.O. Box 42842, Houston, Texas 77242-2842
See cover sheet for local supplier.

TELEPHONE: 281-561-1509
FAX: 281-561-7240

CONTACT PERSON: Sam Hoskin - Manager, Occupational Health

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Sodium carbonate	497-19-8	100 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

amber white powder. Slippery when wet. A nuisance dust.

ACUTE EFFECTS:
HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:
CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ROUTE OF ENTRY:
Inhalation. Skin and/or eye contact.

TARGET ORGANS:
Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (°F): N/D
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:
Carbon dioxide (CO_2). Dry chemicals. Foam. Water spray, fog or mist.

SPECIAL FIRE FIGHTING PROCEDURES:
No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:
No unusual fire or explosion hazards noted.

HAZARDOUS COMBUSTION PRODUCTS:
Irritating gases/vapors/fumes. Oxides of: Carbon. and Sodium.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:
Carefully sweep up and put in closed containers. Avoid making dust. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:
Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:
Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Sodium carbonate	497-19-8	5		3				mg/m3 resp.dust

INGREDIENT COMMENTS:
Exposure limits are for Particulates Not Otherwise Classified (PNOC).

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:
Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator.

PROTECTIVE GLOVES:
Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:
Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:
Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:
Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.	
COLOR:	White.	
ODOR:	Odorless or no characteristic odor.	
SOLUBILITY DESCRIPTION:	Soluble in water.	
MELT./FREEZ. POINT (°F, interval):	1564	
DENSITY/SPECIFIC GRAVITY (g/ml):	2.509	TEMPERATURE (°F): 68
BULK DENSITY:	48 lb/ft3; 769 kg/m3	
VAPOR DENSITY (air=1):	N/A	
VAPOR PRESSURE:	N/A	TEMPERATURE (°F):
pH-VALUE, DILUTED SOLUTION:	11.4	CONCENTRATION (%,M): 1%

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
Reacts with hydrated lime to form sodium hydroxide.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
Strong acids.

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

Component: **Sodium carbonate**

TOXICOLOGICAL DATA:

Corrosive effects.	Eye irritation test.	24 hours.	Eye.	Rabbit.	100 mg - Moderate Irritation
Corrosive effects.		24 hours.	Skin.	Rabbit.	500 mg - Mild Irritaiton

TOXIC DOSE - LD 50: 4090 mg/kg (oral rat)
TOXIC CONC. - LC 50: 1200 mg/m3/2h (inh-mus)

12. ECOLOGICAL INFORMATION

ACUTE AQUATIC TOXICITY:
This product is approved for use under the U.S. Environmental Protection Agency (EPA) Region IX (California) General NPDES Permit which regulates offshore discharges of drilling fluids. Contact M-I's Environmental Affairs Department for more information.
This product passes the mysid shrimp toxicity test required by the U.S. Environmental Protection Agency (EPA) Region VI (Gulf of Mexico) NPDES Permit, which regulates offshore discharge of drilling fluids, when tested in a standard drilling fluid. Contact M-I's Environmental Affairs Department for more information.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.

DISPOSAL METHODS:
Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ: N/A

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Sodium carbonate	497-19-8	Yes	No	No	No	Yes

US FEDERAL REGULATIONS:
WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.

The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
EINECS (Europe)
DSL (Canada)

STATE REGULATIONS:
STATE REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

PROPOSITION 65: This product does not contain chemicals considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer or reproductive toxicity, and for which warnings are now required.

CANADIAN REGULATIONS:
LABELS FOR SUPPLY:

REGULATORY STATUS: This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: D2B - Other Toxic Effects: Toxic Material

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX:	1 Slight Hazard
FLAMMABILITY:	1 Slight Hazard
REACTIVITY:	0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX:	E - Safety Glasses, Gloves, Dust Respirator
USER NOTES:	N/A = Not applicable N/D = Not determined
INFORMATION SOURCES:	OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants. ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition). Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997). Product information provided by the commercial vendor(s).
PREPARED BY:	Sam Hoskin/bb
REVISION No./Repl. MSDS of:	2/January 27, 1998
MSDS STATUS:	Approved.
DATE:	June 16, 2000

DISCLAIMER:
MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET
SMOOTH GROUT 20

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME:	SMOOTH GROUT 20
OTHER NAME:	Bentonite
CHEMICAL CLASS:	Naturally occuring mineral.
APPLICATIONS:	Oil well drilling fluid additive. Viscosifier.
EMERGENCY TELEPHONE:	281-561-1600
SUPPLIER:	Supplied by a Business Unit of M-I L.L.C. P.O. Box 42842, Houston, Texas 77242-2842 See cover sheet for local supplier.
TELEPHONE:	281-561-1509
FAX:	281-561-7240
CONTACT PERSON:	Sam Hoskin

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Silica, crystalline, quartz	14808-60-7	2-6 %		
Bentonite	1302-78-9	94-98 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

This product is a/an to tan transparent powder. Slippery when wet. A nuisance dust.

ACUTE EFFECTS:
HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:
CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ATTENTION! CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC classification Group 1.

ROUTE OF ENTRY:

Inhalation. Skin and/or eye contact.

TARGET ORGANS:

Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (°F): N/D
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:

This material is not combustible. Use extinguishing media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES:

No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:

No unusual fire or explosion hazards noted.

HAZARDOUS COMBUSTION PRODUCTS:

Not relevant.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:

Carefully sweep up and put in closed containers. Avoid making dust. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Silica, crystalline, quartz	14808-60-7	*		0.1				mg/m3 resp.dust
Bentonite	1302-78-9	5		3				mg/m3 resp.dust

INGREDIENT COMMENTS:

* OSHA PELs for Mineral Dusts containing crystalline silica are 10 mg/m3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator. For exposures exceeding 10 x PEL use a NIOSH-approved N100 Particulate Respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:

Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE: Powder, dust.
COLOR: Grey. to Tan.

ODOR:	Odorless or no characteristic odor.
SOLUBILITY DESCRIPTION:	Insoluble in water.
DENSITY/SPECIFIC GRAVITY (g/ml):	2.3-2.6 TEMPERATURE (°F): 68
BULK DENSITY:	48-52lb/ft3; 769-833 kg/m3
VAPOR DENSITY (air=1):	N/A
VAPOR PRESSURE:	N/A TEMPERATURE (°F):

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
N/A.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
N/A

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:
No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

ACUTE AQUATIC TOXICITY:
This product passes the mysid shrimp toxicity test required by the U.S. Environmental Protection Agency (EPA) Region VI (Gulf of Mexico) NPDES Permit, which regulates offshore discharge of drilling fluids, when tested in a standard drilling fluid. Contact M-I's Environmental Affairs Department for more information.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.

DISPOSAL METHODS:
Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Silica, crystalline, quartz	14808-60-7	Yes	No	No	No	Yes
Bentonite	1302-78-9	Yes	No	No	No	Yes

US FEDERAL REGULATIONS:
WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.
2. Delayed (Chronic) Health Effects.
The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
EINECS (Europe)
DSL (Canada)

STATE REGULATIONS:
STATE REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

CANADIAN REGULATIONS:
LABELS FOR SUPPLY:

REGULATORY STATUS: This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: D2A - Other Toxic Effects: Very Toxic Material

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX:	* 1 Slight Hazard
FLAMMABILITY:	0 Minimal Hazard
REACTIVITY:	0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX:	E - Safety Glasses, Gloves, Dust Respirator
USER NOTES:	N/A = Not applicable N/D = Not determined
INFORMATION SOURCES:	OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants. ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition). Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997). IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Silica, Some Silicates, Coal Dust, and para-Aramid Fibrils, Vol. 68, World Health Organization, Lyon, France, 1997.
PREPARED BY:	Sam Hoskin/bb
REVISION No./MSDS of:	01/July 20, 1998
MSDS STATUS:	Approved.

DATE: February 5, 2002

DISCLAIMER:
MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET

Product ID: 12096
Revision Date: 08/05/2002

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name: MAX BORE HDD
Chemical Family: Mixture
Product Use: Oil well drilling fluid additive.
Emergency Telephone (24 hr.): 281-561-1600

Supplied by a Business Unit of: M-I L.L.C.
5950 North Course Dr.
Houston, TX 77072
Telephone: 281-561-1511
Fax: 281-561-7240
Contact Person: Catherine Miller, Occupational Health

Revision Number: New

WHMIS Class: D2A
UN PIN No: Not regulated

HMIS Rating
Health: 1* **Flammability:** 1 **Physical Hazard:** 0 **PPE:** E

HMIS Key: 4=Severe, 3=Serious, 2=Moderate, 1=Slight, 0=Minimal Hazard. *Chronic effects - See Section 11. See Section 8 for Personal Protective Equipment recommendations.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS NO:	Wt. %	Ingredient Comments:
Bentonite	1302-78-9	60 - 100	No comments.
Silica, crystalline, Cristobalite	14464-46-1	5 - 10	No comments.
Silica, crystalline, quartz	14808-60-7	5 - 10	No comments.
Silica, crystalline, Tridymite	15468-32-3	1 - 5	No comments.

3. HAZARDS IDENTIFICATION

Emergency Overview: Caution! May cause eye, skin, and respiratory tract irritation. Long term inhalation of particulates may cause lung damage. Cancer hazard. Contains crystalline silica which may cause lung cancer. There is sufficient evidence that inhaled crystalline silica causes cancer in humans. IARC classification group I carcinogen. Risk of cancer depends on duration and level of exposure.

Potential Health Effects:

Acute Effects

Eye Contact: May irritate eyes.
Skin Contact: May be irritating to the skin.
Inhalation: May be irritating to the respiratory tract if inhaled.
Ingestion: May cause gastric distress, nausea and vomiting if ingested.

Chronic Effects

Carcinogenicity & Chronic Effects: IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC Classification Group I. Crystalline silica is classified by the National Toxicology Program (NTP) as "reasonably anticipated to be a human carcinogen" (6th Annual Report on Carcinogens, 1991).

Routes of Exposure: Inhalation. Dermal (skin) contact. Eyes.
Target Organs: Respiratory System. Skin. Eyes.
Medical Conditions Aggravated By Exposure: Respiratory and skin conditions.

4. FIRST AID MEASURES

Eye Contact: Promptly wash eyes with lots of water while lifting eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

Skin Contact: Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before reuse. Get medical attention if any discomfort continues.

Inhalation: Move person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion: Dilute with 2 - 3 glasses of water or milk, if conscious. Never give anything by mouth to an unconscious person. If signs of irritation or toxicity occur seek medical attention.

General Notes: Persons seeking medical attention should carry a copy of this MSDS with them.

Notes To Physician: None known.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: F (C) Not applicable
Flash Point Method: Not applicable

Flammable Limits in Air - Lower (%): Not applicable
Flammable Limits in Air - Upper (%): Not applicable

Autoignition Temperature: F(C) Not applicable
Flammability Class: Not applicable
Other Flammable Properties: Not determined.
Extinguishing Media: Use extinguishing media appropriate for surrounding fire. This material is not combustible.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: Do not enter fire area without proper personal protective equipment, including NIOSH/MSHA approved self-contained breathing apparatus. Evacuate area and fight fire from a safe distance. Water spray may be used to keep fire-exposed containers cool. Keep water run off out of sewers and waterways.

Hazardous Combustion Products: Not determined.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protective equipment identified in Section 8.

Spill Procedures: Evacuate surrounding area, if necessary. Contain spilled material. Avoid the generation of dust. Sweep, vacuum, or shovel and place into closable container for disposal.

Environmental Precautions: Do not allow to enter sewer or surface and subsurface waters. Waste must be disposed of in accordance with federal, state and local laws.

7. HANDLING AND STORAGE

Handling: Put on appropriate personal protective equipment. Avoid contact with skin and eyes. Avoid generating or breathing dust. Product is slippery if wet. Use only in a well ventilated area. Wash thoroughly after handling.

Storage: Store in dry, well-ventilated area. Keep container closed. Store away from incompatibles.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits

Ingredient	CAS NO:	Wt. %	ACGIH TLV TWA	OSHA PEL TWA	Other	Notes
Bentonite	1302-78-9	60 - 100	Not Listed	Not Listed		(1)
Silica, crystalline, Cristobalite	14464-46-1	5 - 10	0.05 mg/m^3	see Table Z-3		(R)
Silica, crystalline, quartz	14808-60-7	5 - 10	0.05 mg/m^3	see Table Z-3		(R)
Silica, crystalline, Tridymite	15468-32-3	1 - 5	0.05 mg/m^3 TWA (respirable fraction)	see Table Z-3		(R)

Notes:
(1) Control as an ACGIH particulate not otherwise specified (PNOS): 10 mg/m^3 (Inhalable); 3 mg/m^3 (Respirable) and an OSHA particulate not otherwise regulated (PNOR): 15 mg/m^3 (Total); 5 mg/m^3 (Respirable).
(R) Respirable fraction (ACGIH);
Table Z-3: PEL for Mineral Dusts containing crystalline silica are 10 mg/m^3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite.

Engineering Controls: Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to ensure air contamination and keep workers exposure below the applicable limits.

Personal Protection Equipment

Eye/Face Protection: Dust resistant safety goggles.

Skin Protection: Wear appropriate clothing to prevent repeated or prolonged skin contact. Chemical resistant gloves recommended for prolonged or repeated contact. Use protective gloves made of: Neoprene Nitrile

Respiratory Protection: If exposed to particulates/aerosols:
Use at least a NIOSH-approved N95 half-mask disposable particulate respirator.
In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator.
If exposed to organic vapors:
Use a NIOSH/MSHA-approved organic vapor respirator. CCROV: CCR with organic vapor cartridge.

General Hygiene Considerations: Work clothes should be washed separately at the end of each work day. Disposable clothing should be discarded, if contaminated with product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Tan to grey
Odor:	Odorless
Physical State:	Powder
pH:	Not determined.
Vapor Pressure:	Not applicable
Vapor Density (Air=1):	Not determined
Boiling Point:	Not determined
Melting/Freezing Point:	Not determined
Solubility Description:	In water
Solubility:	Insoluble
Density/Specific Gravity:	48 - 52 lb/ft3 (769 - 833 kg/m^3); 2.3 - 2.6 g/cc
Evaporation Rate:	Not applicable
Odor Threshold Lower:	Not determined
Odor Threshold Upper:	Not determined

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Conditions to Avoid:	Not determined.
Materials to Avoid:	Contact with oxidizing agents.
Hazardous Decomposition Products:	None known
Hazardous Polymerization:	Will not occur

11. TOXICOLOGICAL INFORMATION

Component Toxicological Data

Ingredient	Component Toxicological Summary
Bentonite	Prolonged and repeated inhalation of particulate may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma.
Silica, crystalline, quartz	Crystalline silica is the most widely occurring of all minerals. The most common form of silica is sand. One form of crystalline silica, respirable crystalline silica (RCS), is known to be a human carcinogen. This finding is based on sufficient evidence of carcinogenicity from studies in humans indicating a causal relationship between exposure to RCS and increased lung cancer rates in exposed workers (International Agency for Research on Cancer (IARC), 1997)). According to IARC, the overall relative risk associated risk of developing cancer due to exposure to RCS is 1.3 to 1.5. This risk may be influenced by level and length of exposure. The National Toxicology Program (NTP) classifies crystalline silica as "reasonably anticipated to cause cancer in humans" (6th Annual Report on Carcinogens, 1991). Long term inhalation of crystalline silica can also result in the lung disease, silicosis. Symptoms of this disease include coughing and shortness of breath. (NJ HSFS, January 1996)

Product Toxicological Information:
No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

Component Ecotoxicity Data

Ingredient	CAS NO:	Data
Bentonite	1302-78-9	Not determined
Silica, crystalline, Cristobalite	14464-46-1	Not determined
Silica, crystalline, quartz	14808-60-7	Not determined
Silica, crystalline, Tridymite	15468-32-3	Not determined

Product Ecotoxicity Data

Product Data: Contact M-I Environmental Affairs Department for ecotoxicity information.

Chemical Fate Data

Biodegration: Not determined

Bioaccumulation: Not determined

Octanol/Water Partition Coefficient: Not determined

13. DISPOSAL CONSIDERATIONS

Waste Classification: Not determined.

Waste Management: Under RCRA, it is the responsibility of the user to determine at the time of disposal, whether the product meets RCRA criteria for the hazardous waste. This is because product uses, transformations, mixtures, processes, etc., may render the resulting materials hazardous. Empty container retain residues. All labeled precautions must be observed.

Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT
Shipping Description: Not regulated
TDG (Canada):
Shipping Description: Not regulated
UN PIN No: Not regulated

IMDG:
Shipping Description: Not regulated

ICAO/IATA:
Shipping Description: Not regulated

15. REGULATORY INFORMATION

US Regulations

SARA 311/312:

SARA 311/312 Hazard Catagories: Delayed (chronic) health hazard;

Ingredient	SARA 313	CERCLA	SARA 302 / TPQs	CA 65 Cancer	CA 65 Dev. Tox.	CA 65 Repro. F	CA 65 Repro. M
Bentonite	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed
Silica, crystalline, Cristobalite	Not Listed	Not Listed	Not Listed	carcinogen (airborne particles of respirable size); initial date 10/1/88	Not Listed	Not Listed	Not Listed
Silica, crystalline, quartz	Not Listed	Not Listed	Not Listed	carcinogen (airborne particles of respirable size); initial date 10/1/88	Not Listed	Not Listed	Not Listed
Silica, crystalline, Tridymite	Not Listed	Not Listed	Not Listed	carcinogen (airborne particles of respirable size); initial date 10/1/88	Not Listed	Not Listed	Not Listed

State Regulations

State Comments: Proposition 65: This product contains chemical(s) considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 to cause cancer and/or reproductive toxicity. See table under US Regulations for the specific chemicals.

International Inventories

Ingredient	CAS NO:	TSCA	DSL	NDSL	EINECS	AICS
Bentonite	1302-78-9	Listed	Listed	Not Listed	Listed	Listed
Silica, crystalline, Cristobalite	14464-46-1	Listed	Listed	Not Listed	Listed	Listed
Silica, crystalline, quartz	14808-60-7	Listed	Listed	Not Listed	Listed	Listed
Silica, crystalline, Tridymite	15468-32-3	Listed	Listed	Listed	Listed	Listed

Inventory Comment: "Listed" indicates the component is listed or exempt from listing on the chemical inventory.

Canadian Regulations

Controlled Products Regulations Statement: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Class: D2A

16. OTHER INFORMATION

The following has been revised since the last issue of this MSDS:
New issue

Disclaimer:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We can not make any assertions as to its reliability or completeness; therefore, user may rely on it only at user´s risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guartantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET
SMOOTH BORE

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: SMOOTH BORE

OTHER NAME: Bentonite/polymer blend

APPLICATIONS: Oil well drilling fluid additive.

EMERGENCY TELEPHONE: 281-561-1600

SUPPLIER: Supplied by a Business Unit of
M-I L.L.C.
P.O. Box 42842, Houston, Texas 77242-2842
See cover sheet for local supplier.

TELEPHONE: 281-561-1509
FAX: 281-561-7240

CONTACT PERSON: Sam Hoskin - Manager, Occupational Health

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Silica, crystalline, quartz	14808-60-7	2-15 %		
Silica, crystalline, Cristobalite	14464-46-1	2-12 %		
Silica, crystalline, Tridymite	15468-32-3	0-1.5		
Gypsum	13397-24-5	0-1 %		
Proprietary ingredients		70.5-96 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

This product is a/an gray to tan Slippery when wet. powder. May form explosive dust-air mixtures.

ACUTE EFFECTS:
HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:
CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ATTENTION! CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC classification Group 1.

ROUTE OF ENTRY:

Inhalation. Skin and/or eye contact.

TARGET ORGANS:

Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do NOT induce vomiting unless directed to do so by a physician. Never give anything by mouth to an unconscious person. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (°F): N/D
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:

Carbon dioxide (CO_2). Dry chemicals. Foam. Water spray, fog or mist.

SPECIAL FIRE FIGHTING PROCEDURES:

No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:

Dust in high concentrations may form explosive mixtures with air.

HAZARDOUS COMBUSTION PRODUCTS:

Irritating gases/vapors/fumes. Oxides of: Carbon.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:

Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Flush the area with water. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Silica, crystalline, quartz	14808-60-7	*		0.1				mg/m3 resp.dust
Silica, crystalline, Cristobalite	14464-46-1	*		0.05				mg/m3 resp.dust
Silica, crystalline, Tridymite	15468-32-3	*		0.05				mg/m3 resp.dust
Gypsum	13397-24-5	15						mg/m3 total dust
Proprietary ingredients		5		3				mg/m3 resp.dust

INGREDIENT COMMENTS:

* OSHA PELs for Mineral Dusts containing crystalline silica are 10 mg/m3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator. For exposures exceeding 10 x PEL use a NIOSH-approved N100 Particulate Respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:
Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.
COLOR:	Grey. to Tan.
ODOR:	Odorless or no characteristic odor.
SOLUBILITY DESCRIPTION:	Insoluble in water.
DENSITY/SPECIFIC GRAVITY (g/ml):	2.3-2.6 TEMPERATURE (°F): 68
BULK DENSITY:	48-52 lb/ft3; 769-833 kg/m3
VAPOR DENSITY (air=1):	N/A
VAPOR PRESSURE:	N/A TEMPERATURE (°F):

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
N/D.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
N/D

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:
No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION:
Contact M-I Environmental Affairs for ecological information.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:

This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.
Empty containers retain residues. All labeled precautions must be observed.

DISPOSAL METHODS:

Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ: N/A

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Silica, crystalline, quartz	14808-60-7	Yes	No	No	No	Yes
Silica, crystalline, Cristobalite	14464-46-1	Yes	No	No	No	Yes
Silica, crystalline, Tridymite	15468-32-3	Yes	No	No	No	Yes
Gypsum	13397-24-5	Yes	No	No	No	Yes
Proprietary ingredients		Yes	No	No	No	Yes

US FEDERAL REGULATIONS:
WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.
2. Delayed (Chronic) Health Effects.
The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)

STATE REGULATIONS:

STATE REGULATORY STATUS:

This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.
Pennsylvania Right-to-Know.
Illinois Right-to-Know.
New Jersey Right-to-Know.

PROPOSITION 65: This product contains the following chemical(s) considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer or reproductive toxicity, and for which warnings are now required:
Silica, crystalline

CANADIAN REGULATIONS:
LABELS FOR SUPPLY:

REGULATORY STATUS:

This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: D2A - Other Toxic Effects: Very Toxic Material

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: * 1 Slight Hazard
FLAMMABILITY: 0 Minimal Hazard
REACTIVITY: 0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX: E - Safety Glasses, Gloves, Dust Respirator

USER NOTES: N/A = Not applicable N/D = Not determined

INFORMATION SOURCES:

OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants.
ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition).
Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997).
IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Silica, Some Silicates, Coal Dust, and para-Aramid Fibrils, Vol. 68, World Health Organization, Lyon, France, 1997.
Product information provided by the commercial vendor(s).

PREPARED BY: Sam Hoskin/bb

REVISION No./Repl. MSDS of: 1/September 25, 1997

MSDS STATUS: Approved.

DATE: January 11, 1999

DISCLAIMER:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

APPENDIX C – EH&S INCIDENT INVESTIGATION FORM

APPENDIX D – REQUIRED SIGNATURE FORMS

Management Approval and Cleanup Commitment
40 CFR §112.7

This Spill Prevention, Control and Countermeasures Plan (Plan), including the Spill Procedures Chart and Supplemental Document, which has been prepared in accordance with 40 CFR 112, has been reviewed and approved by the Project Manager. The Project Manager has the level of authority to commit the necessary resources to fully implement this Plan and to contain and clean up any oil discharged at this facility. By signing below, the **Project Manager** also **authorizes station supervisors to expediently commit manpower, equipment, and materials necessary to contain and remove any harmful quantity of oil discharged from this facility** (40 CFR §112.7). **This commitment includes the authority to use company and/or contract personnel and equipment.**

Facility Name: _____

Location: _____

Signature: _____

Name: _____

Date: _____

Title: _____

CERTIFICATE OF DETERMINATION OF SUBSTANTIAL HARM CRITERIA

Facility Name: _____

Location: _____

Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity greater than or equal to 42,000 gallons? Yes___ No ___

Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and does the facility lack secondary containment that is large enough to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area? Yes___ No ___

Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in rule 40 CFR 112 Attachment C-III or a comparable formula) such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments? For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (see Appendix E to this Part, Section 13, for availability) and the applicable Area Contingency Plan.
Yes___ No ___

Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula) such that a discharge from the facility would shut down public drinking water intake? For the purpose of 40 CFR 112, public drinking water intakes are analogous to public water systems as described in 40 CFR 143.2(c)
Yes___ No ___

Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil discharge in an amount greater than or equal to 10,000 gallons within the last five years?
Yes___ No ___

Certification
I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for this information, I believe that the submitted information is true, accurate, and complete.

Signature: _____
Title: _____

Name (please type or print): _____

Date: _____

APPENDIX E – PIPEYARD / FACILITY STORAGE DRAWING

APPENDIX E

CONTRACTOR IDENTIFICATION AND CONTRACTOR CERTIFICATION STATEMENT

ALGONQUIN AIM PROJECT

CONTACTOR/SUBCONTRACTOR CERTIFICATION STATEMENT
(Section 5(b)(1)(B)(viii)(b) of the General Permit)

"I certify under penalty of law that I have read and understand the terms and conditions of the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities. I understand that as a contractor or subcontractor at the site, I am authorized by this general permit, and must comply with the terms and conditions of this general permit, including but not limited to the requirements of the Stormwater Pollution Control Plan prepared for the site."

Signed:_____ Date:_____

Printed Name: _____ Telephone:_____

Title: _____

Firm:_____ Construction Location:

Firm Address:_____ _____

_____ _____

_____ _____

_____

APPENDIX F

CHAPLIN AND COMPRESSOR STATION DRAINAGE CALCULATIONS AND SITE PLAN

Chaplin, CT Compressor Station

Post Construction Stormwater Management Plan/Calculations

Willbros Professional Services, Engineering is designing the compressor station expansion for Algonquin Gas Transmission, LLC's Chaplin, Connecticut Compressor Station. Upon completion of the project Algonquin Gas Transmission, LLC will operate the expanded station.

The proposed project will construct an additional natural gas compressor, GEC building and related facilities in support of the expansion project at the existing Algonquin Gas Transmission, LLC Compressor Station in Chaplin, Connecticut. The proposed compressor will be constructed entirely within the existing Chaplin compressor station campus located at 539 Tower Hill Road, Chaplin, Windham County, Connecticut. This narrative discusses the analysis and design of the post construction stormwater best management practices (BMPs) planned as part of the compressor station site expansion. BMPs prepared for the compressor station project are in accordance with the 2000 Connecticut Department of Transportation Drainage Manual and the Connecticut Department of Energy and Environmental Protection (CTDEEP) 2004 Connecticut Stormwater Quality Manual.

Drainage Conditions and Hydrology

A hydrologic and hydraulic analysis has been conducted for this project. The watershed analysis for existing and proposed conditions was completed using the HydroCAD Software Solutions computer program. The HydroCAD program is based on NRCS TR-20 methods. The methods described in the NRCS TR-55 manual were followed to calculate the curve number and time of concentration input data for this model.

The existing and proposed drainage areas for the project site were delineated using the site specific survey provided by Willbros Professional Services, Engineering.

Pre-Construction Conditions and Hydrology

The pre-construction topography found at the Chaplin project site directs runoff overland in two general directions. The western portion of the site runoff flows in a north-westerly direction to the low-lying area west of the site. The eastern portion of the site flows in a north-easterly direction to the low lying wetland areas found to the northeast of the site straddling the compressor station access driveway. Only those portions of the site that will experience changes have been included in the post-construction stormwater management calculations. Areas that will not experience any change in topography from the pre-construction to the post-construction state (and thus not experience any change in rate or volume of runoff) have been excluded from analysis. See Attachment A for Pre-Development Drainage Area Maps and Calculations.

The majority of the subject parcel is undeveloped and wooded outside the developed area footprint. The existing developed site consists of a gas metering station and the surfaces consist of a combination of gravel/crushed stone and various pavement (driveways, parking areas, sidewalks, etc.) and roof areas.

Soil types have been determined using the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey. The Custom Soil Report identifies six soil types within the project area. The names of each of the soil types and corresponding hydrologic soil group are defined in Table 1. The majority of the Chaplin project site is HSG C. The Custom Soils Resource Report prepared for the project is provided in Attachment D.

Table 1. NRCS Hydrologic Soil Group Summary

Map Unit Symbol	Map Unit Name	Hydrologic Soil Group	Percentage of Site
3	Ridgebury, Leicester, and Whitman soils, extremely stony	D	12.3%
47C	Woodbridge fine sandy loam, 2 to 15 percent slopes, extremely stony	C	16.0%
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	B	7.4%
62D	Canton and Charlton soils, 15 to 35 percent slopes, extremely stony	B	0.7%
85B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes, very stony	C	0.4%
86C	Paxton and Mantauk fine sandy loams, 3 to 15 percent slopes, extremely stony	C	63.1%

Post Construction Conditions and Hydrology

The existing site will primarily undergo construction just west and just south of the compressor station campus. Permanent surface improvements include the construction of a compressor building, a GEC building, an emergency generator, and paved areas (driveway). Approximately 1,730 SF of existing pavement will be removed. See Attachment B for Post-Development Drainage Area Maps and Calculations.

The post construction hydrology of the site will remain largely unchanged. The northern portion of the will remain as in the pre-construction state, and the newly developed areas will discharge to a rip-rap lined swale / grass bottom detention basin to the west and the existing grass swale to the east.

For detailed information on erosion and sediment control measures, refer to the prepared stormwater pollution prevention plan (SWPPP), submitted under separate cover.

Post-Construction Stormwater Management

The CTDEEP 2004 Connecticut Stormwater Quality Manual provides guiding stormwater management principles aimed to prevent or mitigate urban runoff problems and protect beneficial uses of receiving waters. The manual primarily addresses water quality controls through effective site planning and design, source control practices and pollution prevention, and stormwater treatment practices which are described in detail below.

Site Planning and Design

A guiding principle of effective site planning is to preserve pre-development hydrologic conditions such as runoff volume and rate, groundwater recharge, stream baseflow, and runoff water quality. Site planning practices that designers should consider are listed below.

1. Designing the Development to Fit the Terrain
2. Limiting Land Disturbance Activities
3. Reducing or Disconnecting Impervious Areas
4. Preserving and Utilizing Natural Drainage Systems
5. Providing Setbacks and Vegetated Buffers
6. Minimizing the Creation of Steep Slopes
7. Maintaining Pre-Development Vegetation

The current site plan has been designed using the seven site planning principles.

Source Control Practices

Source control practices and pollution prevention can include a wide variety of management techniques that address stormwater and other nonpoint sources of pollution. Based on the list provided in the CTDEEP 2004 Connecticut Stormwater Quality Manual, appropriate source control practices for the Chaplin, CT compressor station are:

- Street and Parking Lot Sweeping
- Illicit Discharge Detection and Elimination
- Lawn Care and Landscaping Practices
- Employee Education

Stormwater Treatment Practices and Pollution Prevention

Stormwater treatment practices have been designed to accomplish the following primary objectives:

- Pollutant Reduction
- Runoff volume reduction and groundwater recharge
- Stream channel protection and peak flow control

Table 2 summarizes the hydrologic sizing criteria for stormwater treatment practice in Connecticut. The sizing criteria are based on stormwater runoff generated by 24-hour duration storms of various frequencies. Rainfall depth amounts for Windham County, Connecticut for various return frequencies are provided in Table 2, and shall be used for design unless otherwise specified.

Table 2. Design Rainfall Amounts for Windham County

	24-hour Rainfall Amount (inches)				
	1-Year	2-Year	10-Year	25-Year	100-Year
Windham County	2.6	3.2	4.8	5.5	6.9

Pollutant Reduction

The pollutant reduction criterion is designed to improve the water quality of stormwater discharges by treating a prescribed water quality volume or associate peak flow, referred to as the water quality flow.

Water Quality Volume (WQV)

The water quality volume (WQV) is the amount of stormwater runoff from any given storm that should be captured and treated in order to remove a majority of stormwater pollutants on an average annual basis. WQV is calculated using the following equation:

$$WQV = [(1'')(R)(A)]/12$$

Where:

WQV=water quality volume (ac-ft)
R=volumetric runoff coefficient =0.05 + 0.009(I)
I=percent impervious cover
A=site area in acres

For the Chaplin project site, the required water quality volume (WQV) is summarized in Table 3 below.

Table 3. Required Water Quality Volume (WQV)

	I	A	R	WQV (ac-ft)
Watershed 1S	14	1.27	0.176	0.0186
Watershed 2S	15	2.30	0.185	0.0355
Watershed 3S	17	0.71	0.203	0.0120

Peak Flow Control

Peak flow criteria are intended to address increases in the frequency and magnitude of a range of potential flood conditions resulting from development. Natural Resource Conservation Service (NRCS) peak flow calculation methods such as TR-55 or TR-20 should be used to compute the required peak flow rates for each of the criteria described above.

Conveyance Protection

The conveyance system to, from and through stormwater management facilities has been designed based on the peak discharge rate for the 10-year, 24-hour storm. See Table 7, below.

Table 7. Conveyance System Protection Summary (10-Year, 24-Hour)

	Pre-Development	Post-Development	Difference
Watershed 1S	4.38	3.44	(-0.94)
Watershed 2S	4.48	3.55	(-0.93)
Watershed 3S	2.19	1.99	(-0.20)

Peak Runoff Attenuation

The peak runoff attenuation criterion is designed to address increases in frequency and magnitude of flooding caused by development.

The recommended peak runoff attenuation criterion in Connecticut includes control of post-development peak discharge rates from the 10-year, 25-year, and 100-year storms to the corresponding pre-development peak discharge rates as required by the local review authority.

Table 8. Peak Runoff Attenuation Summary (10 Year, 24-Hour)

	Pre-Development	Post-Development	Difference
Watershed 1S	4.38	3.44	(-0.94)
Watershed 2S	4.48	3.55	(-0.93)
Watershed 3S	2.19	1.99	(-0.20)

Table 9. Peak Runoff Attenuation Summary (25 Year, 24-Hour)

	Pre-Development	Post-Development	Difference
Watershed 1S	5.46	4.27	(-1.19)
Watershed 2S	5.58	4.69	(-0.89)
Watershed 3S	2.70	2.46	(-0.24)

Table 10. Peak Runoff Attenuation Summary (100 Year, 24-Hour)

	Pre-Development	Post-Development	Difference
Watershed 1S	7.66	5.95	(-1.71)
Watershed 2S	7.83	7.50	(-0.33)
Watershed 3S	3.74	3.40	(-0.34)

Stormwater Management System Operation / Maintenance

The stormwater management system, including all structural stormwater controls and conveyances, must have an operation and maintenance plan to ensure that it continues to function as designed.

The continued operation and maintenance of the existing vegetated swale and proposed rip-rap lined swale / grass bottom detention basin will be the responsibility of Algonquin Gas Transmission, LLC.

Inspection

The swales and detention basin will be inspected four times per year and after rain event of one-inch or more. The procedure for inspection is as follows:

1. Inspect for damage to vegetation, erosion and debris.
2. Inspect for and remove litter.
3. Document inspection process.

Maintenance

The swales/detention basin will need to be cleaned and maintained periodically. After inspections are performed according to the schedule described above, maintenance will be performed at the discretion

of individuals responsible for the post-construction stormwater management. Maintenance practices area as follows:

Table 11. Maintenance Practice(s)

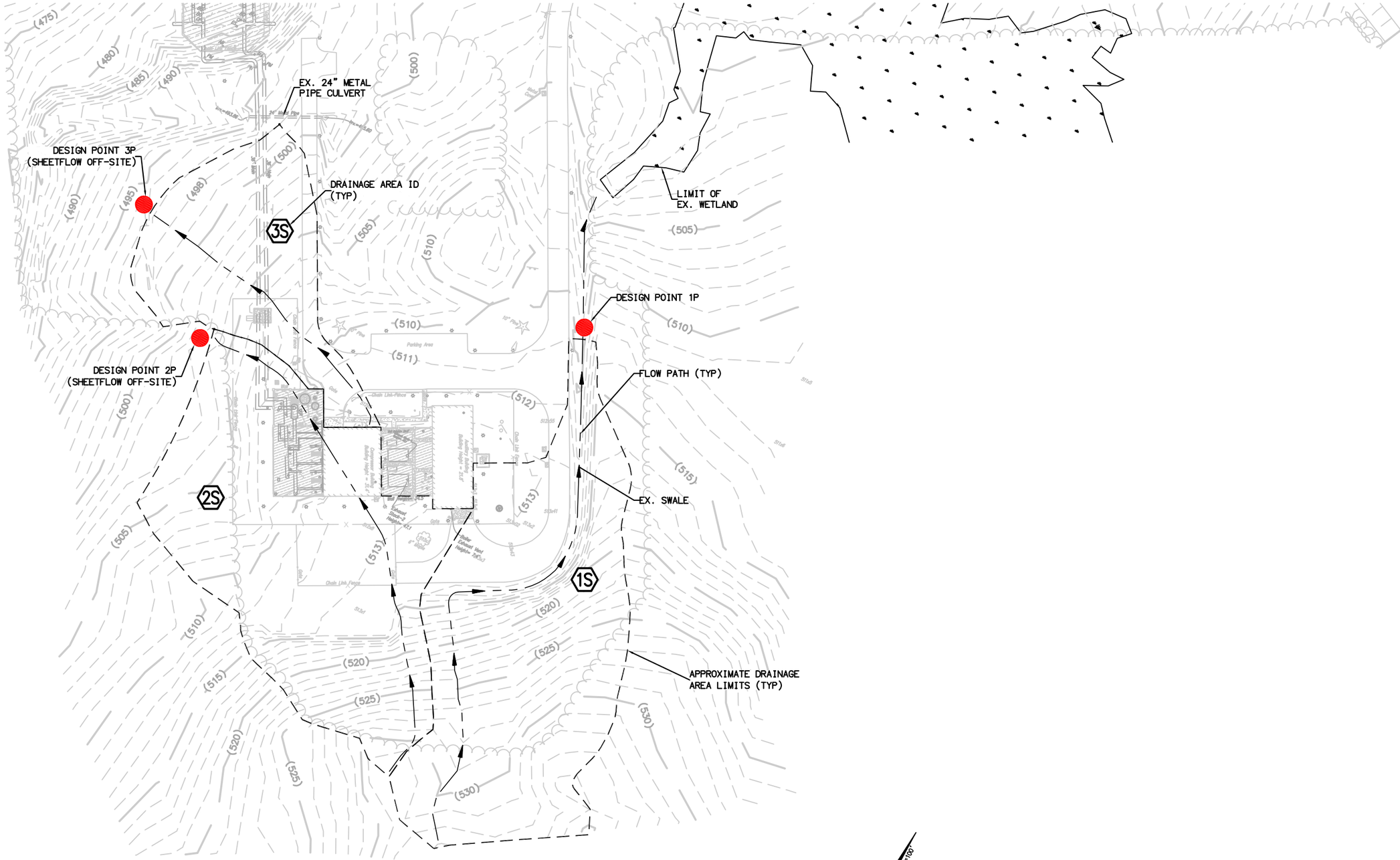
BMP Device	Maintenance Practice	Schedule
Vegetated Swale	Restore grade to original design	As needed
	Mow vegetation for safety and to maintain operation.	As needed; Dry swales should be mowed as required to maintain grass heights of 4 to 6 inches during the growing season.
	Irrigate vegetation	As needed
Detention Basin	Note erosion of pond banks or bottom.	Semiannual inspection
	Inspect for damage to the embankment. Monitor for sediment accumulation in the facility and forebay. Examine to ensure that inlet and outlet devices are free of debris and operational.	Annual inspection
	Repair undercut or eroded areas Mow side slopes. Manage pesticide and nutrients Remove litter and debris.	Standard maintenance
	Seed or sod to restore dead or damaged ground cover.	Annual maintenance (as needed)
	Remove sediment from the forebay.	5- to 7-year maintenance
	Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25 percent.	25- to 50-year maintenance

Additionally, accumulated sediment may need to be removed when it begins to impact vegetative growth or normal surface water flow.

Be sure to conform to all safety regulations when performing maintenance.

Attachment A

Pre-Development Drainage Calculations

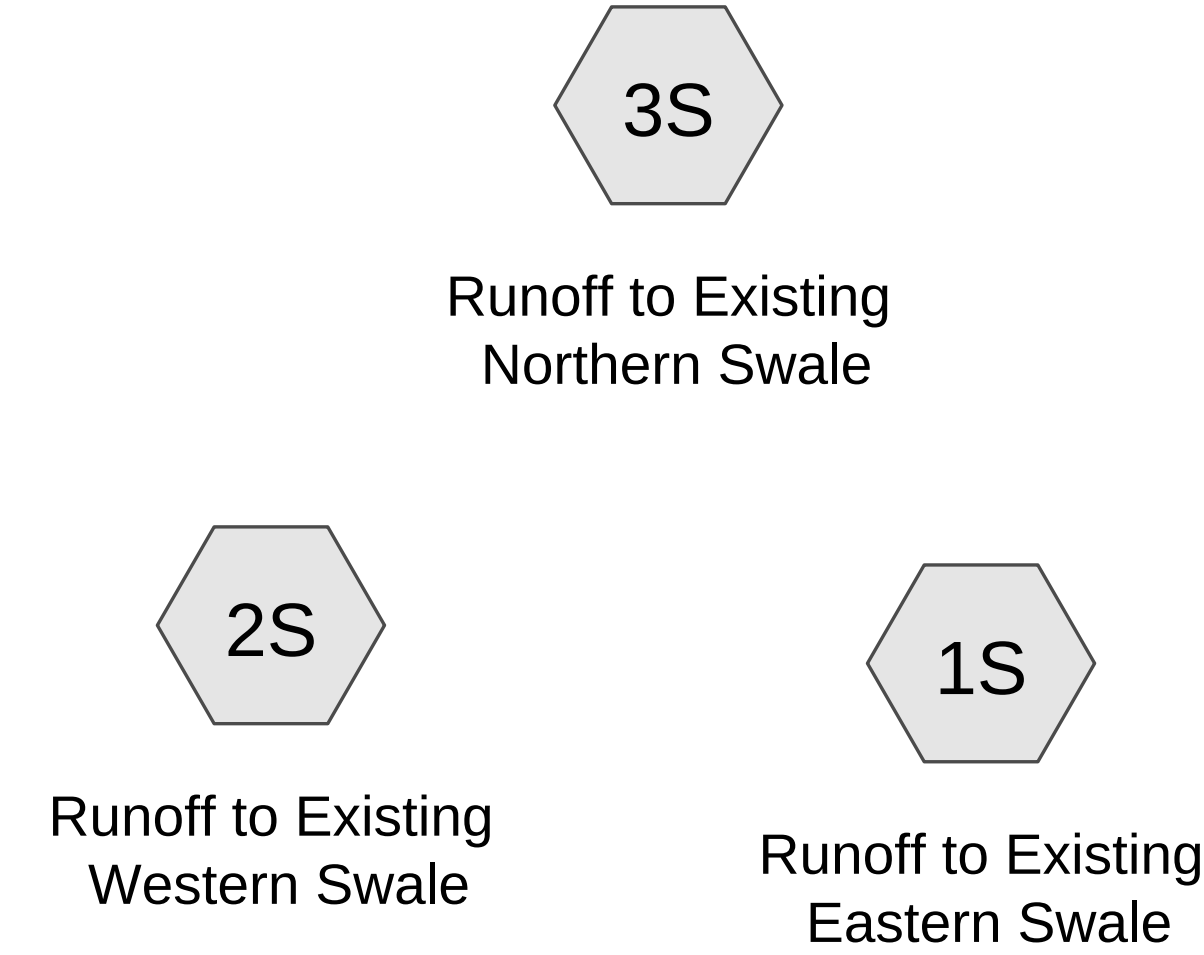


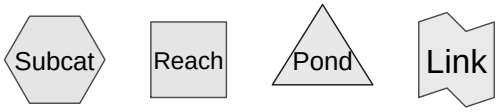
Pre-Development Drainage Area
Chaplin, CT Compressor Station

0 100 200

SCALE:1"=100'

Michael Baker INTERNATIONAL
500 ENTERPRISE DRIVE, SUITE 2B
ROCKY HILL, CT 06067
(860) 563-3044





Routing Diagram for existing, 2014 05 08
Prepared by Michael Baker Corporation, Printed 8/28/2014
HydroCAD® 10.00 s/n 06697 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.404	98	impervious (1S, 2S, 3S)
3.752	74	pervious (1S, 2S, 3S)
4.156	**76**	**TOTAL AREA**

Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Existing Runoff Area=72,766 sf 9.76% Impervious Runoff Depth>0.99"
Tc=5.0 min CN=76 Runoff=2.08 cfs 0.138 af

Subcatchment 2S: Runoff to Existing Runoff Area=74,340 sf 7.04% Impervious Runoff Depth>0.99"
Tc=5.0 min CN=76 Runoff=2.13 cfs 0.141 af

Subcatchment 3S: Runoff to Existing Runoff Area=33,909 sf 15.46% Impervious Runoff Depth>1.11"
Tc=5.0 min CN=78 Runoff=1.08 cfs 0.072 af

Total Runoff Area = 4.156 ac Runoff Volume = 0.351 af Average Runoff Depth = 1.01"
90.29% Pervious = 3.752 ac 9.71% Impervious = 0.404 ac

Summary for Subcatchment 1S: Runoff to Existing Eastern Swale

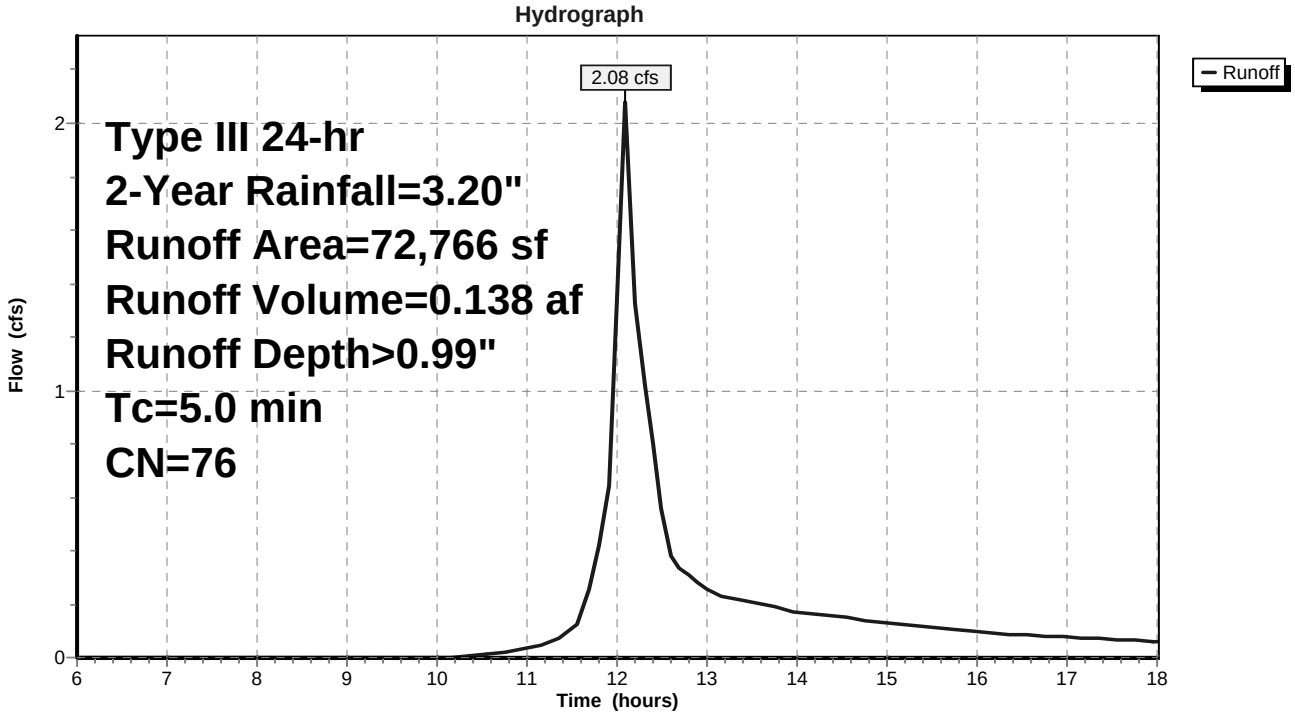
Runoff = 2.08 cfs @ 12.10 hrs, Volume= 0.138 af, Depth> 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	7,105	98	impervious
*	65,661	74	pervious
	72,766	76	Weighted Average
	65,661		90.24% Pervious Area
	7,105		9.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Existing Eastern Swale



Summary for Subcatchment 2S: Runoff to Existing Western Swale

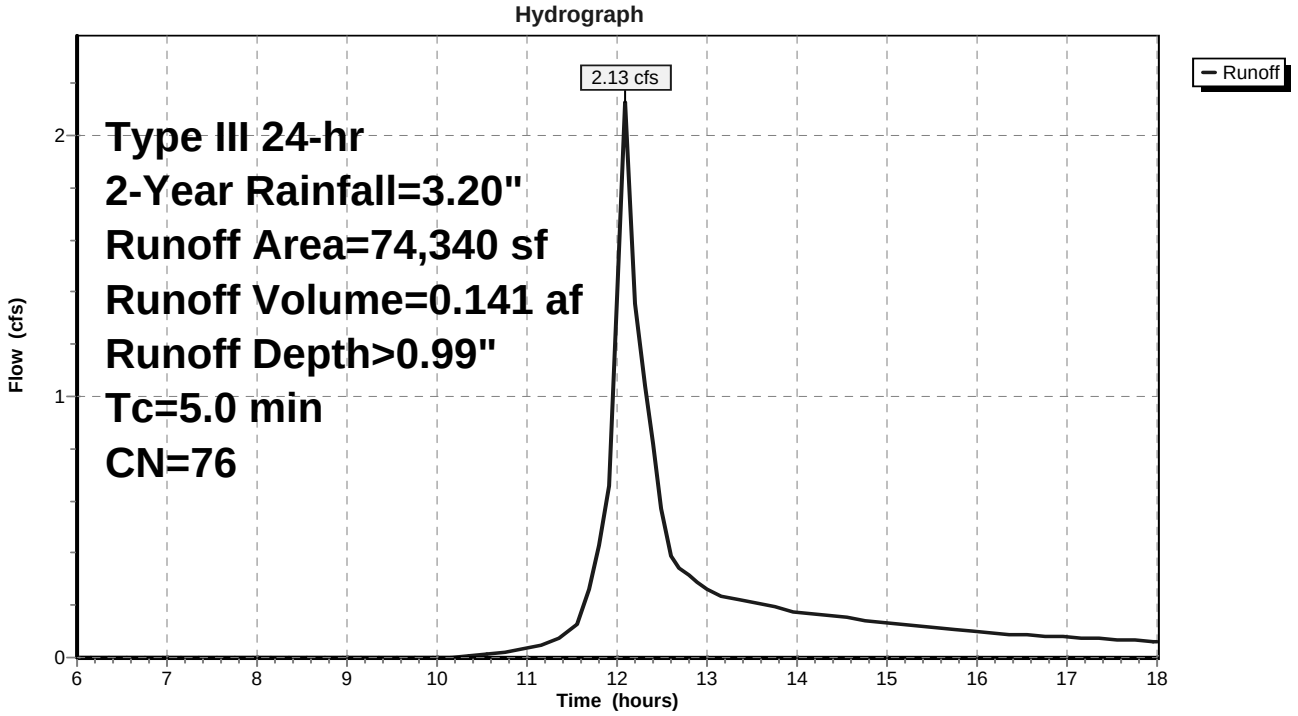
Runoff = 2.13 cfs @ 12.10 hrs, Volume= 0.141 af, Depth> 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	5,236	98	impervious
*	69,104	74	pervious
	74,340	76	Weighted Average
	69,104		92.96% Pervious Area
	5,236		7.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Runoff to Existing Western Swale



Summary for Subcatchment 3S: Runoff to Existing Northern Swale

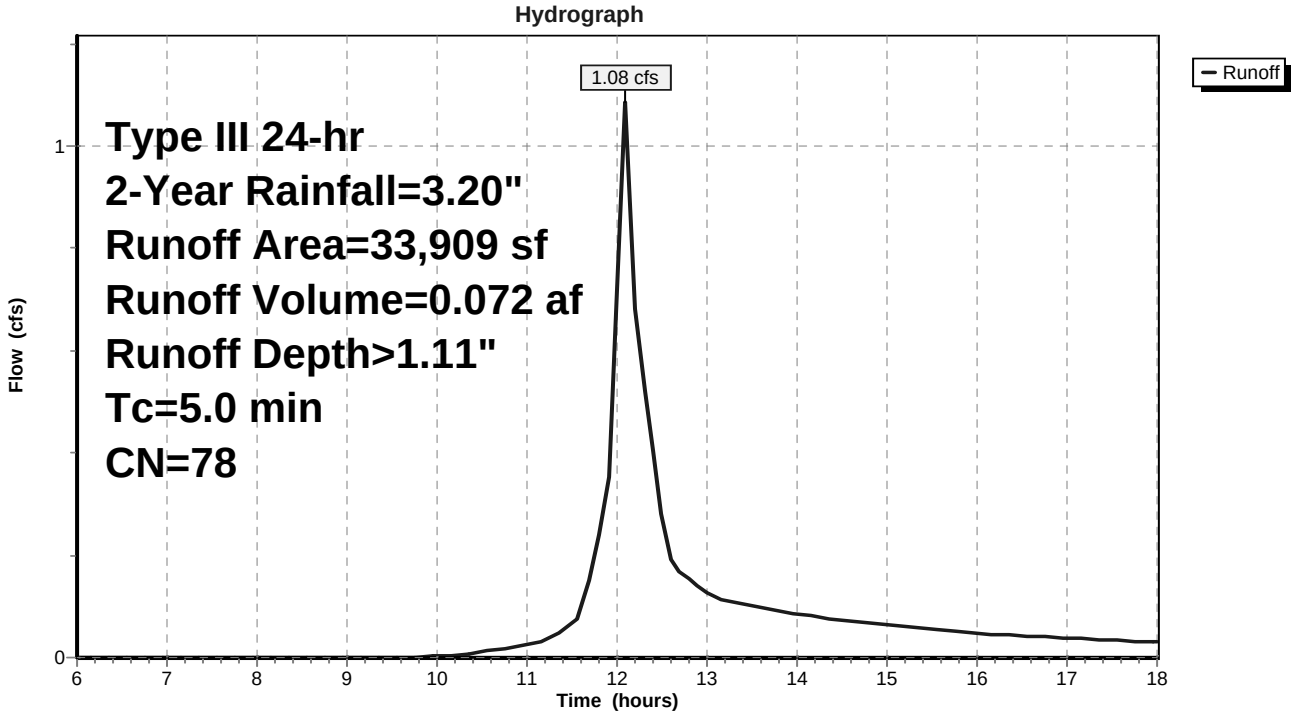
Runoff = 1.08 cfs @ 12.10 hrs, Volume= 0.072 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	5,242	98	impervious
*	28,667	74	pervious
	33,909	78	Weighted Average
	28,667		84.54% Pervious Area
	5,242		15.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Runoff to Existing Northern Swale



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Existing Runoff Area=72,766 sf 9.76% Impervious Runoff Depth>2.09"
Tc=5.0 min CN=76 Runoff=4.38 cfs 0.291 af

Subcatchment 2S: Runoff to Existing Runoff Area=74,340 sf 7.04% Impervious Runoff Depth>2.09"
Tc=5.0 min CN=76 Runoff=4.48 cfs 0.297 af

Subcatchment 3S: Runoff to Existing Runoff Area=33,909 sf 15.46% Impervious Runoff Depth>2.25"
Tc=5.0 min CN=78 Runoff=2.19 cfs 0.146 af

Total Runoff Area = 4.156 ac Runoff Volume = 0.735 af Average Runoff Depth = 2.12"
90.29% Pervious = 3.752 ac 9.71% Impervious = 0.404 ac

Summary for Subcatchment 1S: Runoff to Existing Eastern Swale

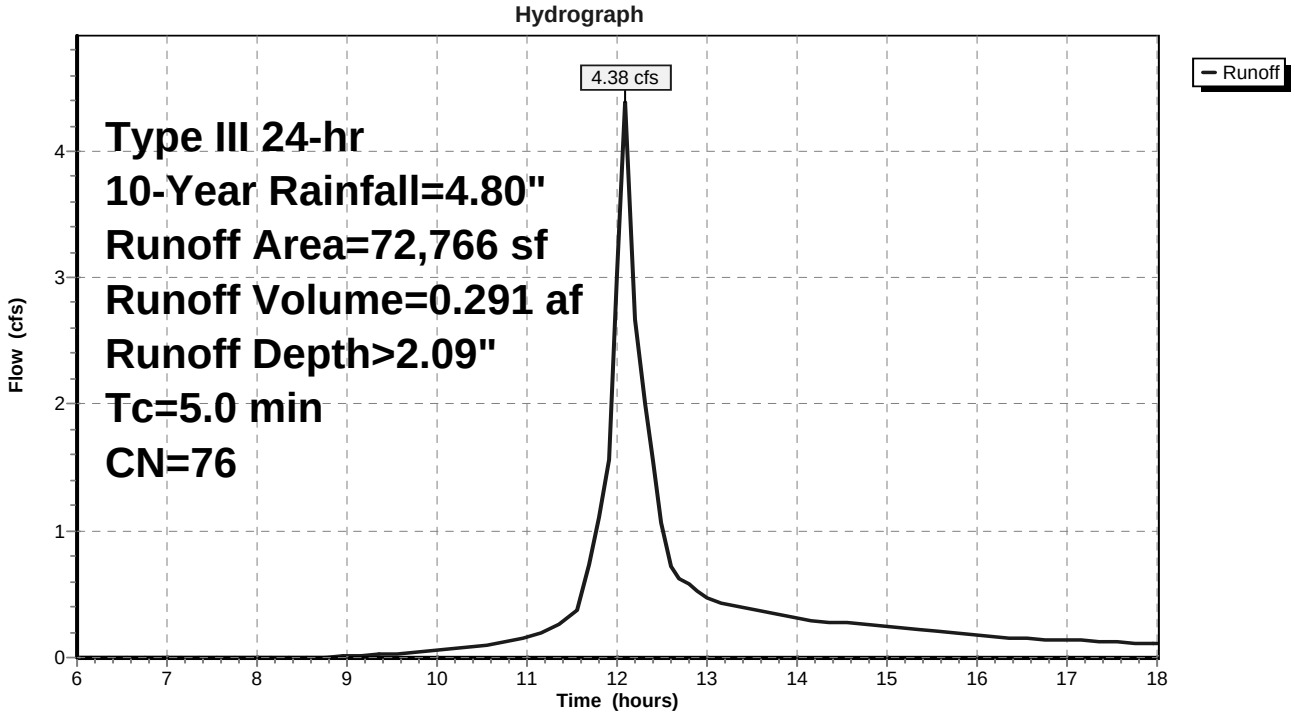
Runoff = 4.38 cfs @ 12.09 hrs, Volume= 0.291 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	7,105	98	impervious
*	65,661	74	pervious
	72,766	76	Weighted Average
	65,661		90.24% Pervious Area
	7,105		9.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Existing Eastern Swale



Summary for Subcatchment 2S: Runoff to Existing Western Swale

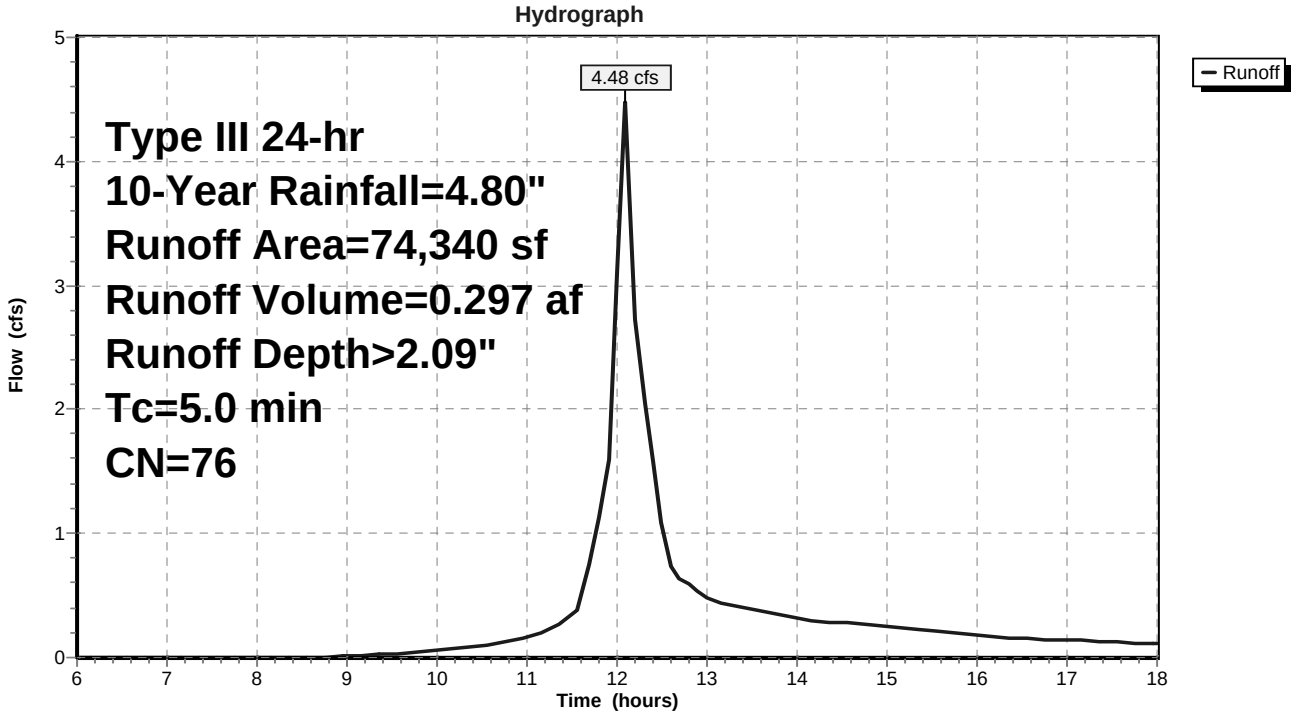
Runoff = 4.48 cfs @ 12.09 hrs, Volume= 0.297 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	5,236	98	impervious
*	69,104	74	pervious
	74,340	76	Weighted Average
	69,104		92.96% Pervious Area
	5,236		7.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Runoff to Existing Western Swale



Summary for Subcatchment 3S: Runoff to Existing Northern Swale

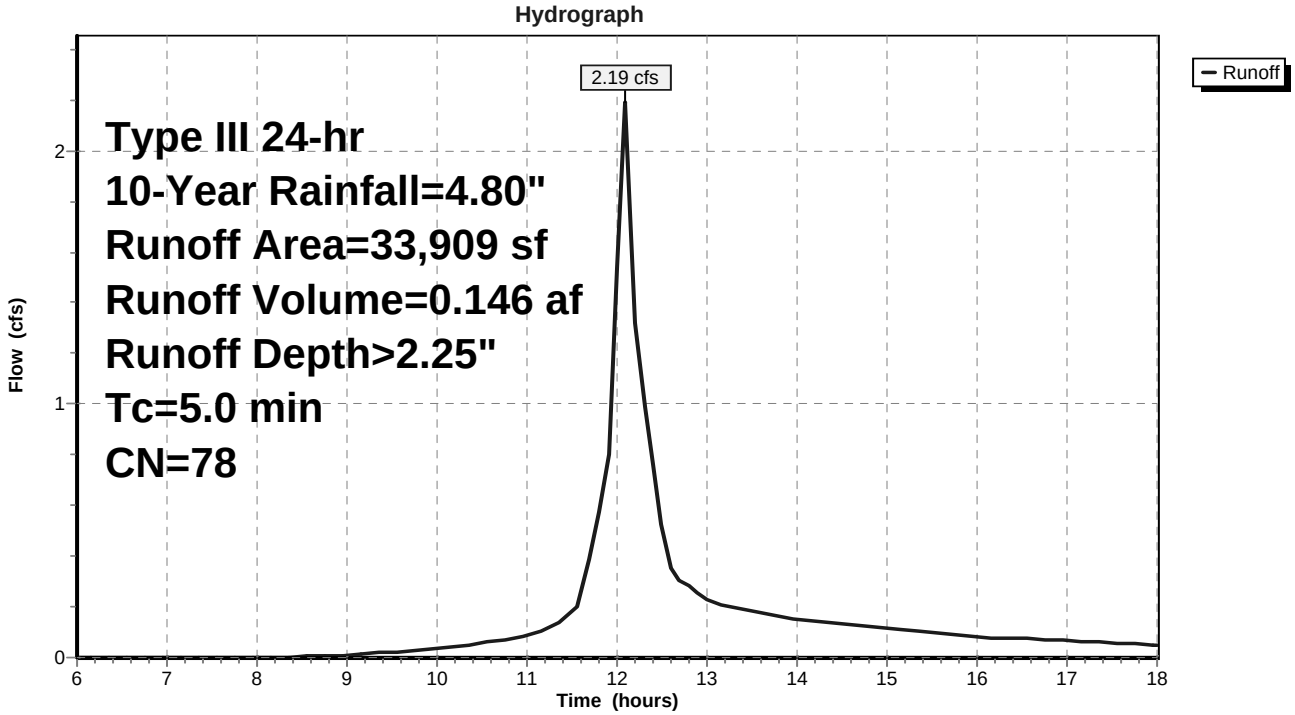
Runoff = 2.19 cfs @ 12.09 hrs, Volume= 0.146 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	5,242	98	impervious
*	28,667	74	pervious
	33,909	78	Weighted Average
	28,667		84.54% Pervious Area
	5,242		15.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Runoff to Existing Northern Swale



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Existing Runoff Area=72,766 sf 9.76% Impervious Runoff Depth>2.62"
Tc=5.0 min CN=76 Runoff=5.46 cfs 0.365 af

Subcatchment 2S: Runoff to Existing Runoff Area=74,340 sf 7.04% Impervious Runoff Depth>2.62"
Tc=5.0 min CN=76 Runoff=5.58 cfs 0.373 af

Subcatchment 3S: Runoff to Existing Runoff Area=33,909 sf 15.46% Impervious Runoff Depth>2.80"
Tc=5.0 min CN=78 Runoff=2.70 cfs 0.182 af

Total Runoff Area = 4.156 ac Runoff Volume = 0.919 af Average Runoff Depth = 2.65"
90.29% Pervious = 3.752 ac 9.71% Impervious = 0.404 ac

Summary for Subcatchment 1S: Runoff to Existing Eastern Swale

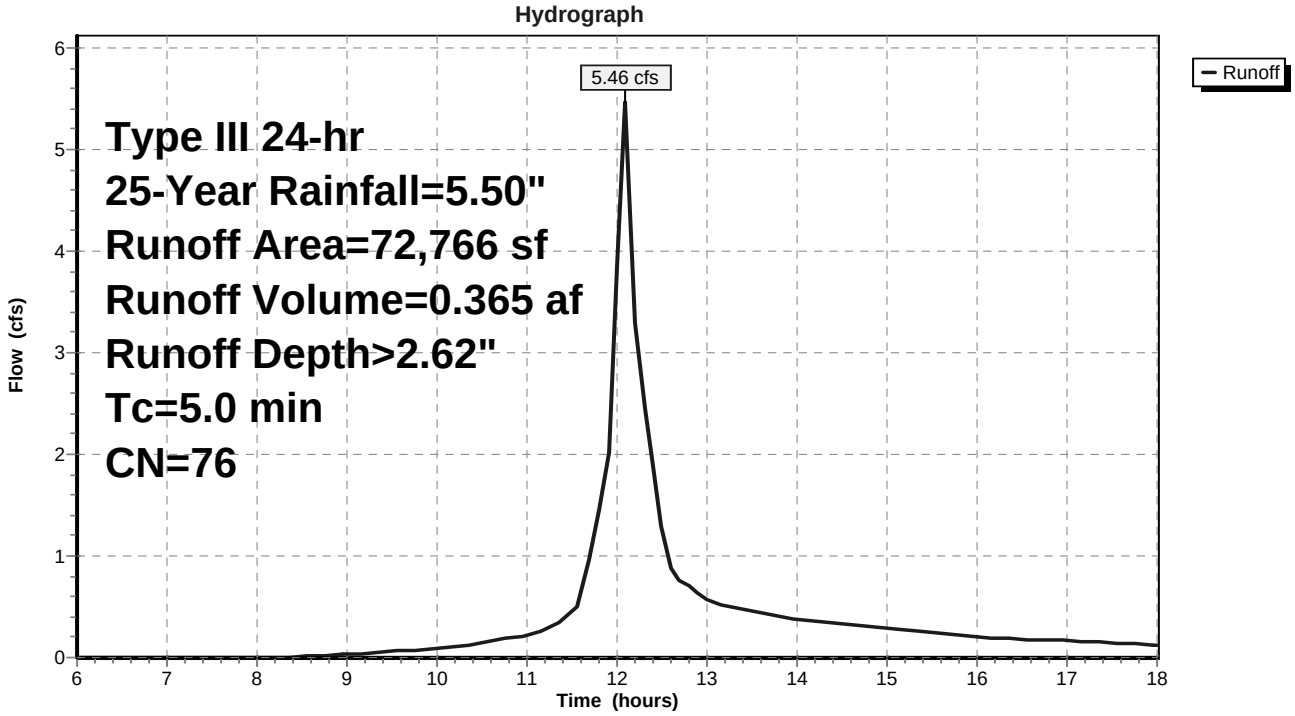
Runoff = 5.46 cfs @ 12.09 hrs, Volume= 0.365 af, Depth> 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
*	7,105	98	impervious
*	65,661	74	pervious
	72,766	76	Weighted Average
	65,661		90.24% Pervious Area
	7,105		9.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Existing Eastern Swale



Summary for Subcatchment 2S: Runoff to Existing Western Swale

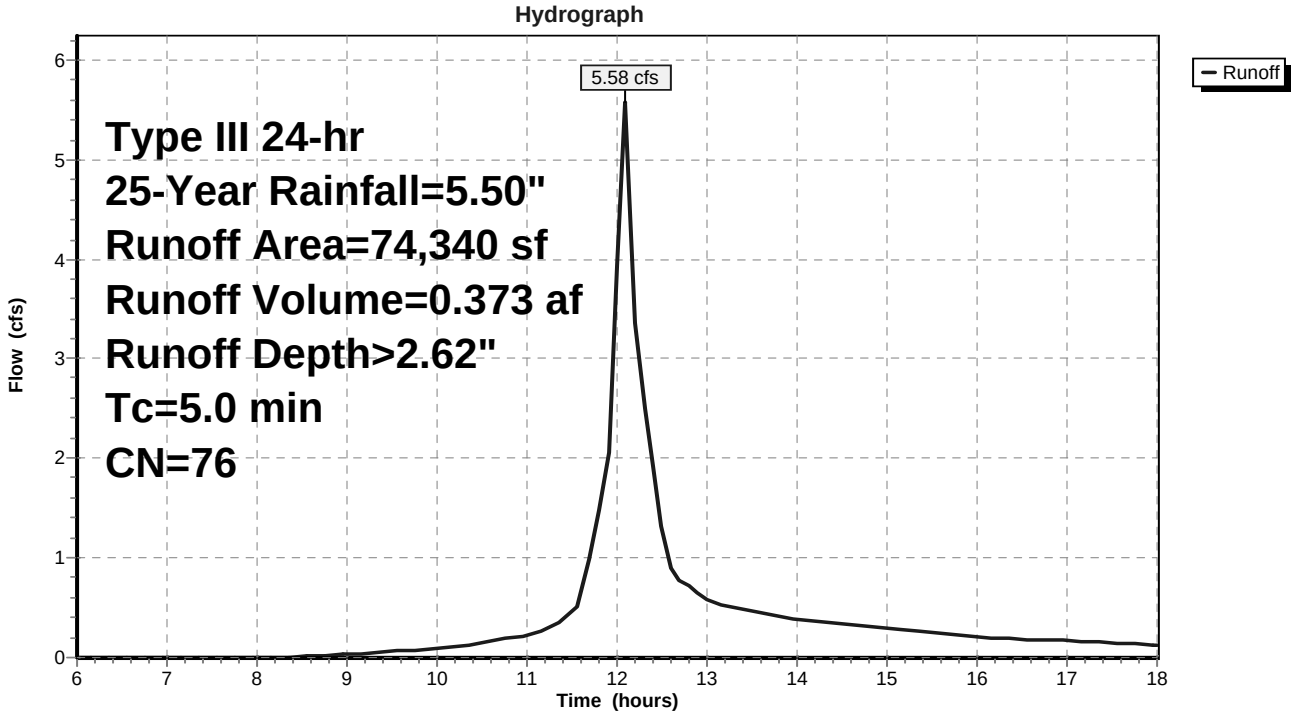
Runoff = 5.58 cfs @ 12.09 hrs, Volume= 0.373 af, Depth> 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
*	5,236	98	impervious
*	69,104	74	pervious
	74,340	76	Weighted Average
	69,104		92.96% Pervious Area
	5,236		7.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Runoff to Existing Western Swale



Summary for Subcatchment 3S: Runoff to Existing Northern Swale

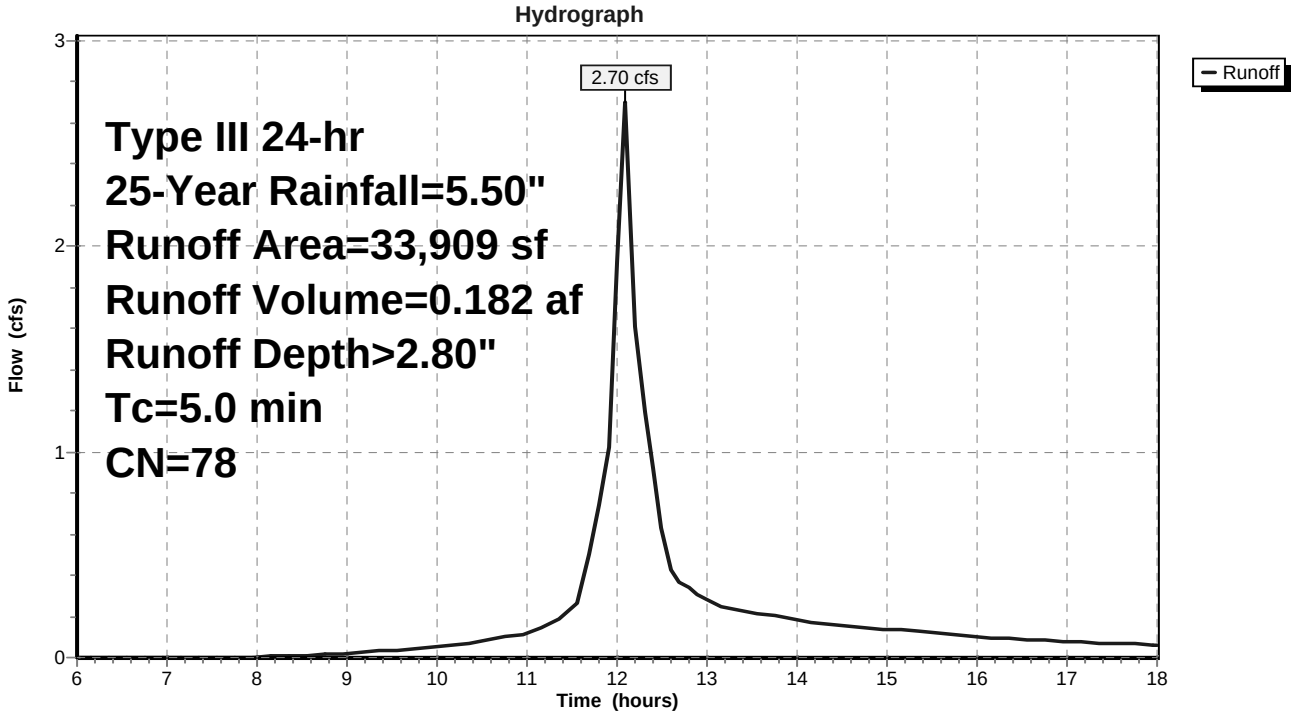
Runoff = 2.70 cfs @ 12.09 hrs, Volume= 0.182 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
*	5,242	98	impervious
*	28,667	74	pervious
	33,909	78	Weighted Average
	28,667		84.54% Pervious Area
	5,242		15.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Runoff to Existing Northern Swale



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Existing Runoff Area=72,766 sf 9.76% Impervious Runoff Depth>3.73"
Tc=5.0 min CN=76 Runoff=7.66 cfs 0.519 af

Subcatchment 2S: Runoff to Existing Runoff Area=74,340 sf 7.04% Impervious Runoff Depth>3.73"
Tc=5.0 min CN=76 Runoff=7.83 cfs 0.530 af

Subcatchment 3S: Runoff to Existing Runoff Area=33,909 sf 15.46% Impervious Runoff Depth>3.93"
Tc=5.0 min CN=78 Runoff=3.74 cfs 0.255 af

Total Runoff Area = 4.156 ac Runoff Volume = 1.304 af Average Runoff Depth = 3.77"
90.29% Pervious = 3.752 ac 9.71% Impervious = 0.404 ac

Summary for Subcatchment 1S: Runoff to Existing Eastern Swale

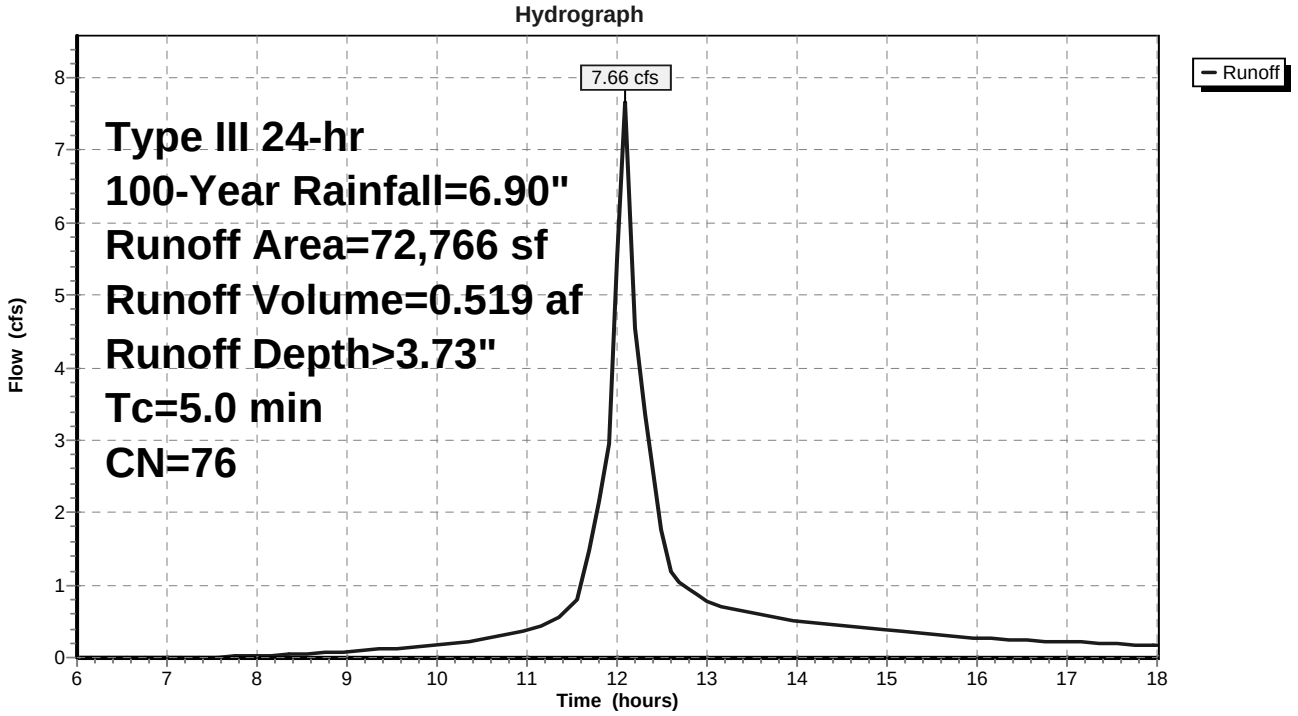
Runoff = 7.66 cfs @ 12.09 hrs, Volume= 0.519 af, Depth> 3.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (sf)	CN	Description
*	7,105	98	impervious
*	65,661	74	pervious
	72,766	76	Weighted Average
	65,661		90.24% Pervious Area
	7,105		9.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Existing Eastern Swale



Summary for Subcatchment 2S: Runoff to Existing Western Swale

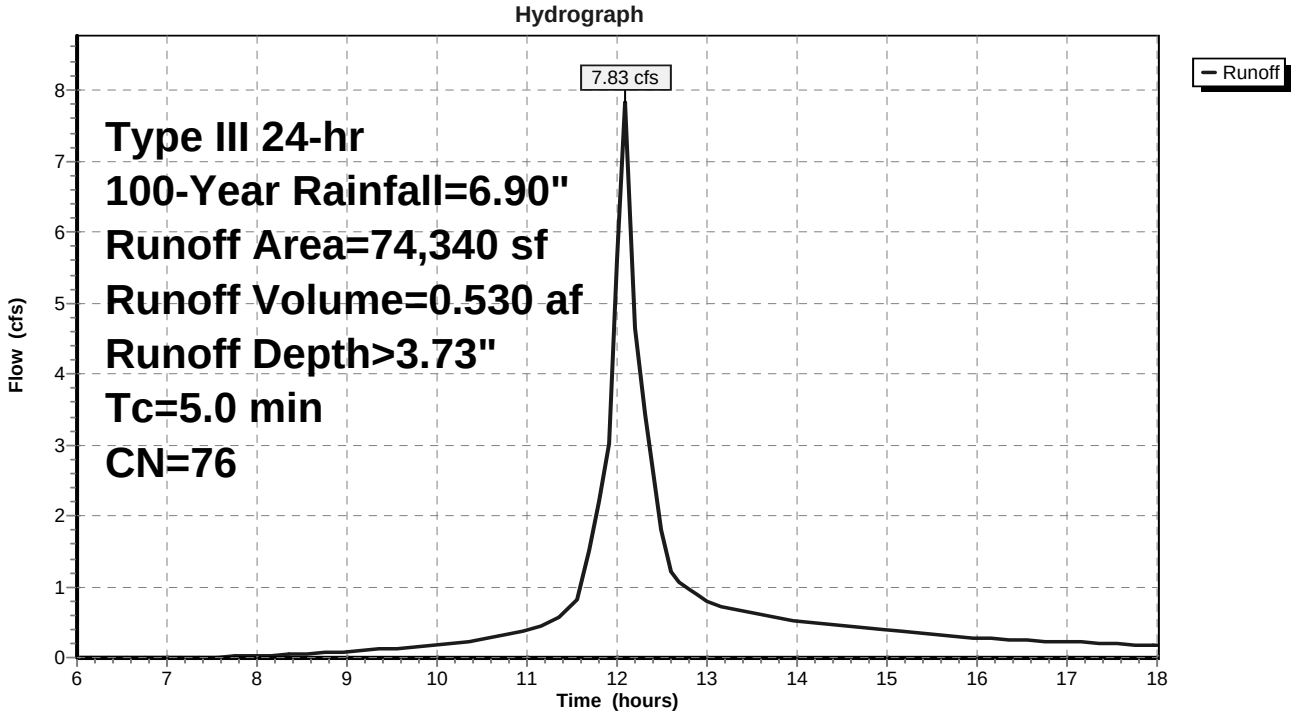
Runoff = 7.83 cfs @ 12.09 hrs, Volume= 0.530 af, Depth> 3.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (sf)	CN	Description
*	5,236	98	impervious
*	69,104	74	pervious
	74,340	76	Weighted Average
	69,104		92.96% Pervious Area
	5,236		7.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Runoff to Existing Western Swale



Summary for Subcatchment 3S: Runoff to Existing Northern Swale

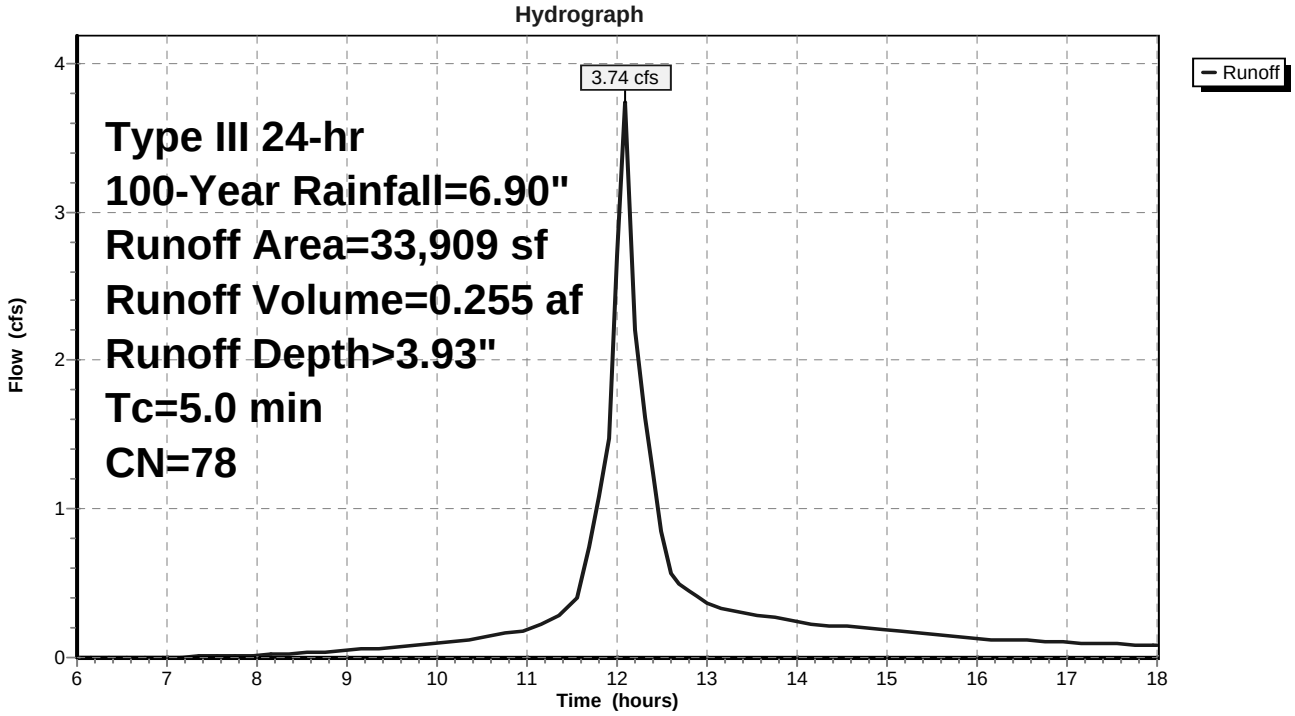
Runoff = 3.74 cfs @ 12.09 hrs, Volume= 0.255 af, Depth> 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (sf)	CN	Description
*	5,242	98	impervious
*	28,667	74	pervious
	33,909	78	Weighted Average
	28,667		84.54% Pervious Area
	5,242		15.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Runoff to Existing Northern Swale



Attachment B

Post-Development Drainage Calculations

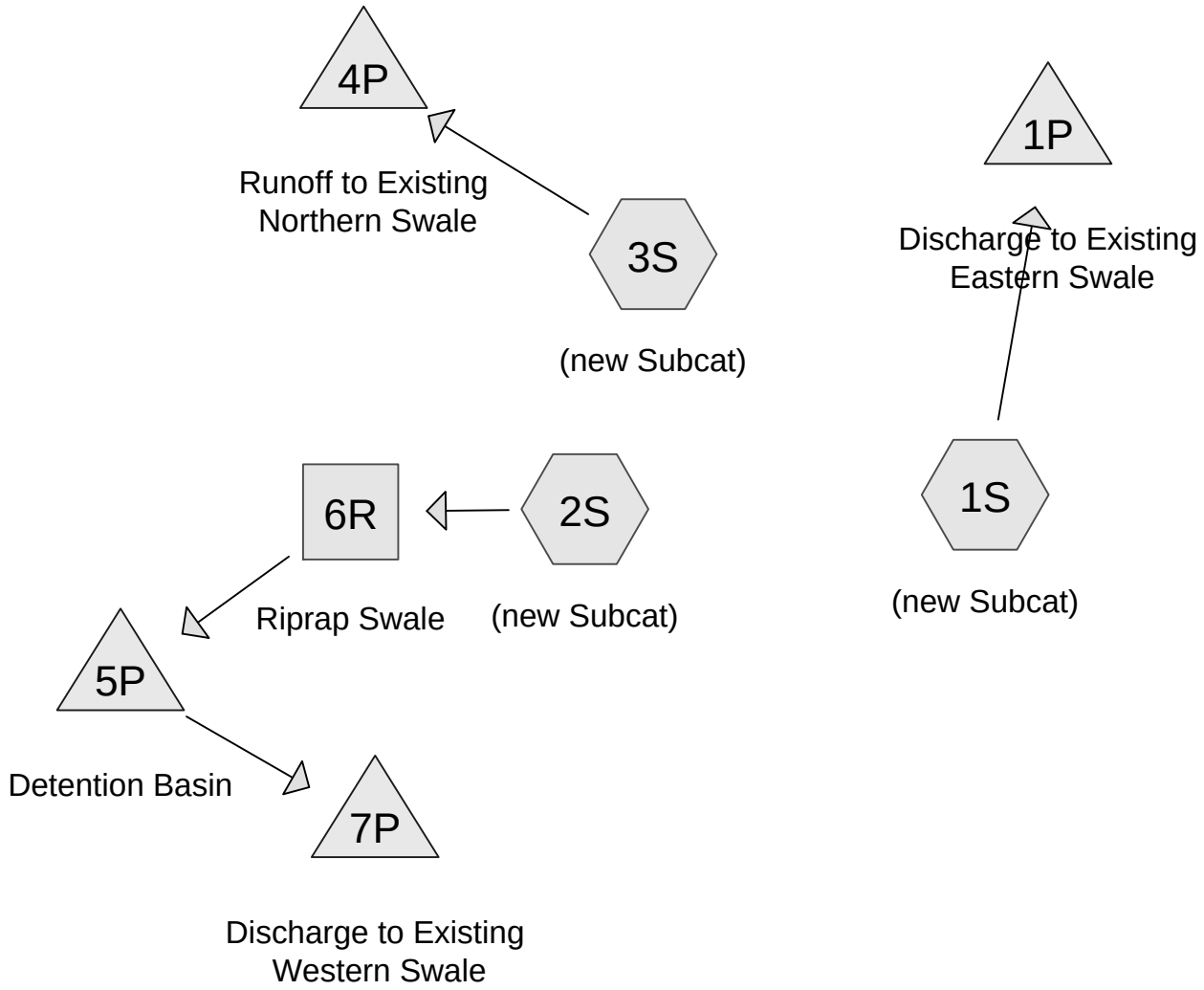
Post-Development Drainage Area
Chaplin, CT Compressor Station

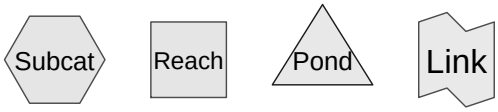
0 100 200

SCALE: 1"=100'

SCALE: 1"=100'

Michael Baker INTERNATIONAL
500 ENTERPRISE DRIVE, SUITE 2B
ROCKY HILL, CT 06067
(860) 563-3044





Routing Diagram for proposed, 2014 08 21
Prepared by Michael Baker Corporation, Printed 8/28/2014
HydroCAD® 10.00 s/n 06697 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.639	98	impervious (1S, 2S, 3S)
3.637	74	pervious (1S, 2S, 3S)
4.275	**78**	**TOTAL AREA**

Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: (new Subcat) Runoff Area=55,189 sf 14.27% Impervious Runoff Depth>1.05"
Tc=5.0 min CN=77 Runoff=1.67 cfs 0.111 af

Subcatchment 2S: (new Subcat) Runoff Area=100,201 sf 14.68% Impervious Runoff Depth>1.11"
Tc=5.0 min CN=78 Runoff=3.20 cfs 0.212 af

Subcatchment 3S: (new Subcat) Runoff Area=30,850 sf 16.99% Impervious Runoff Depth>1.11"
Tc=5.0 min CN=78 Runoff=0.99 cfs 0.065 af

Reach 6R: Riprap Swale Avg. Flow Depth=0.28' Max Vel=2.63 fps Inflow=3.20 cfs 0.212 af
n=0.033 L=480.0' S=0.0250 '/' Capacity=140.69 cfs Outflow=2.70 cfs 0.210 af

Pond 1P: Discharge to Existing Eastern Swale Inflow=1.67 cfs 0.111 af
Primary=1.67 cfs 0.111 af

Pond 4P: Runoff to Existing Northern Swale Inflow=0.99 cfs 0.065 af
Primary=0.99 cfs 0.065 af

Pond 5P: Detention Basin Peak Elev=502.67' Storage=2,996 cf Inflow=2.70 cfs 0.210 af
Discarded=0.02 cfs 0.011 af Primary=1.57 cfs 0.156 af Outflow=1.59 cfs 0.168 af

Pond 7P: Discharge to Existing Western Swale Inflow=1.57 cfs 0.156 af
Primary=1.57 cfs 0.156 af

Total Runoff Area = 4.275 ac Runoff Volume = 0.388 af Average Runoff Depth = 1.09"
85.06% Pervious = 3.637 ac 14.94% Impervious = 0.639 ac

Summary for Subcatchment 1S: (new Subcat)

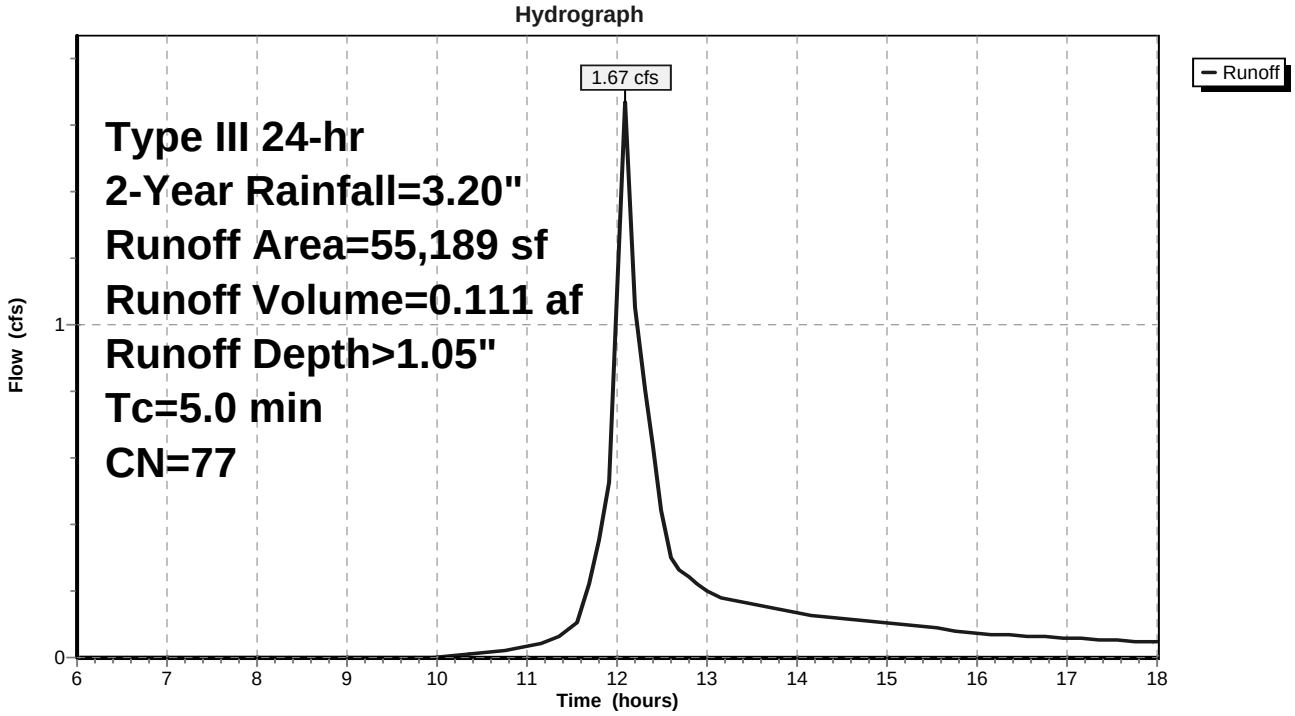
Runoff = 1.67 cfs @ 12.10 hrs, Volume= 0.111 af, Depth> 1.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	7,876	98	impervious
*	47,313	74	pervious
	55,189	77	Weighted Average
	47,313		85.73% Pervious Area
	7,876		14.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: (new Subcat)



Summary for Subcatchment 2S: (new Subcat)

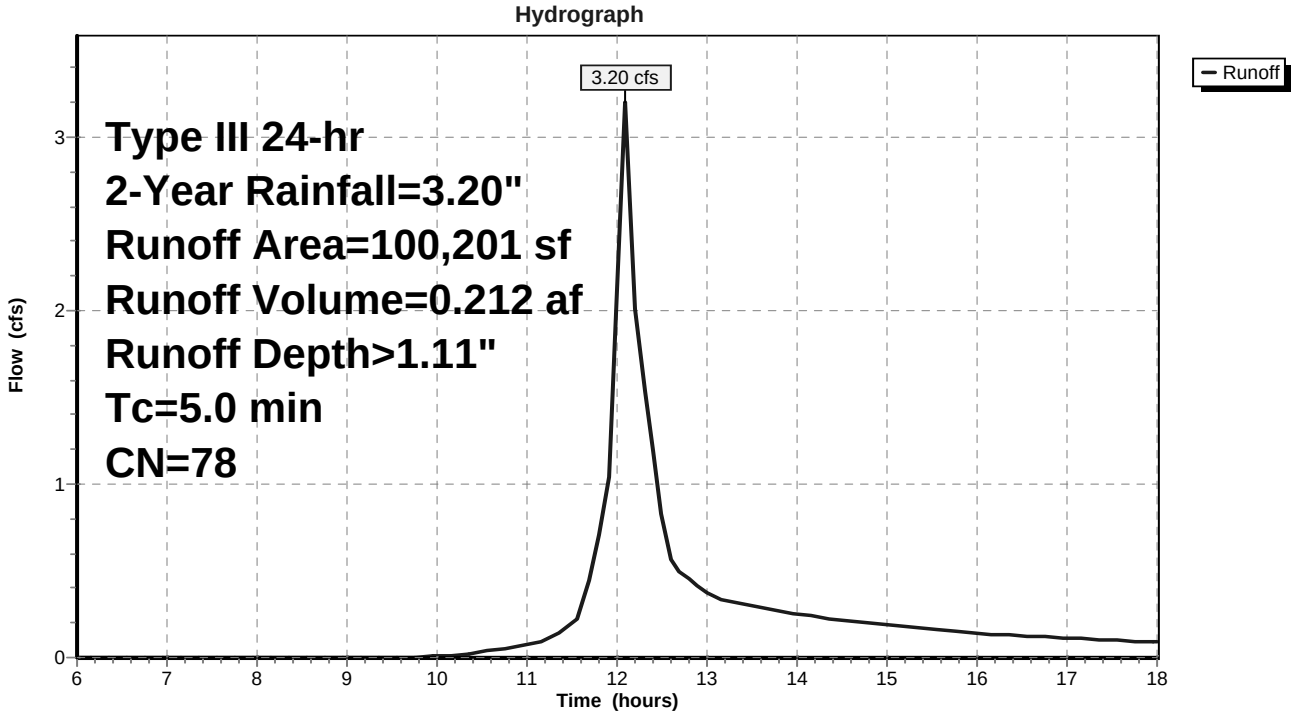
Runoff = 3.20 cfs @ 12.10 hrs, Volume= 0.212 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	14,711	98	impervious
*	85,490	74	pervious
	100,201	78	Weighted Average
	85,490		85.32% Pervious Area
	14,711		14.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: (new Subcat)



Summary for Subcatchment 3S: (new Subcat)

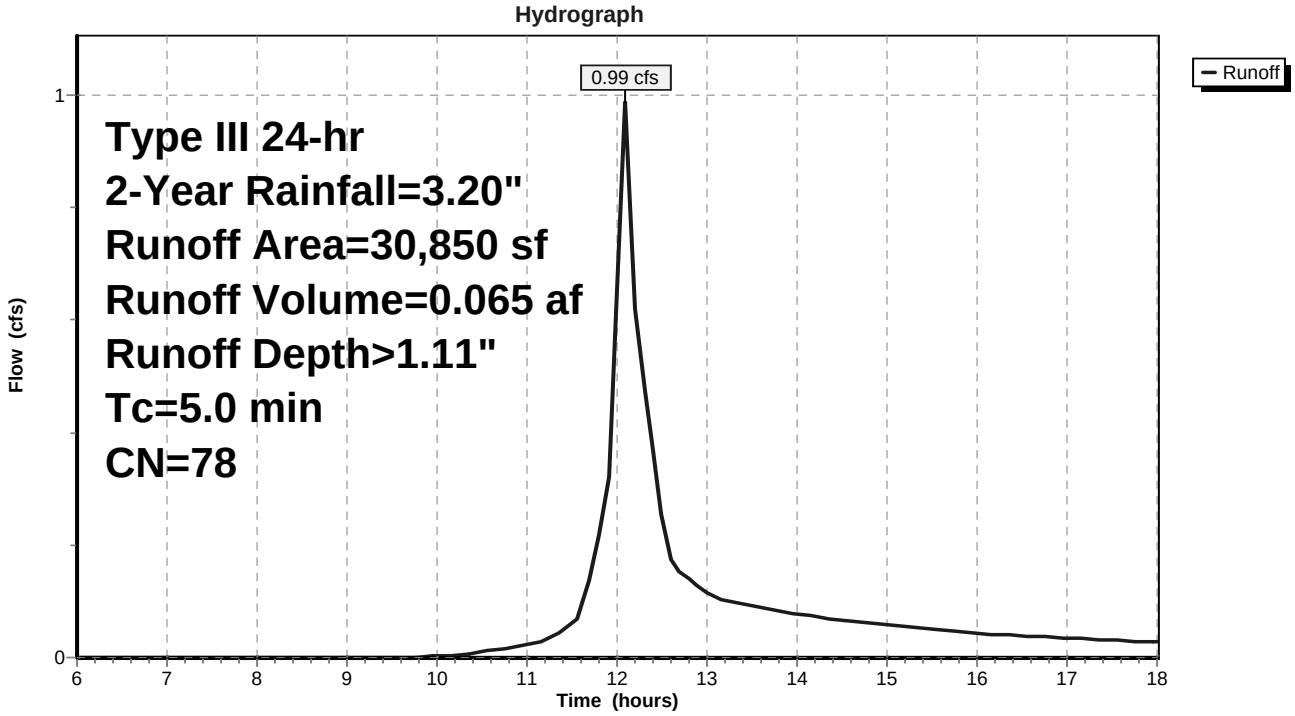
Runoff = 0.99 cfs @ 12.10 hrs, Volume= 0.065 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	5,240	98	impervious
*	25,610	74	pervious
	30,850	78	Weighted Average
	25,610		83.01% Pervious Area
	5,240		16.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: (new Subcat)



Summary for Reach 6R: Riprap Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 1.11" for 2-Year event
Inflow = 3.20 cfs @ 12.10 hrs, Volume= 0.212 af
Outflow = 2.70 cfs @ 12.20 hrs, Volume= 0.210 af, Atten= 16%, Lag= 5.9 min

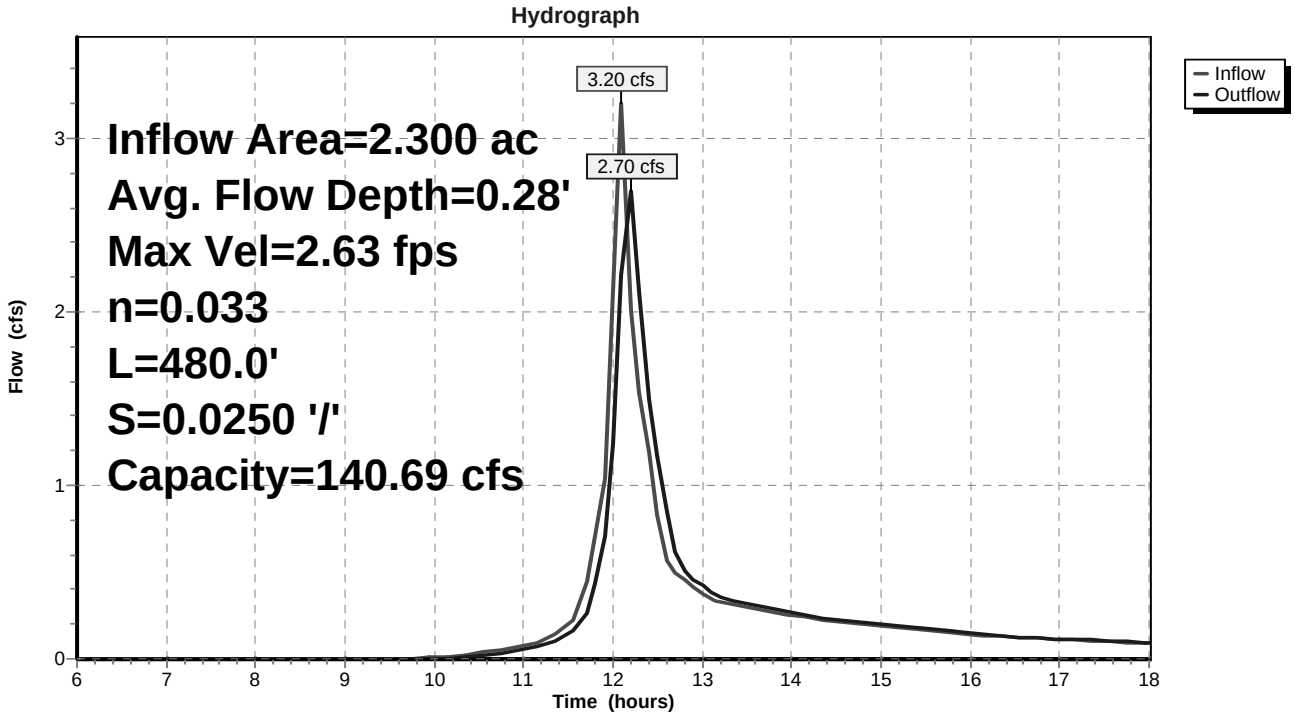
Routing by Stor-Ind+Trans method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Max. Velocity= 2.63 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 7.6 min

Peak Storage= 525 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 140.69 cfs

3.00' x 2.00' deep channel, n= 0.033
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 480.0' Slope= 0.0250 '/'
Inlet Invert= 512.00', Outlet Invert= 500.00'

‡

Reach 6R: Riprap Swale

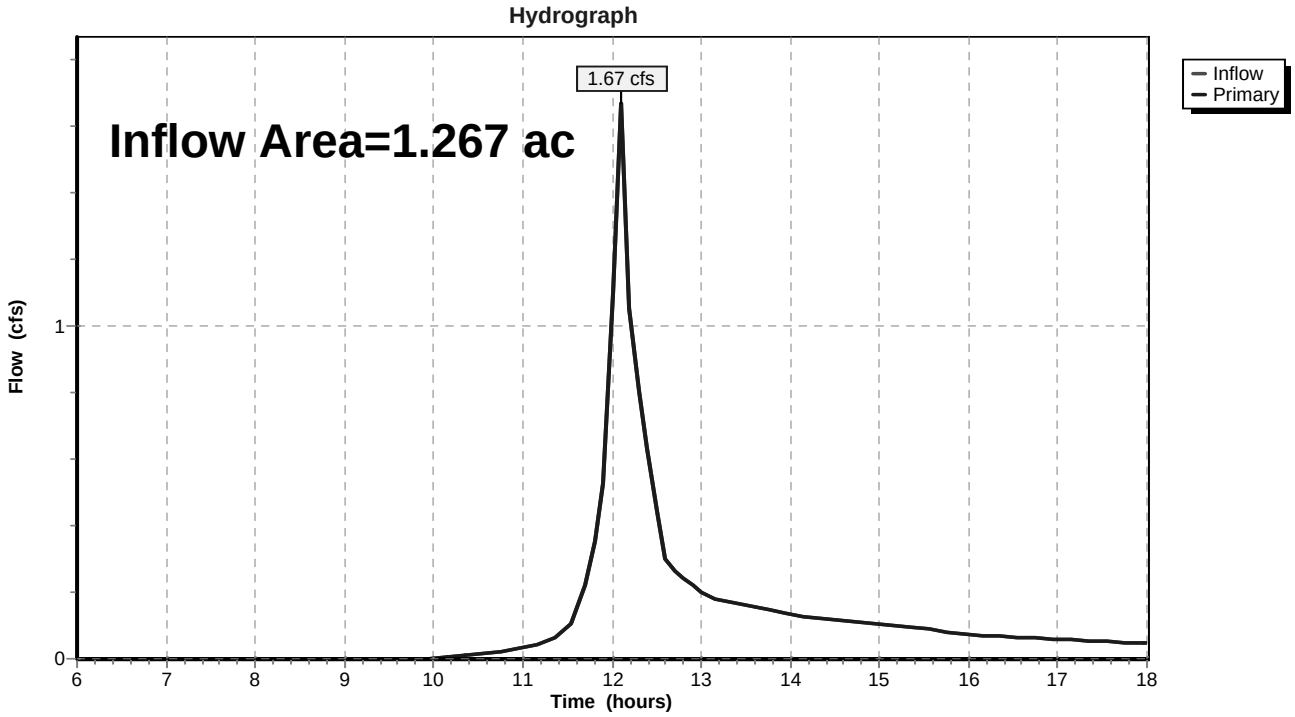


Summary for Pond 1P: Discharge to Existing Eastern Swale

Inflow Area = 1.267 ac, 14.27% Impervious, Inflow Depth > 1.05" for 2-Year event
Inflow = 1.67 cfs @ 12.10 hrs, Volume= 0.111 af
Primary = 1.67 cfs @ 12.10 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 1P: Discharge to Existing Eastern Swale

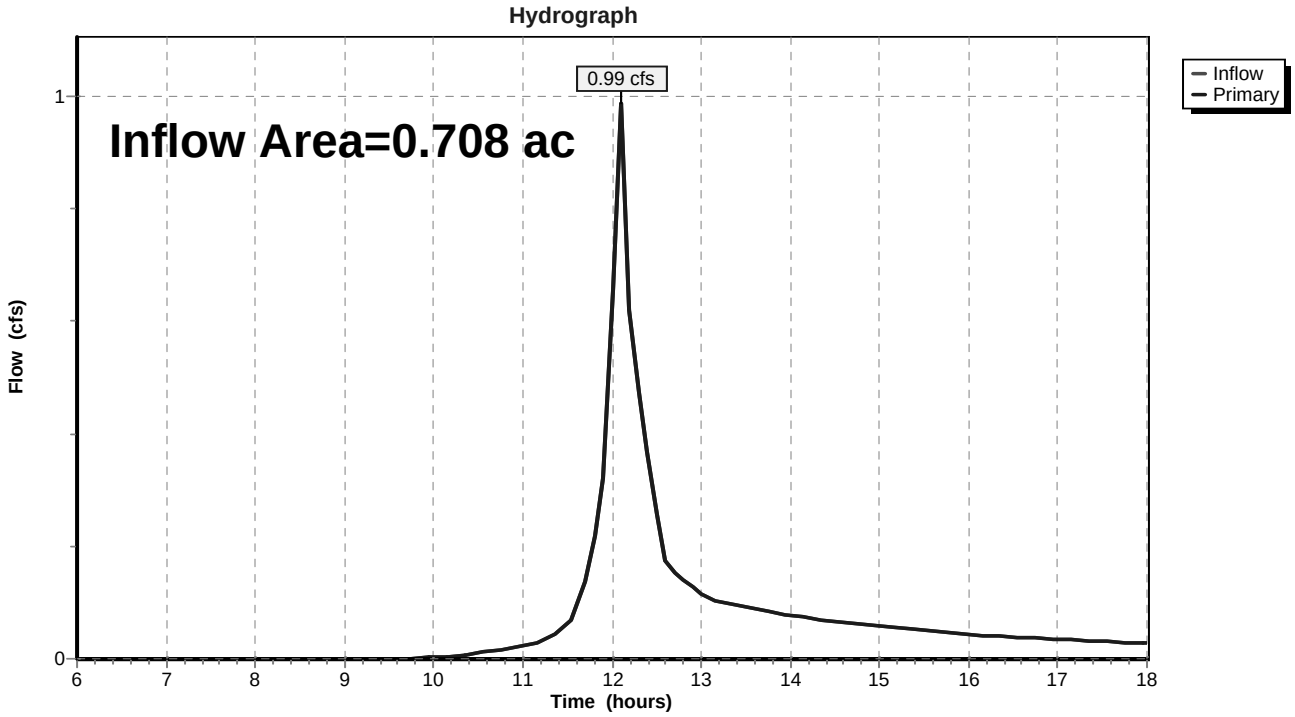


Summary for Pond 4P: Runoff to Existing Northern Swale

Inflow Area = 0.708 ac, 16.99% Impervious, Inflow Depth > 1.11" for 2-Year event
Inflow = 0.99 cfs @ 12.10 hrs, Volume= 0.065 af
Primary = 0.99 cfs @ 12.10 hrs, Volume= 0.065 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Runoff to Existing Northern Swale



Summary for Pond 5P: Detention Basin

Inflow Area =	2.300 ac, 14.68% Impervious, Inflow Depth > 1.10" for 2-Year event				
Inflow =	2.70 cfs @	12.20 hrs, Volume=	0.210 af		
Outflow =	1.59 cfs @	12.41 hrs, Volume=	0.168 af, Atten= 41%, Lag= 12.9 min		
Discarded =	0.02 cfs @	12.41 hrs, Volume=	0.011 af		
Primary =	1.57 cfs @	12.41 hrs, Volume=	0.156 af		

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 502.67' @ 12.41 hrs Surf.Area= 3,238 sf Storage= 2,996 cf

Plug-Flow detention time= 73.4 min calculated for 0.166 af (79% of inflow)
Center-of-Mass det. time= 32.5 min (827.0 - 794.4)

Volume	Invert	Avail.Storage	Storage Description
#1	501.00'	6,679 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
#2	500.00'	350 cf	**Custom Stage Data (Conic)** Listed below (Recalc) 875 cf Overall x 40.0% Voids
		7,029 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
501.00	875	0	0	875
502.00	1,725	1,276	1,276	1,734
503.00	2,710	2,199	3,475	2,733
504.00	3,725	3,204	6,679	3,768

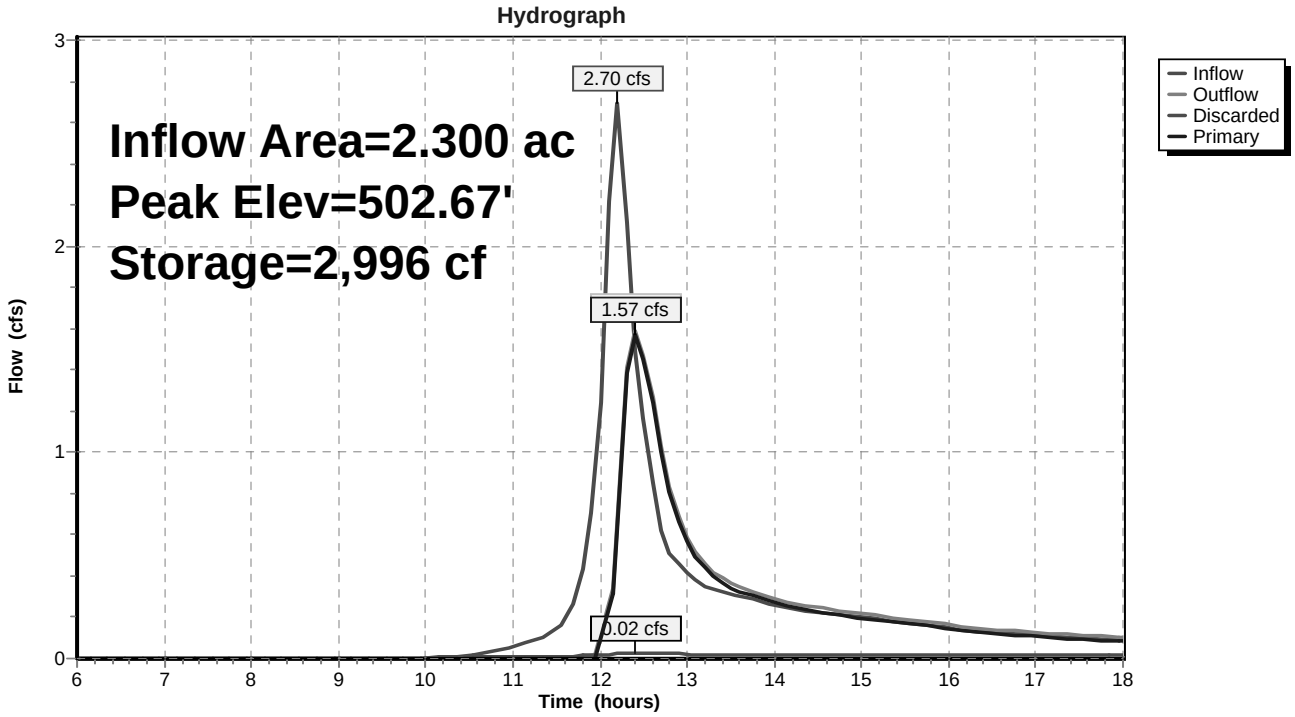
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
500.00	875	0	0	875
501.00	875	875	875	980

Device	Routing	Invert	Outlet Devices
#1	Discarded	500.00'	**0.300 in/hr Exfiltration over Wetted area**
#2	Primary	502.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	503.50'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	504.00'	**90.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.02 cfs @ 12.41 hrs HW=502.67' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.56 cfs @ 12.41 hrs HW=502.67' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 1.56 cfs @ 2.79 fps)
├─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Detention Basin

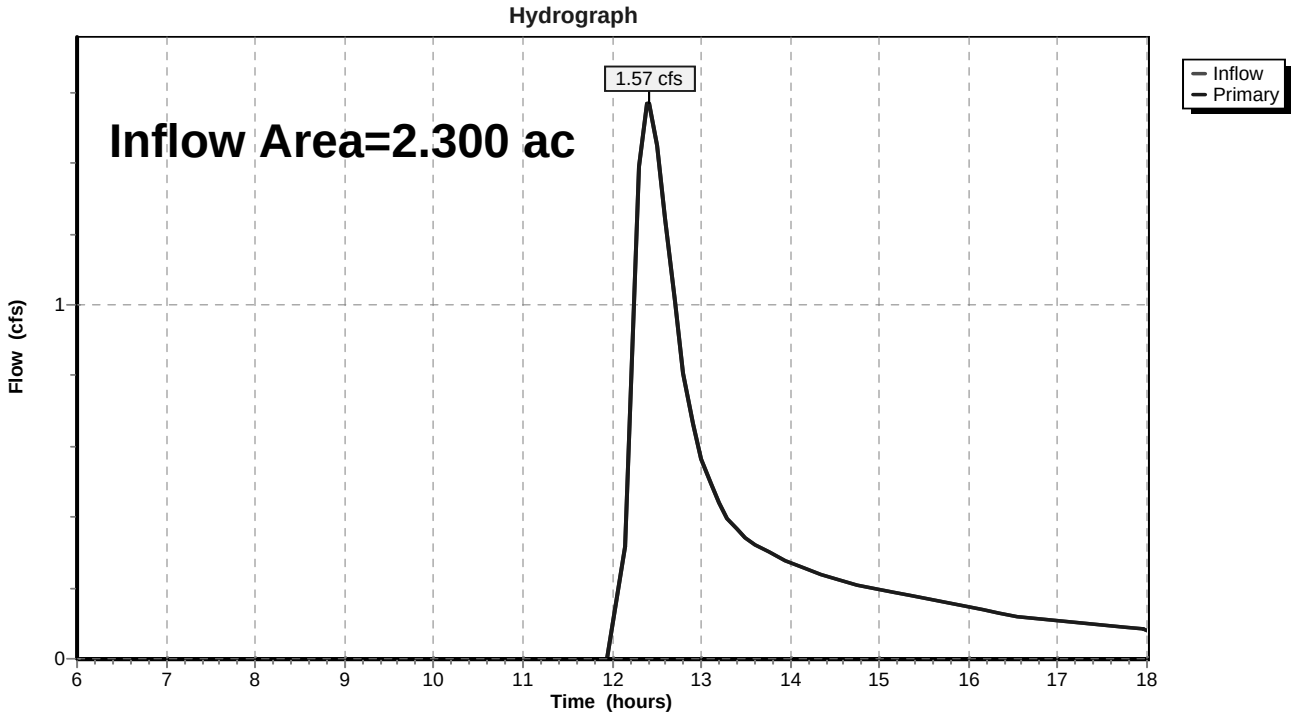


Summary for Pond 7P: Discharge to Existing Western Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 0.82" for 2-Year event
Inflow = 1.57 cfs @ 12.41 hrs, Volume= 0.156 af
Primary = 1.57 cfs @ 12.41 hrs, Volume= 0.156 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Discharge to Existing Western Swale



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: (new Subcat) Runoff Area=55,189 sf 14.27% Impervious Runoff Depth>2.17"
Tc=5.0 min CN=77 Runoff=3.44 cfs 0.229 af

Subcatchment 2S: (new Subcat) Runoff Area=100,201 sf 14.68% Impervious Runoff Depth>2.25"
Tc=5.0 min CN=78 Runoff=6.47 cfs 0.432 af

Subcatchment 3S: (new Subcat) Runoff Area=30,850 sf 16.99% Impervious Runoff Depth>2.25"
Tc=5.0 min CN=78 Runoff=1.99 cfs 0.133 af

Reach 6R: Riprap Swale Avg. Flow Depth=0.42' Max Vel=3.31 fps Inflow=6.47 cfs 0.432 af
n=0.033 L=480.0' S=0.0250 '/' Capacity=140.69 cfs Outflow=5.47 cfs 0.430 af

Pond 1P: Discharge to Existing Eastern Swale Inflow=3.44 cfs 0.229 af
Primary=3.44 cfs 0.229 af

Pond 4P: Runoff to Existing Northern Swale Inflow=1.99 cfs 0.133 af
Primary=1.99 cfs 0.133 af

Pond 5P: Detention Basin Peak Elev=503.38' Storage=4,932 cf Inflow=5.47 cfs 0.430 af
Discarded=0.03 cfs 0.014 af Primary=3.55 cfs 0.371 af Outflow=3.58 cfs 0.385 af

Pond 7P: Discharge to Existing Western Swale Inflow=3.55 cfs 0.371 af
Primary=3.55 cfs 0.371 af

Total Runoff Area = 4.275 ac Runoff Volume = 0.794 af Average Runoff Depth = 2.23"
85.06% Pervious = 3.637 ac 14.94% Impervious = 0.639 ac

Summary for Subcatchment 1S: (new Subcat)

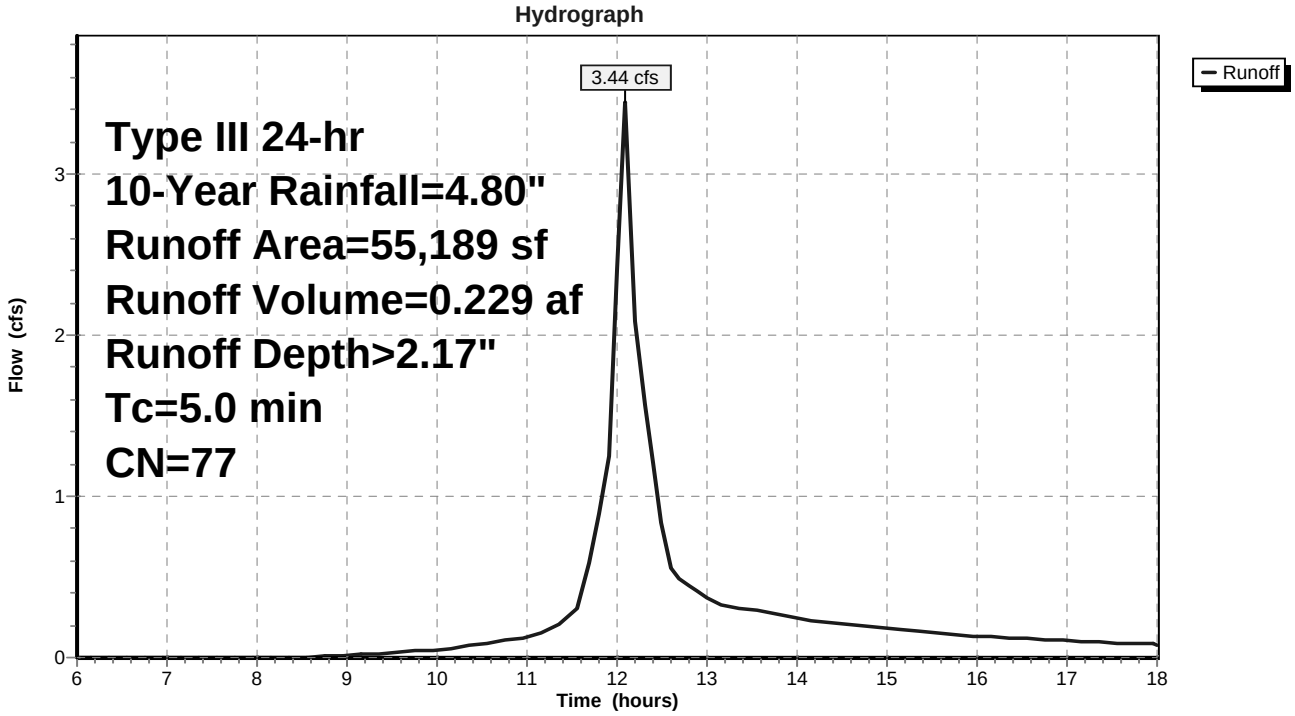
Runoff = 3.44 cfs @ 12.09 hrs, Volume= 0.229 af, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	7,876	98	impervious
*	47,313	74	pervious
	55,189	77	Weighted Average
	47,313		85.73% Pervious Area
	7,876		14.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: (new Subcat)



Summary for Subcatchment 2S: (new Subcat)

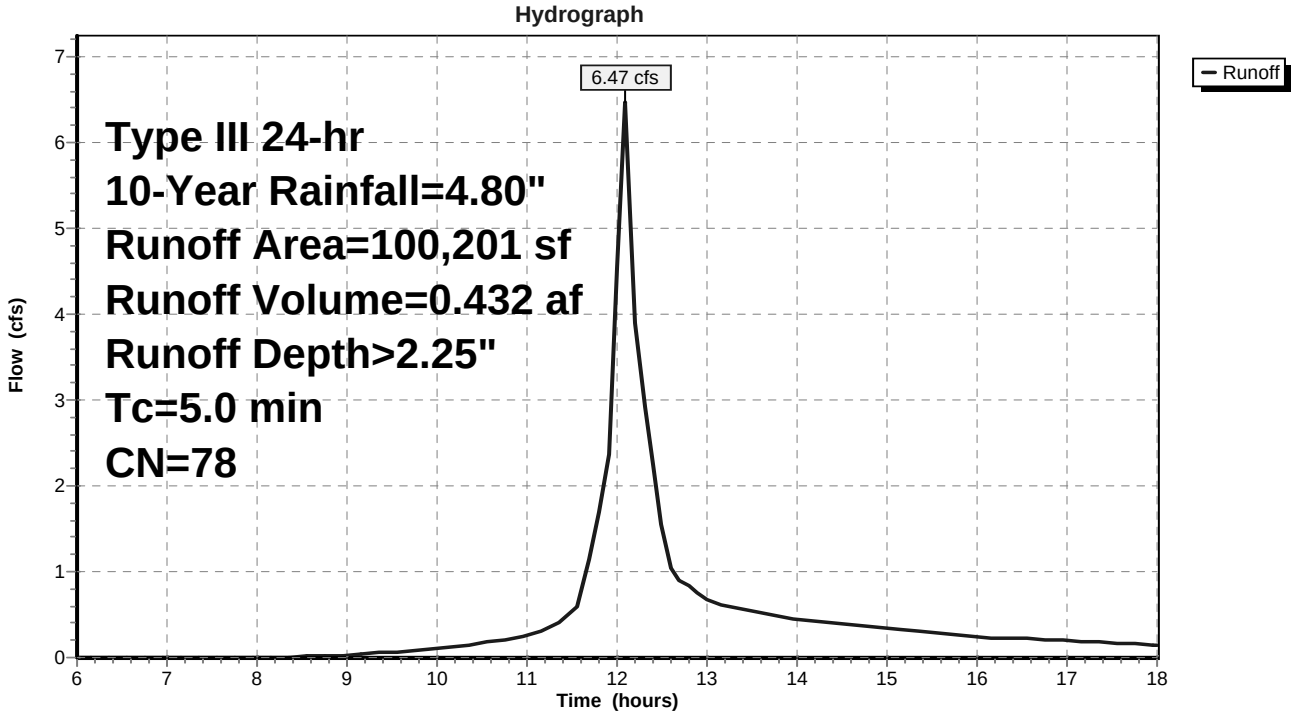
Runoff = 6.47 cfs @ 12.09 hrs, Volume= 0.432 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	14,711	98	impervious
*	85,490	74	pervious
	100,201	78	Weighted Average
	85,490		85.32% Pervious Area
	14,711		14.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: (new Subcat)



Summary for Subcatchment 3S: (new Subcat)

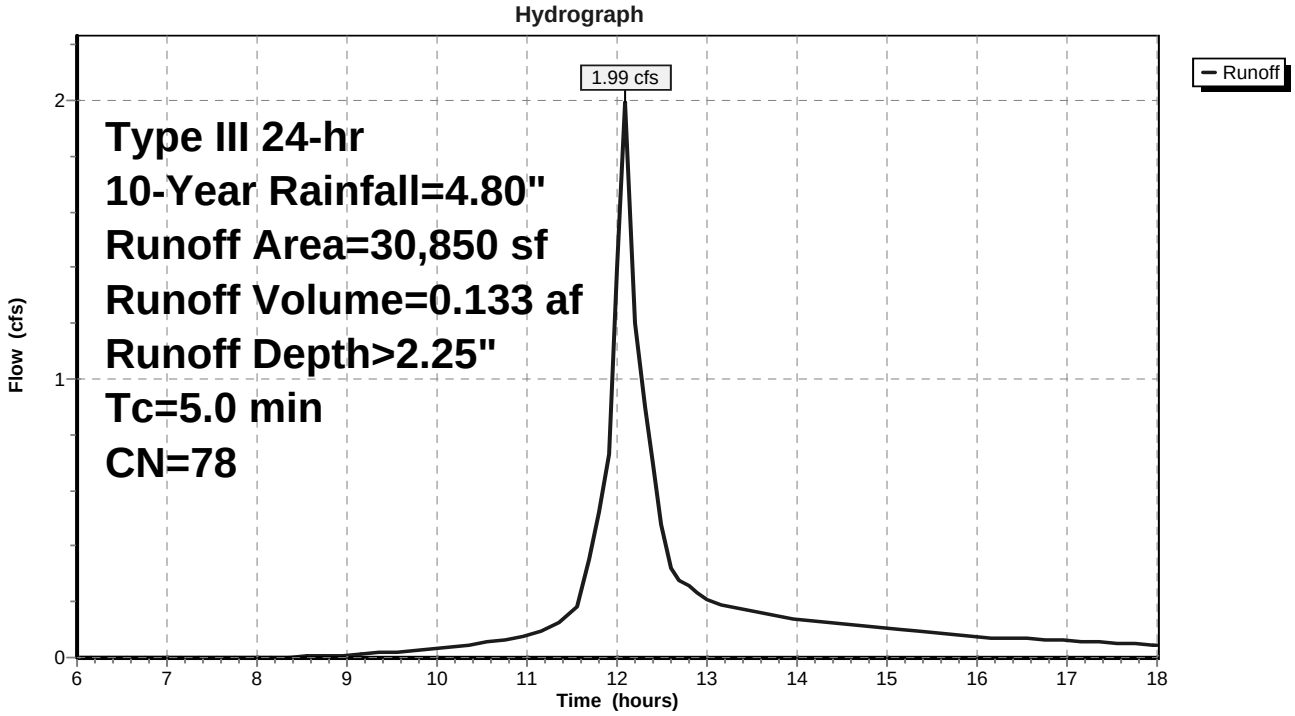
Runoff = 1.99 cfs @ 12.09 hrs, Volume= 0.133 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	5,240	98	impervious
*	25,610	74	pervious
	30,850	78	Weighted Average
	25,610		83.01% Pervious Area
	5,240		16.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: (new Subcat)



Summary for Reach 6R: Riprap Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 2.25" for 10-Year event
Inflow = 6.47 cfs @ 12.09 hrs, Volume= 0.432 af
Outflow = 5.47 cfs @ 12.17 hrs, Volume= 0.430 af, Atten= 15%, Lag= 4.5 min

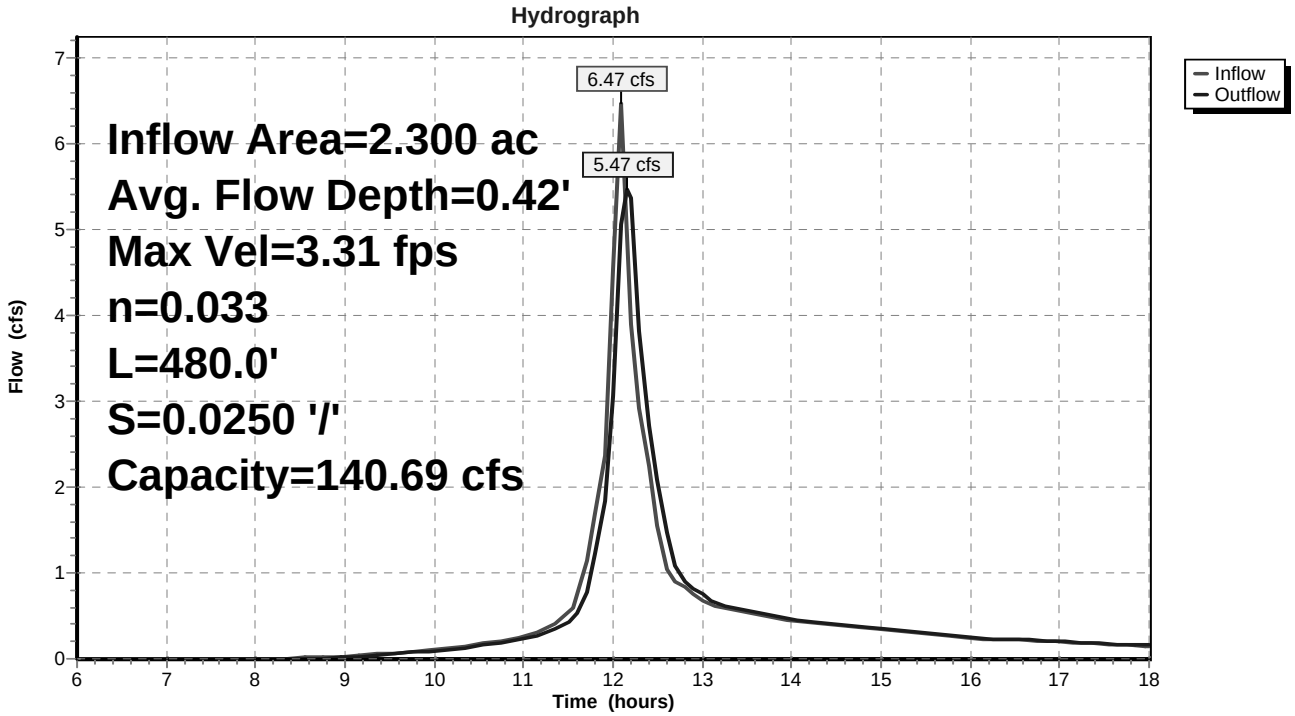
Routing by Stor-Ind+Trans method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Max. Velocity= 3.31 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 1.24 fps, Avg. Travel Time= 6.4 min

Peak Storage= 870 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 140.69 cfs

3.00' x 2.00' deep channel, n= 0.033
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 480.0' Slope= 0.0250 '/'
Inlet Invert= 512.00', Outlet Invert= 500.00'

‡

Reach 6R: Riprap Swale

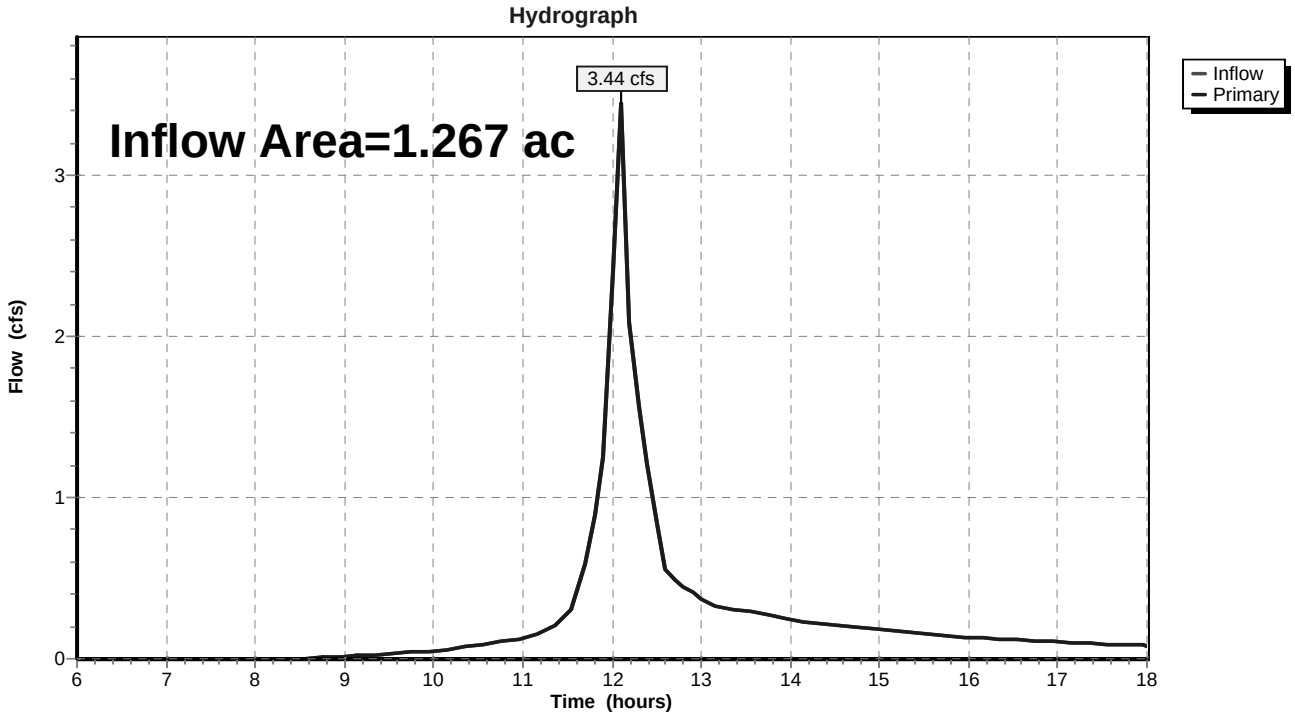


Summary for Pond 1P: Discharge to Existing Eastern Swale

Inflow Area = 1.267 ac, 14.27% Impervious, Inflow Depth > 2.17" for 10-Year event
Inflow = 3.44 cfs @ 12.09 hrs, Volume= 0.229 af
Primary = 3.44 cfs @ 12.09 hrs, Volume= 0.229 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 1P: Discharge to Existing Eastern Swale

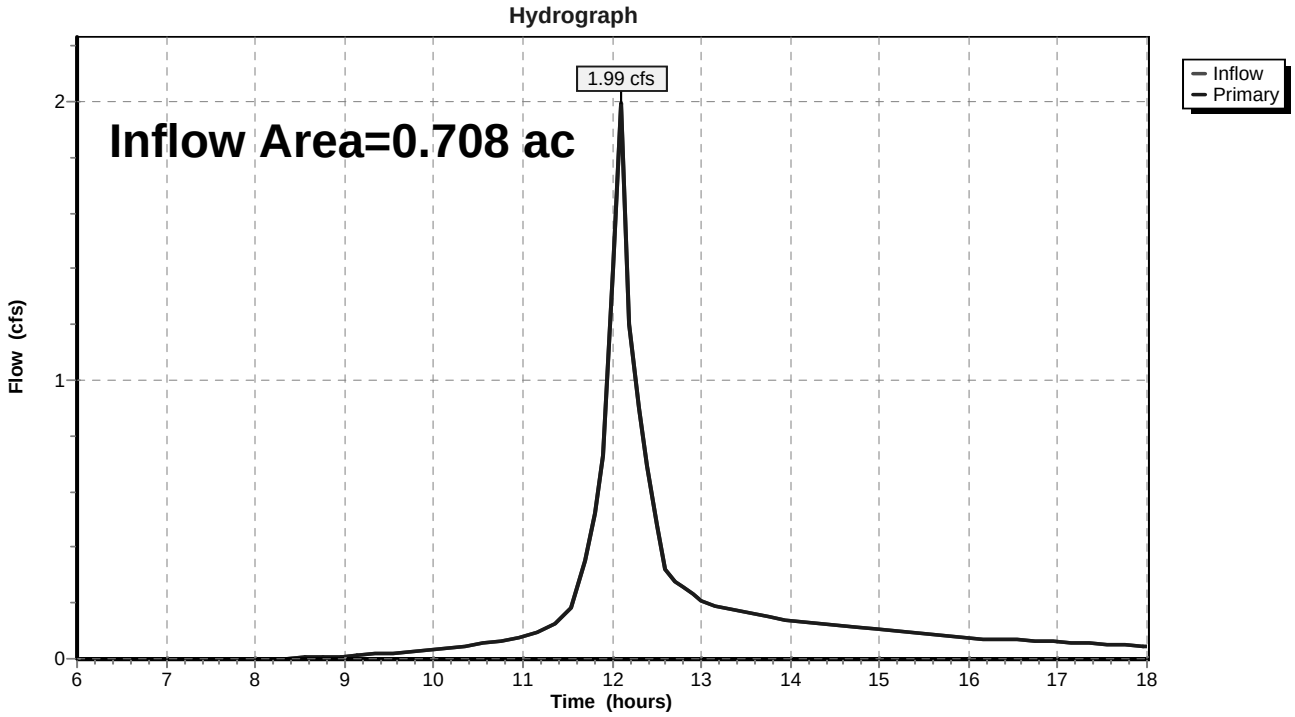


Summary for Pond 4P: Runoff to Existing Northern Swale

Inflow Area = 0.708 ac, 16.99% Impervious, Inflow Depth > 2.25" for 10-Year event
Inflow = 1.99 cfs @ 12.09 hrs, Volume= 0.133 af
Primary = 1.99 cfs @ 12.09 hrs, Volume= 0.133 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Runoff to Existing Northern Swale



Summary for Pond 5P: Detention Basin

Inflow Area =	2.300 ac, 14.68% Impervious, Inflow Depth > 2.24" for 10-Year event				
Inflow =	5.47 cfs @	12.17 hrs, Volume=	0.430 af		
Outflow =	3.58 cfs @	12.33 hrs, Volume=	0.385 af, Atten= 35%, Lag= 10.0 min		
Discarded =	0.03 cfs @	12.33 hrs, Volume=	0.014 af		
Primary =	3.55 cfs @	12.33 hrs, Volume=	0.371 af		

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 503.38' @ 12.33 hrs Surf.Area= 3,954 sf Storage= 4,932 cf

Plug-Flow detention time= 48.7 min calculated for 0.381 af (89% of inflow)
Center-of-Mass det. time= 24.1 min (803.8 - 779.7)

Volume	Invert	Avail.Storage	Storage Description
#1	501.00'	6,679 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
#2	500.00'	350 cf	**Custom Stage Data (Conic)** Listed below (Recalc) 875 cf Overall x 40.0% Voids
		7,029 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
501.00	875	0	0	875
502.00	1,725	1,276	1,276	1,734
503.00	2,710	2,199	3,475	2,733
504.00	3,725	3,204	6,679	3,768

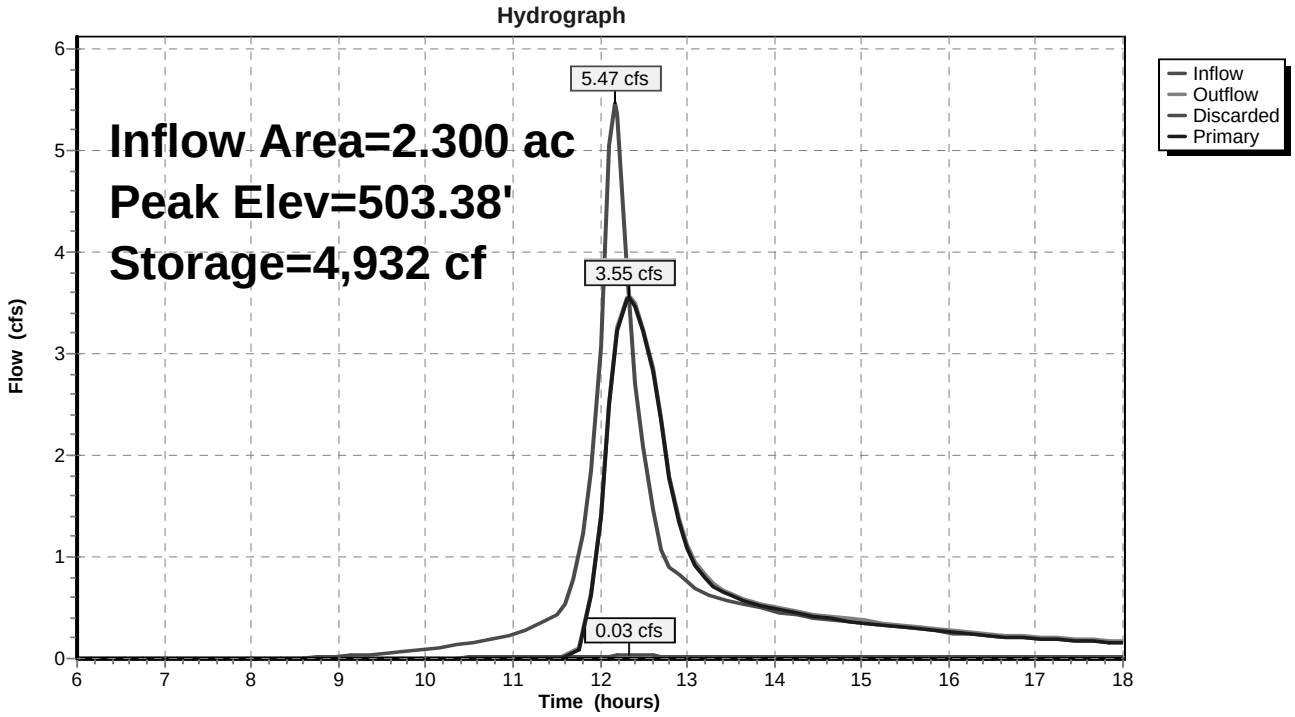
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
500.00	875	0	0	875
501.00	875	875	875	980

Device	Routing	Invert	Outlet Devices
#1	Discarded	500.00'	**0.300 in/hr Exfiltration over Wetted area**
#2	Primary	502.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	503.50'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	504.00'	**90.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 12.33 hrs HW=503.36' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=3.51 cfs @ 12.33 hrs HW=503.36' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 3.51 cfs @ 4.47 fps)
├─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Detention Basin

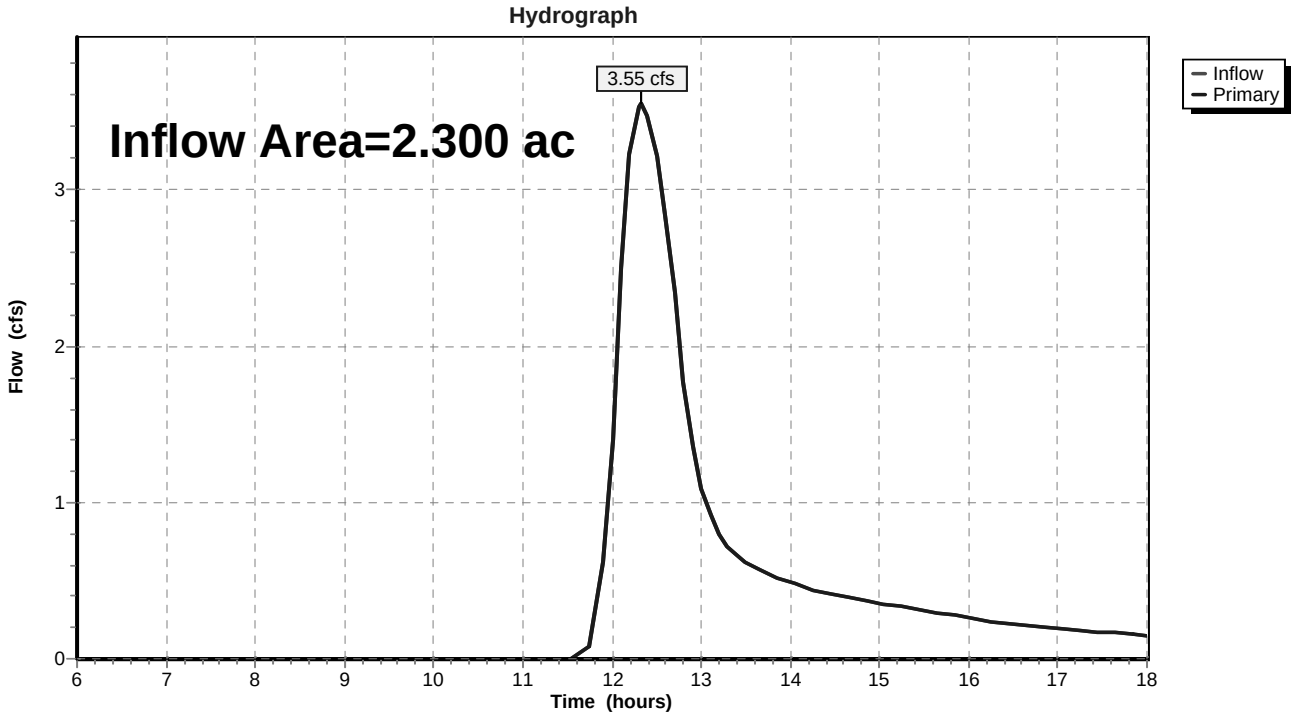


Summary for Pond 7P: Discharge to Existing Western Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 1.94" for 10-Year event
Inflow = 3.55 cfs @ 12.33 hrs, Volume= 0.371 af
Primary = 3.55 cfs @ 12.33 hrs, Volume= 0.371 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Discharge to Existing Western Swale



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: (new Subcat) Runoff Area=55,189 sf 14.27% Impervious Runoff Depth>2.71"
Tc=5.0 min CN=77 Runoff=4.27 cfs 0.286 af

Subcatchment 2S: (new Subcat) Runoff Area=100,201 sf 14.68% Impervious Runoff Depth>2.80"
Tc=5.0 min CN=78 Runoff=7.98 cfs 0.536 af

Subcatchment 3S: (new Subcat) Runoff Area=30,850 sf 16.99% Impervious Runoff Depth>2.80"
Tc=5.0 min CN=78 Runoff=2.46 cfs 0.165 af

Reach 6R: Riprap Swale Avg. Flow Depth=0.48' Max Vel=3.53 fps Inflow=7.98 cfs 0.536 af
n=0.033 L=480.0' S=0.0250 '/' Capacity=140.69 cfs Outflow=6.76 cfs 0.534 af

Pond 1P: Discharge to Existing Eastern Swale Inflow=4.27 cfs 0.286 af
Primary=4.27 cfs 0.286 af

Pond 4P: Runoff to Existing Northern Swale Inflow=2.46 cfs 0.165 af
Primary=2.46 cfs 0.165 af

Pond 5P: Detention Basin Peak Elev=503.66' Storage=5,827 cf Inflow=6.76 cfs 0.534 af
Discarded=0.03 cfs 0.015 af Primary=4.69 cfs 0.473 af Outflow=4.72 cfs 0.488 af

Pond 7P: Discharge to Existing Western Swale Inflow=4.69 cfs 0.473 af
Primary=4.69 cfs 0.473 af

Total Runoff Area = 4.275 ac Runoff Volume = 0.987 af Average Runoff Depth = 2.77"
85.06% Pervious = 3.637 ac 14.94% Impervious = 0.639 ac

Summary for Subcatchment 1S: (new Subcat)

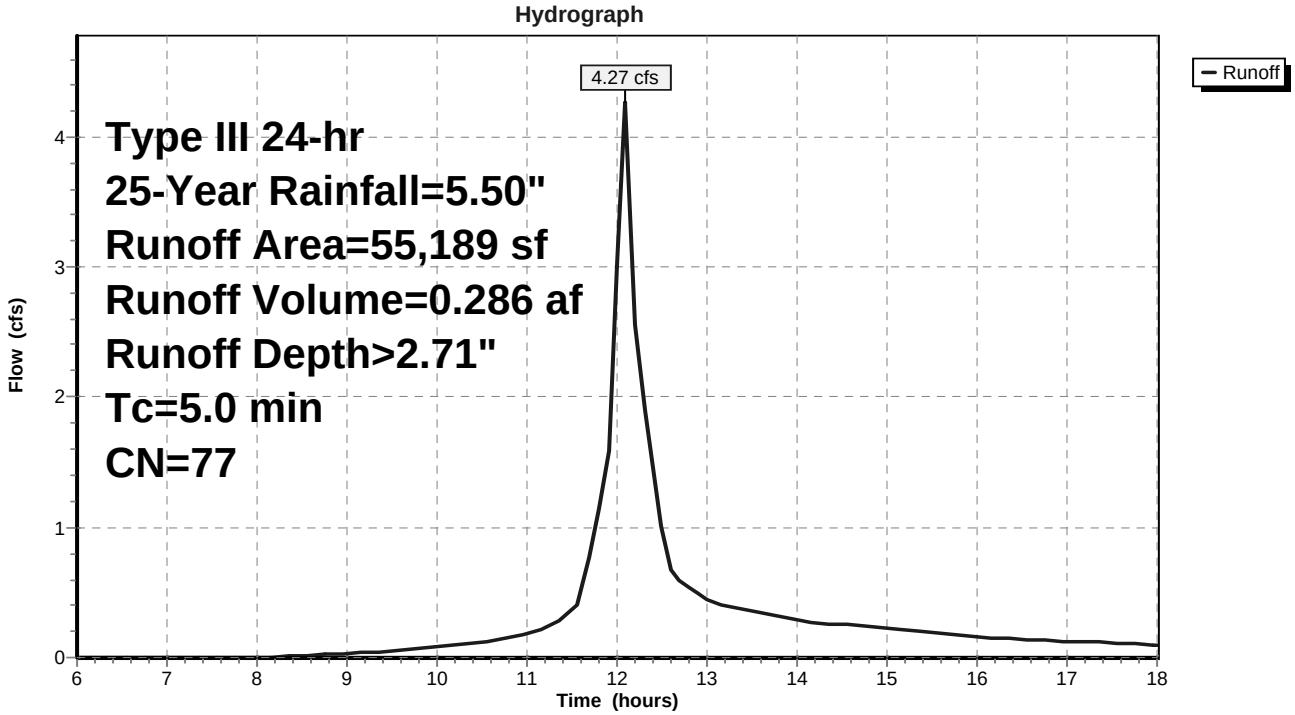
Runoff = 4.27 cfs @ 12.09 hrs, Volume= 0.286 af, Depth> 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
*	7,876	98	impervious
*	47,313	74	pervious
	55,189	77	Weighted Average
	47,313		85.73% Pervious Area
	7,876		14.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: (new Subcat)



Summary for Subcatchment 2S: (new Subcat)

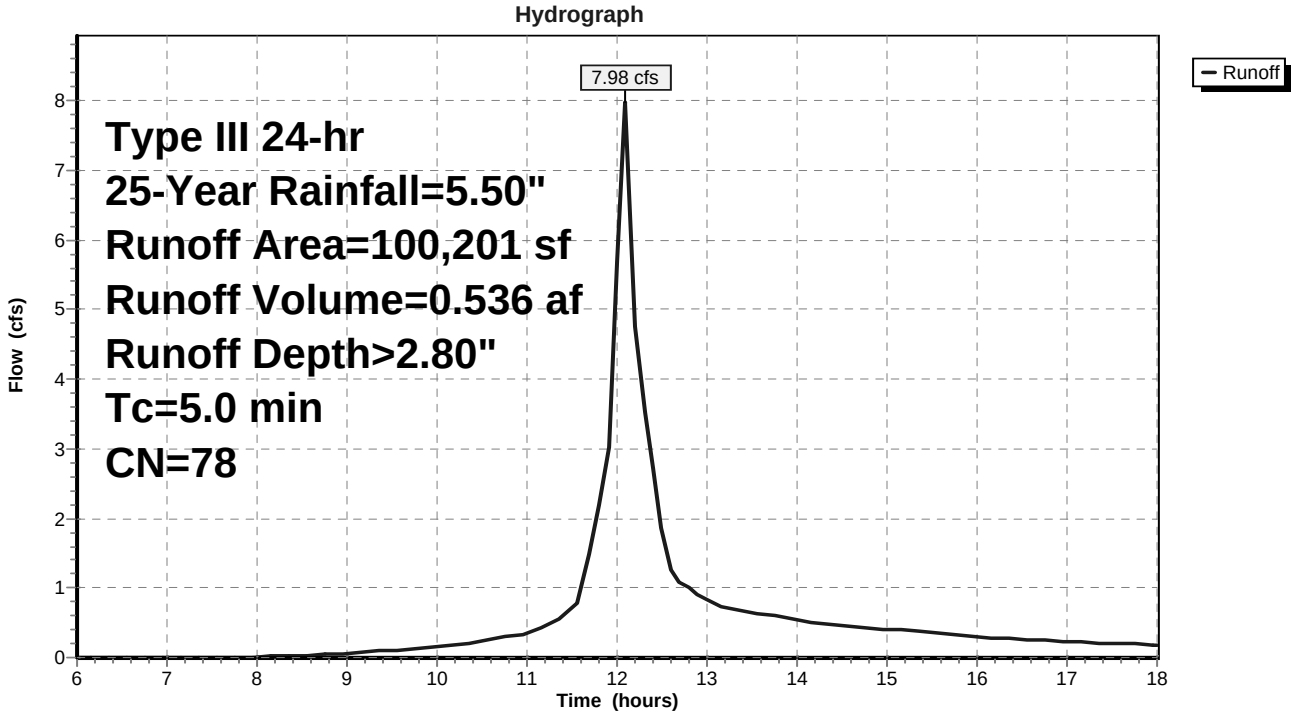
Runoff = 7.98 cfs @ 12.09 hrs, Volume= 0.536 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
*	14,711	98	impervious
*	85,490	74	pervious
	100,201	78	Weighted Average
	85,490		85.32% Pervious Area
	14,711		14.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: (new Subcat)



Summary for Subcatchment 3S: (new Subcat)

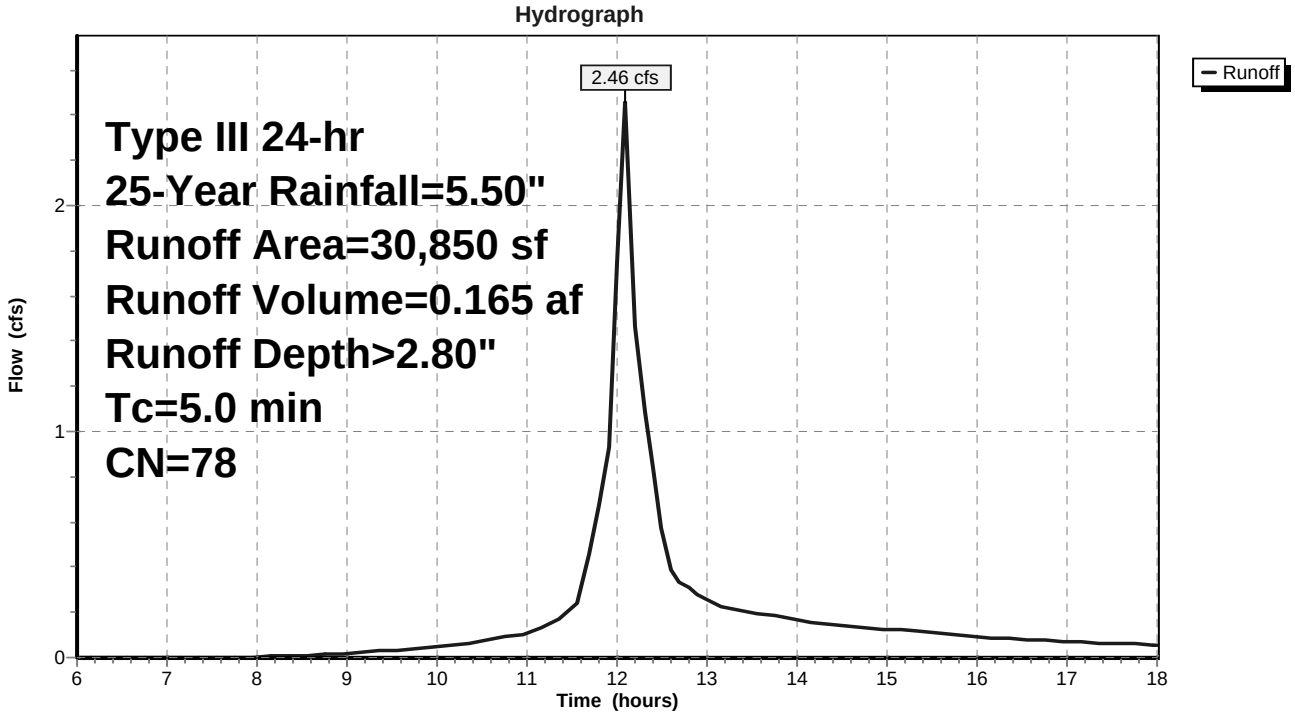
Runoff = 2.46 cfs @ 12.09 hrs, Volume= 0.165 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
*	5,240	98	impervious
*	25,610	74	pervious
	30,850	78	Weighted Average
	25,610		83.01% Pervious Area
	5,240		16.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: (new Subcat)



Summary for Reach 6R: Riprap Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 2.80" for 25-Year event
Inflow = 7.98 cfs @ 12.09 hrs, Volume= 0.536 af
Outflow = 6.76 cfs @ 12.16 hrs, Volume= 0.534 af, Atten= 15%, Lag= 4.0 min

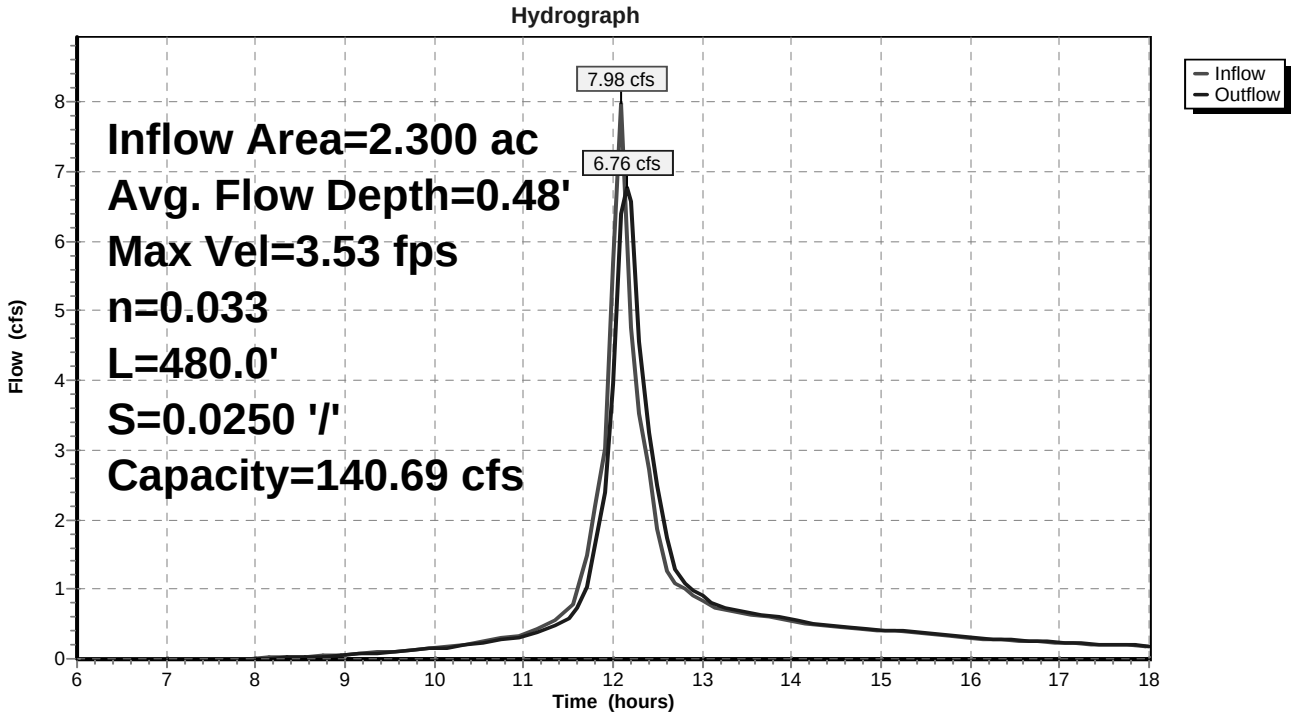
Routing by Stor-Ind+Trans method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Max. Velocity= 3.53 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 6.1 min

Peak Storage= 1,013 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 140.69 cfs

3.00' x 2.00' deep channel, n= 0.033
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 480.0' Slope= 0.0250 '/'
Inlet Invert= 512.00', Outlet Invert= 500.00'

‡

Reach 6R: Riprap Swale

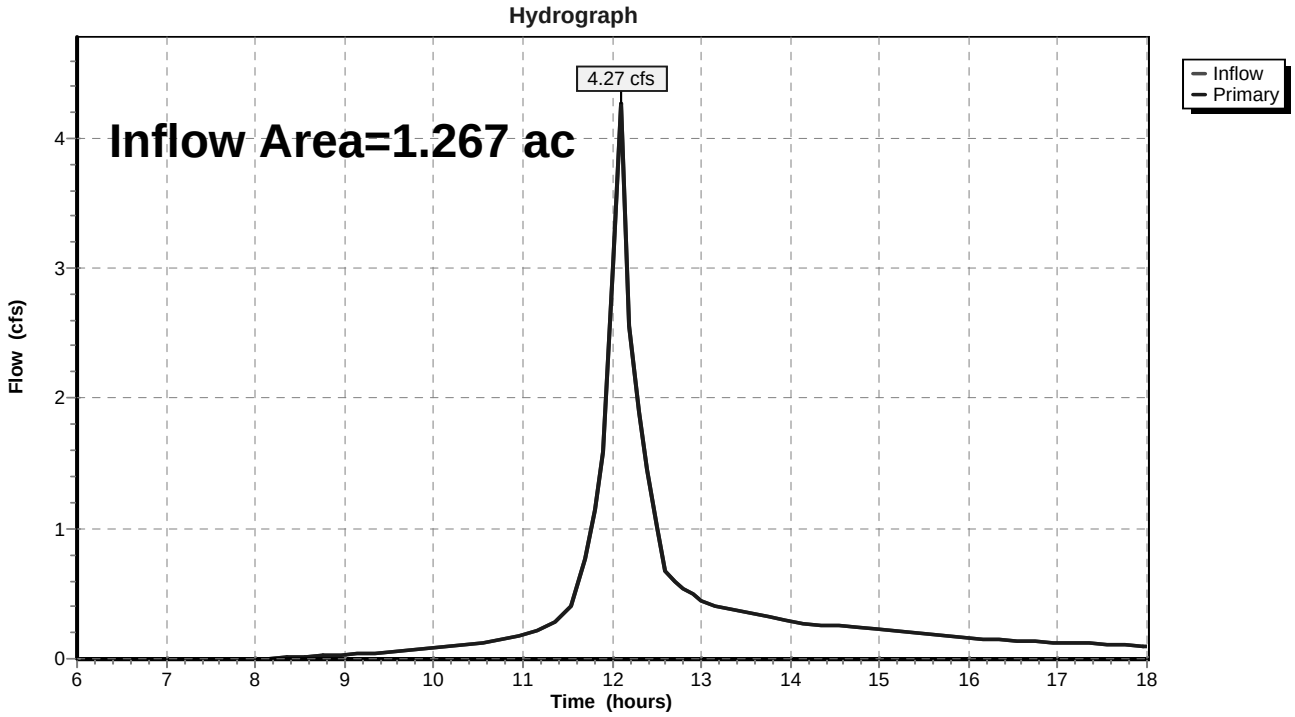


Summary for Pond 1P: Discharge to Existing Eastern Swale

Inflow Area = 1.267 ac, 14.27% Impervious, Inflow Depth > 2.71" for 25-Year event
Inflow = 4.27 cfs @ 12.09 hrs, Volume= 0.286 af
Primary = 4.27 cfs @ 12.09 hrs, Volume= 0.286 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 1P: Discharge to Existing Eastern Swale

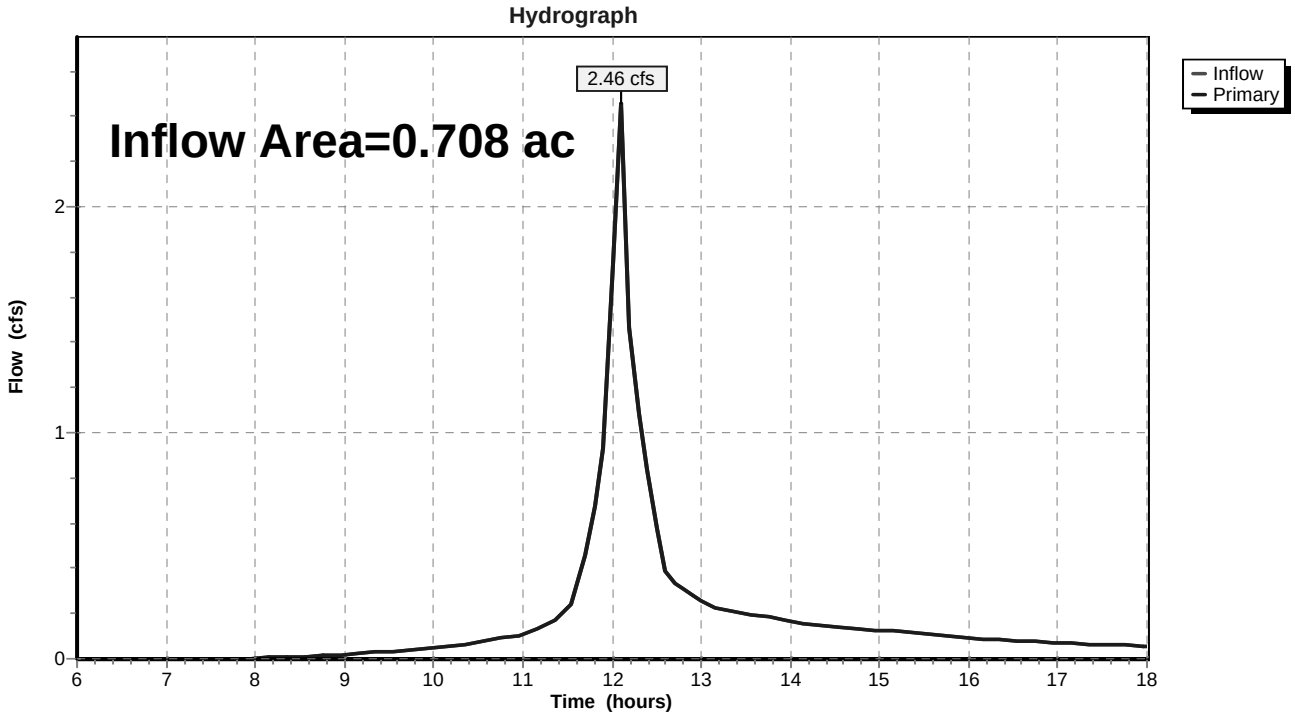


Summary for Pond 4P: Runoff to Existing Northern Swale

Inflow Area = 0.708 ac, 16.99% Impervious, Inflow Depth > 2.80" for 25-Year event
Inflow = 2.46 cfs @ 12.09 hrs, Volume= 0.165 af
Primary = 2.46 cfs @ 12.09 hrs, Volume= 0.165 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Runoff to Existing Northern Swale



Summary for Pond 5P: Detention Basin

Inflow Area =	2.300 ac, 14.68% Impervious, Inflow Depth > 2.78" for 25-Year event				
Inflow =	6.76 cfs @	12.16 hrs, Volume=	0.534 af		
Outflow =	4.72 cfs @	12.32 hrs, Volume=	0.488 af, Atten= 30%, Lag= 9.5 min		
Discarded =	0.03 cfs @	12.32 hrs, Volume=	0.015 af		
Primary =	4.69 cfs @	12.32 hrs, Volume=	0.473 af		

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 503.66' @ 12.32 hrs Surf.Area= 4,237 sf Storage= 5,827 cf

Plug-Flow detention time= 45.2 min calculated for 0.488 af (91% of inflow)
Center-of-Mass det. time= 23.5 min (798.5 - 775.0)

Volume	Invert	Avail.Storage	Storage Description
#1	501.00'	6,679 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
#2	500.00'	350 cf	**Custom Stage Data (Conic)** Listed below (Recalc) 875 cf Overall x 40.0% Voids
		7,029 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
501.00	875	0	0	875
502.00	1,725	1,276	1,276	1,734
503.00	2,710	2,199	3,475	2,733
504.00	3,725	3,204	6,679	3,768

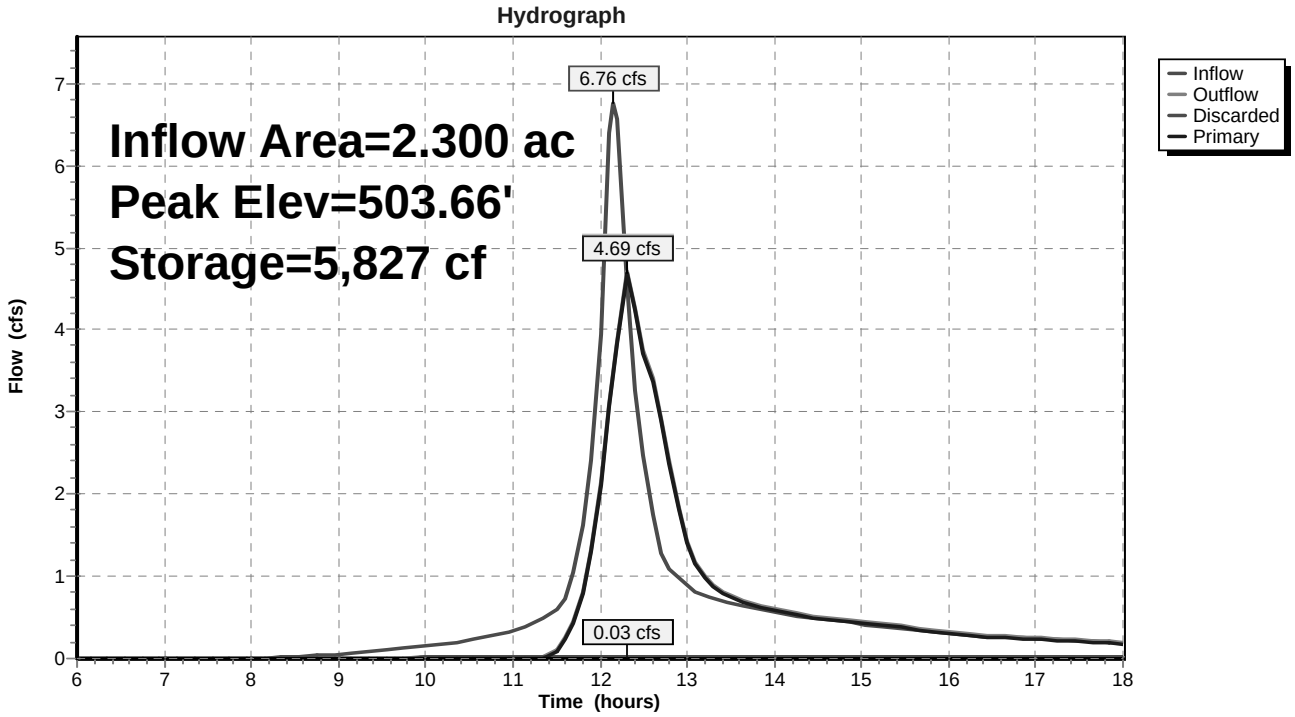
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
500.00	875	0	0	875
501.00	875	875	875	980

Device	Routing	Invert	Outlet Devices
#1	Discarded	500.00'	**0.300 in/hr Exfiltration over Wetted area**
#2	Primary	502.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	503.50'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	504.00'	**90.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 12.32 hrs HW=503.64' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=4.59 cfs @ 12.32 hrs HW=503.65' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 4.05 cfs @ 5.16 fps)
├─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.55 cfs @ 1.25 fps)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Detention Basin

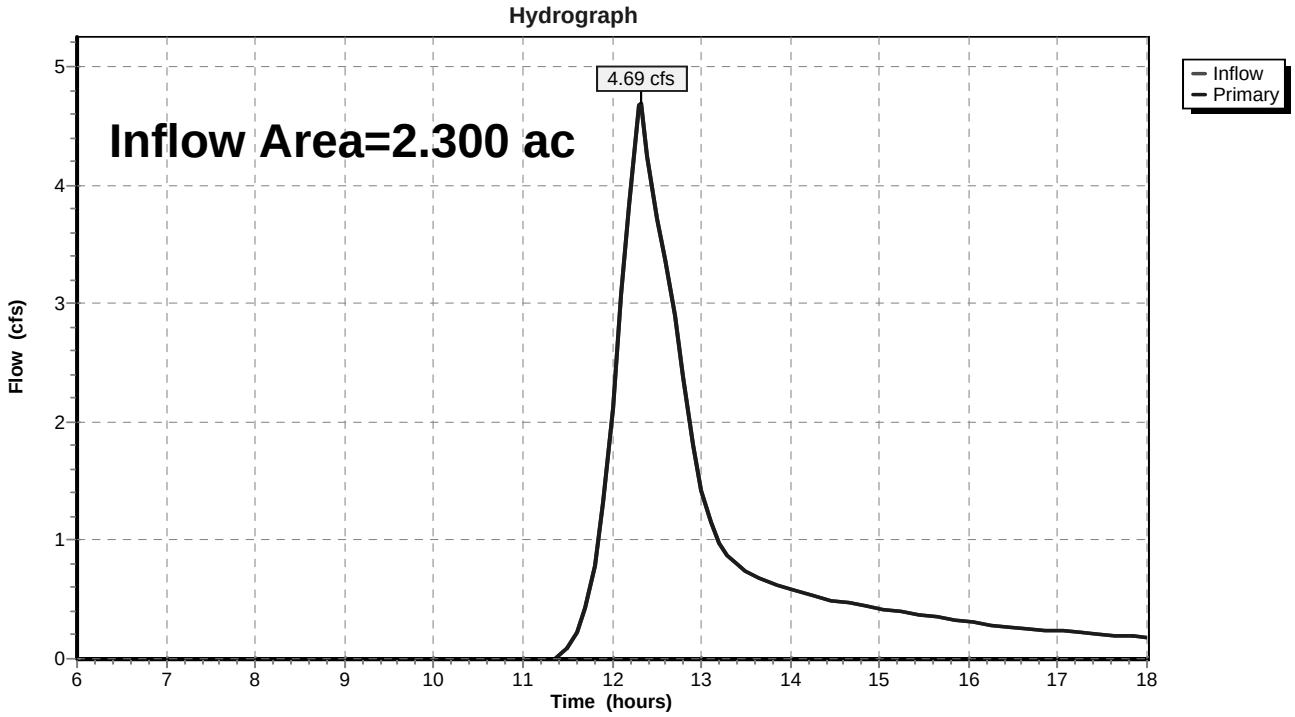


Summary for Pond 7P: Discharge to Existing Western Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 2.47" for 25-Year event
Inflow = 4.69 cfs @ 12.32 hrs, Volume= 0.473 af
Primary = 4.69 cfs @ 12.32 hrs, Volume= 0.473 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Discharge to Existing Western Swale



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: (new Subcat) Runoff Area=55,189 sf 14.27% Impervious Runoff Depth>3.83"
Tc=5.0 min CN=77 Runoff=5.95 cfs 0.404 af

Subcatchment 2S: (new Subcat) Runoff Area=100,201 sf 14.68% Impervious Runoff Depth>3.93"
Tc=5.0 min CN=78 Runoff=11.05 cfs 0.754 af

Subcatchment 3S: (new Subcat) Runoff Area=30,850 sf 16.99% Impervious Runoff Depth>3.93"
Tc=5.0 min CN=78 Runoff=3.40 cfs 0.232 af

Reach 6R: Riprap Swale Avg. Flow Depth=0.57' Max Vel=3.90 fps Inflow=11.05 cfs 0.754 af
n=0.033 L=480.0' S=0.0250 '/' Capacity=140.69 cfs Outflow=9.51 cfs 0.751 af

Pond 1P: Discharge to Existing Eastern Swale Inflow=5.95 cfs 0.404 af
Primary=5.95 cfs 0.404 af

Pond 4P: Runoff to Existing Northern Swale Inflow=3.40 cfs 0.232 af
Primary=3.40 cfs 0.232 af

Pond 5P: Detention Basin Peak Elev=503.96' Storage=6,873 cf Inflow=9.51 cfs 0.751 af
Discarded=0.03 cfs 0.017 af Primary=7.50 cfs 0.687 af Outflow=7.53 cfs 0.704 af

Pond 7P: Discharge to Existing Western Swale Inflow=7.50 cfs 0.687 af
Primary=7.50 cfs 0.687 af

Total Runoff Area = 4.275 ac Runoff Volume = 1.391 af Average Runoff Depth = 3.90"
85.06% Pervious = 3.637 ac 14.94% Impervious = 0.639 ac

Summary for Subcatchment 1S: (new Subcat)

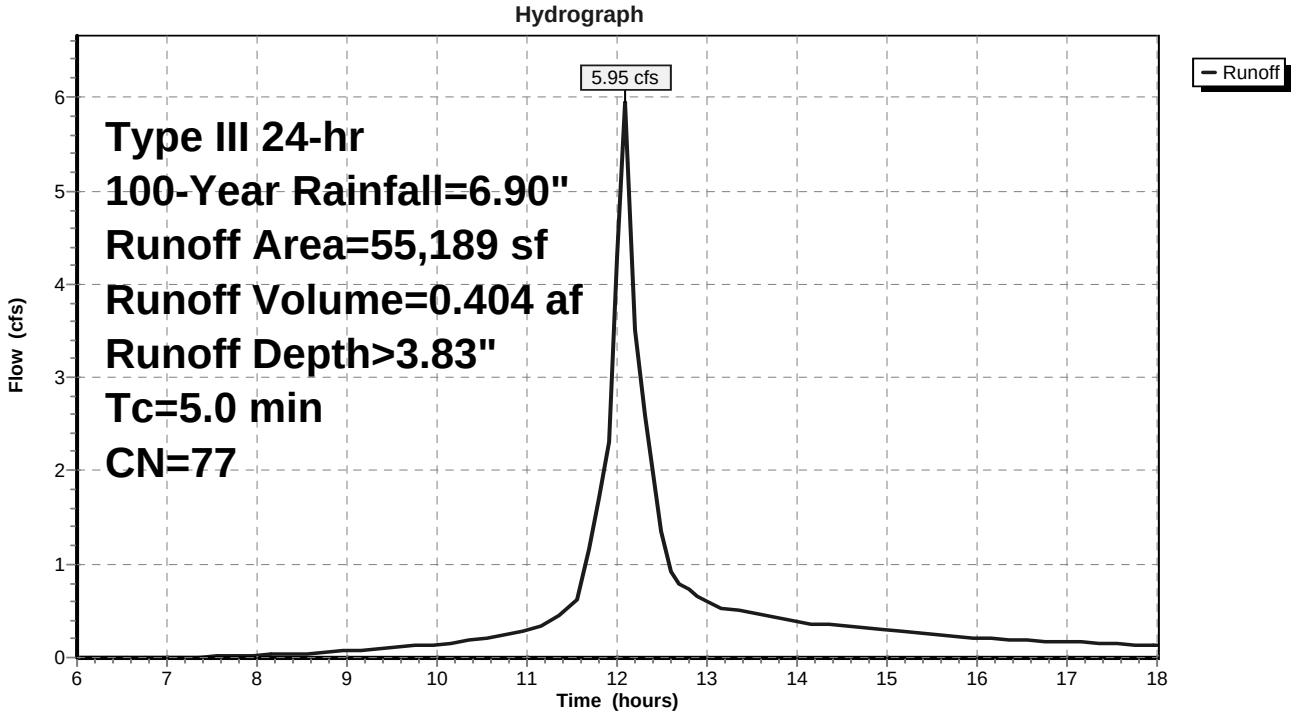
Runoff = 5.95 cfs @ 12.09 hrs, Volume= 0.404 af, Depth> 3.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (sf)	CN	Description
*	7,876	98	impervious
*	47,313	74	pervious
	55,189	77	Weighted Average
	47,313		85.73% Pervious Area
	7,876		14.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: (new Subcat)



Summary for Subcatchment 2S: (new Subcat)

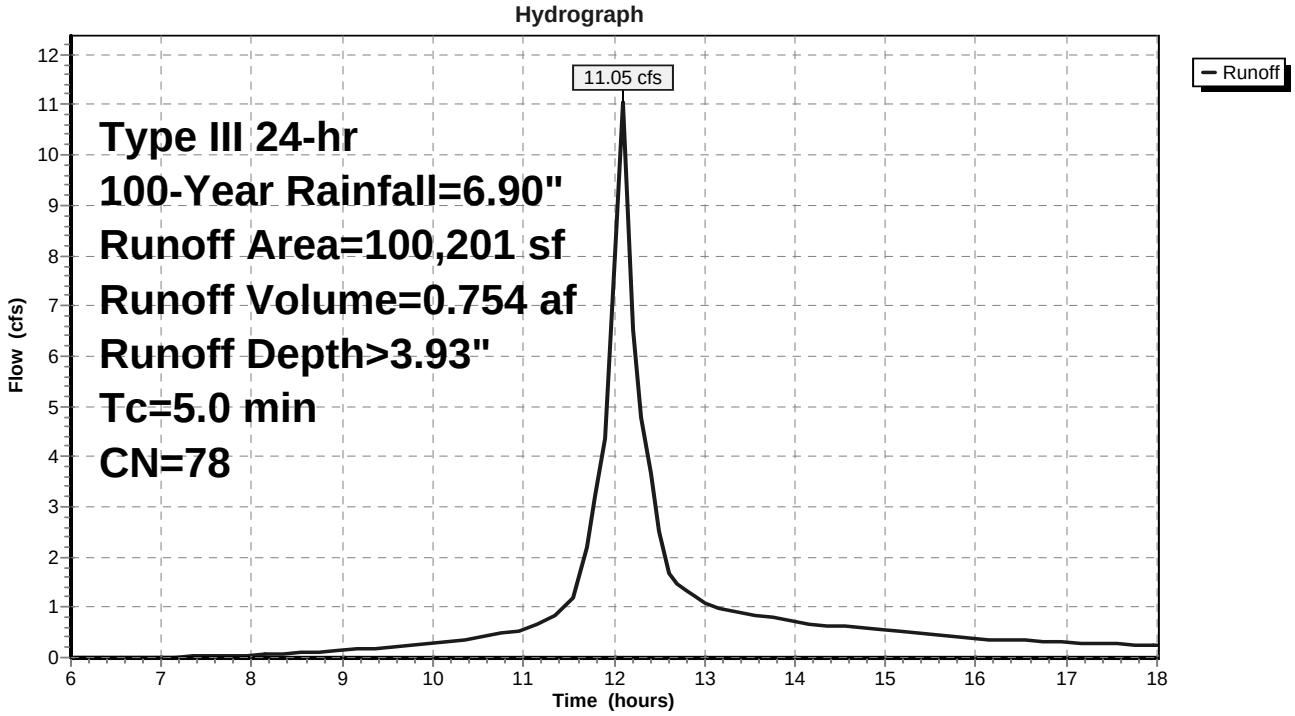
Runoff = 11.05 cfs @ 12.09 hrs, Volume= 0.754 af, Depth> 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (sf)	CN	Description
*	14,711	98	impervious
*	85,490	74	pervious
	100,201	78	Weighted Average
	85,490		85.32% Pervious Area
	14,711		14.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: (new Subcat)



Summary for Subcatchment 3S: (new Subcat)

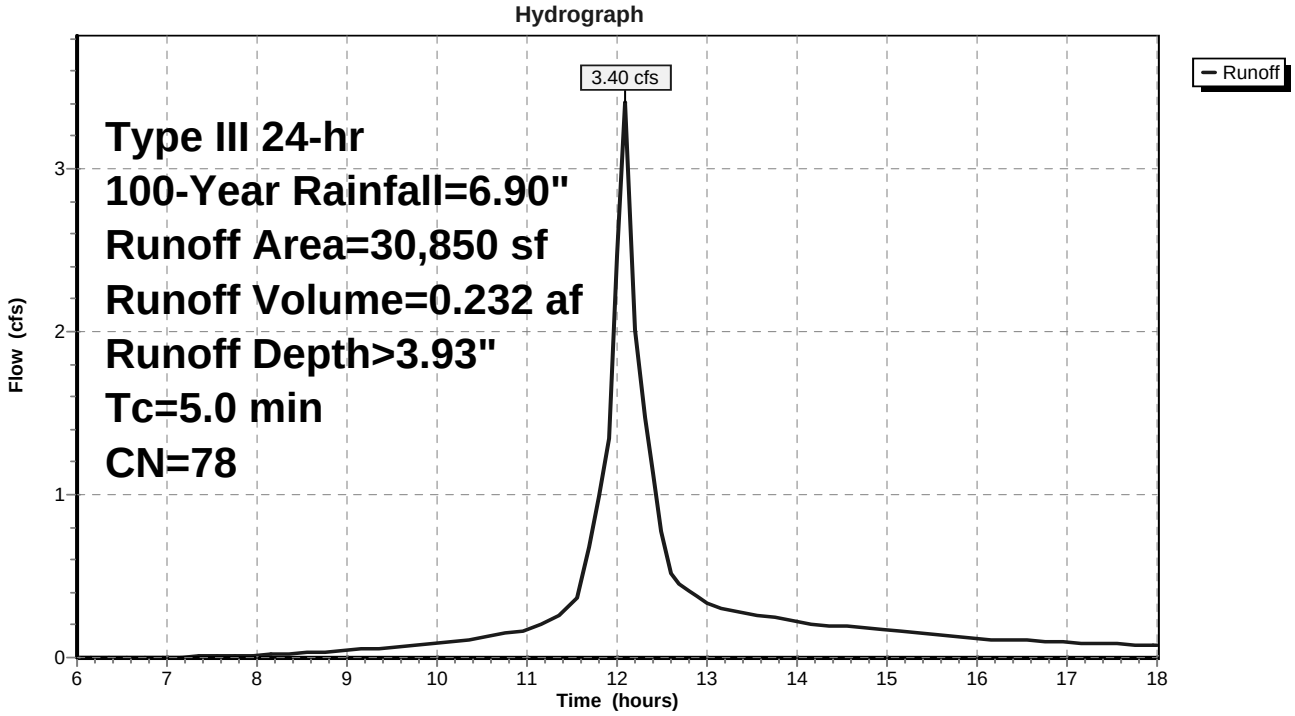
Runoff = 3.40 cfs @ 12.09 hrs, Volume= 0.232 af, Depth> 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (sf)	CN	Description
*	5,240	98	impervious
*	25,610	74	pervious
	30,850	78	Weighted Average
	25,610		83.01% Pervious Area
	5,240		16.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: (new Subcat)



Summary for Reach 6R: Riprap Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 3.93" for 100-Year event
Inflow = 11.05 cfs @ 12.09 hrs, Volume= 0.754 af
Outflow = 9.51 cfs @ 12.14 hrs, Volume= 0.751 af, Atten= 14%, Lag= 3.3 min

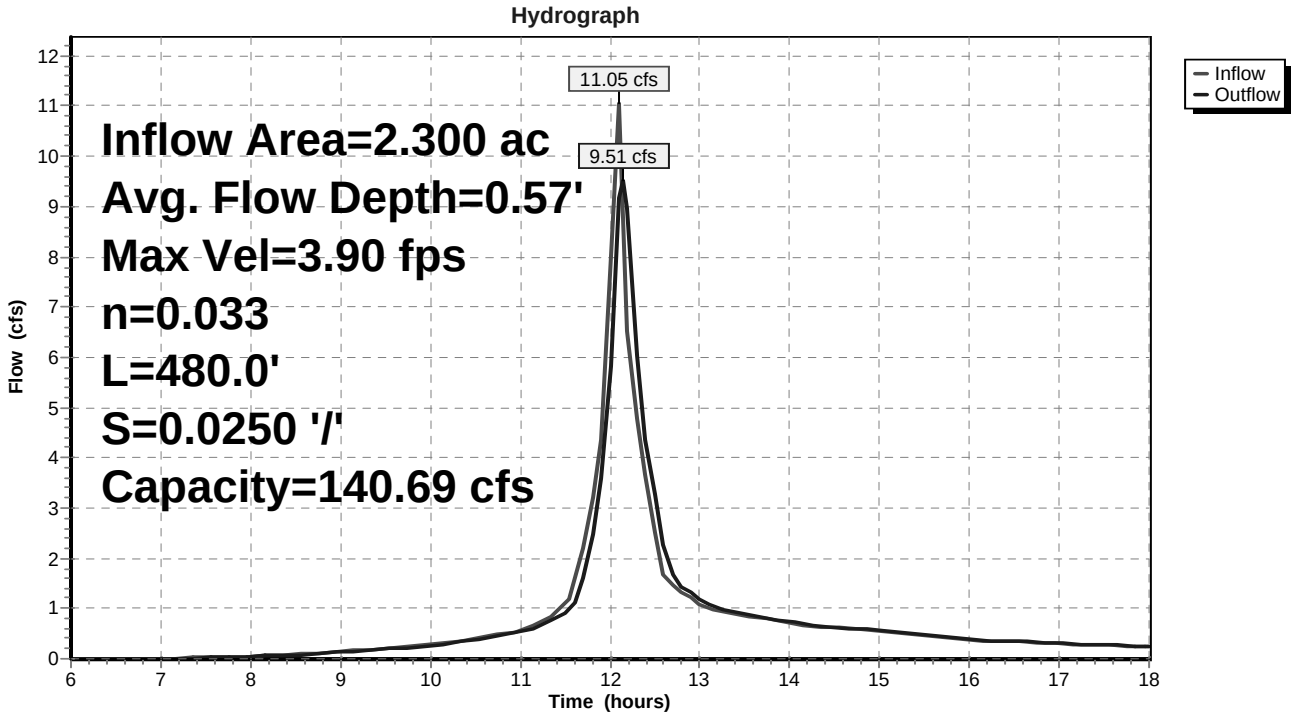
Routing by Stor-Ind+Trans method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Max. Velocity= 3.90 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 5.7 min

Peak Storage= 1,285 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 140.69 cfs

3.00' x 2.00' deep channel, n= 0.033
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 480.0' Slope= 0.0250 '/'
Inlet Invert= 512.00', Outlet Invert= 500.00'

‡

Reach 6R: Riprap Swale

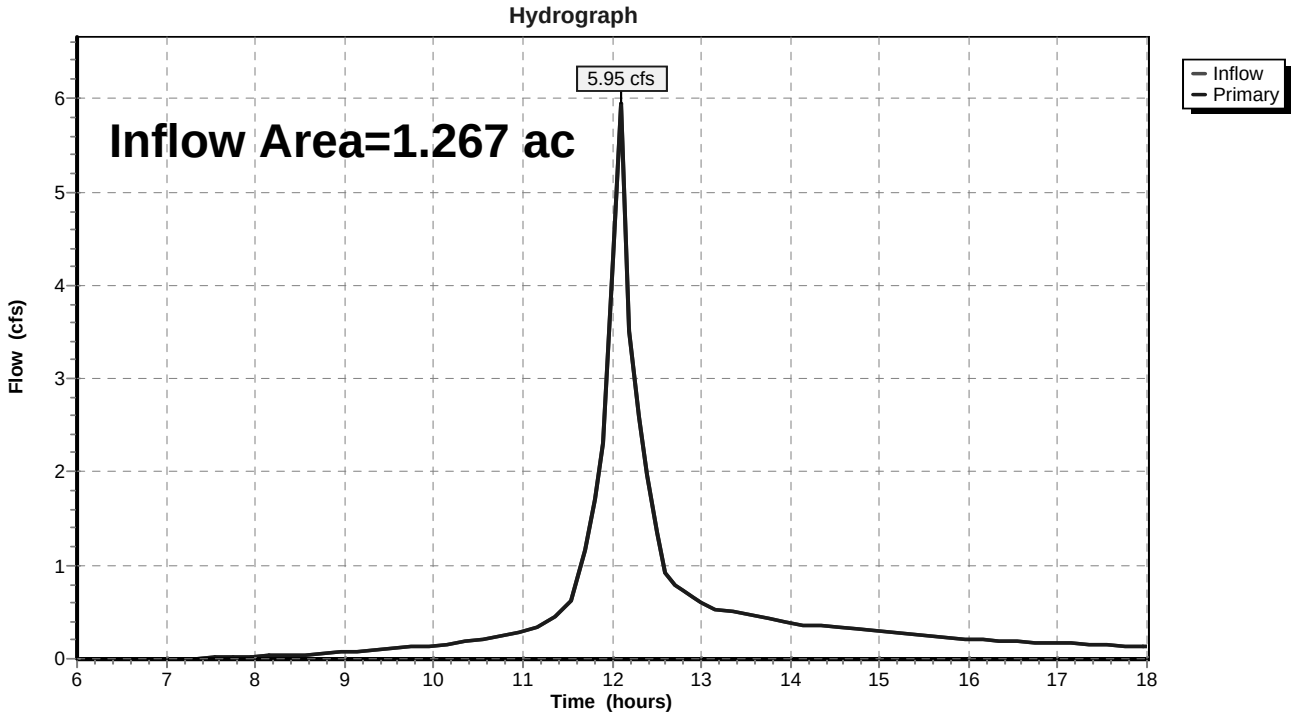


Summary for Pond 1P: Discharge to Existing Eastern Swale

Inflow Area = 1.267 ac, 14.27% Impervious, Inflow Depth > 3.83" for 100-Year event
Inflow = 5.95 cfs @ 12.09 hrs, Volume= 0.404 af
Primary = 5.95 cfs @ 12.09 hrs, Volume= 0.404 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 1P: Discharge to Existing Eastern Swale

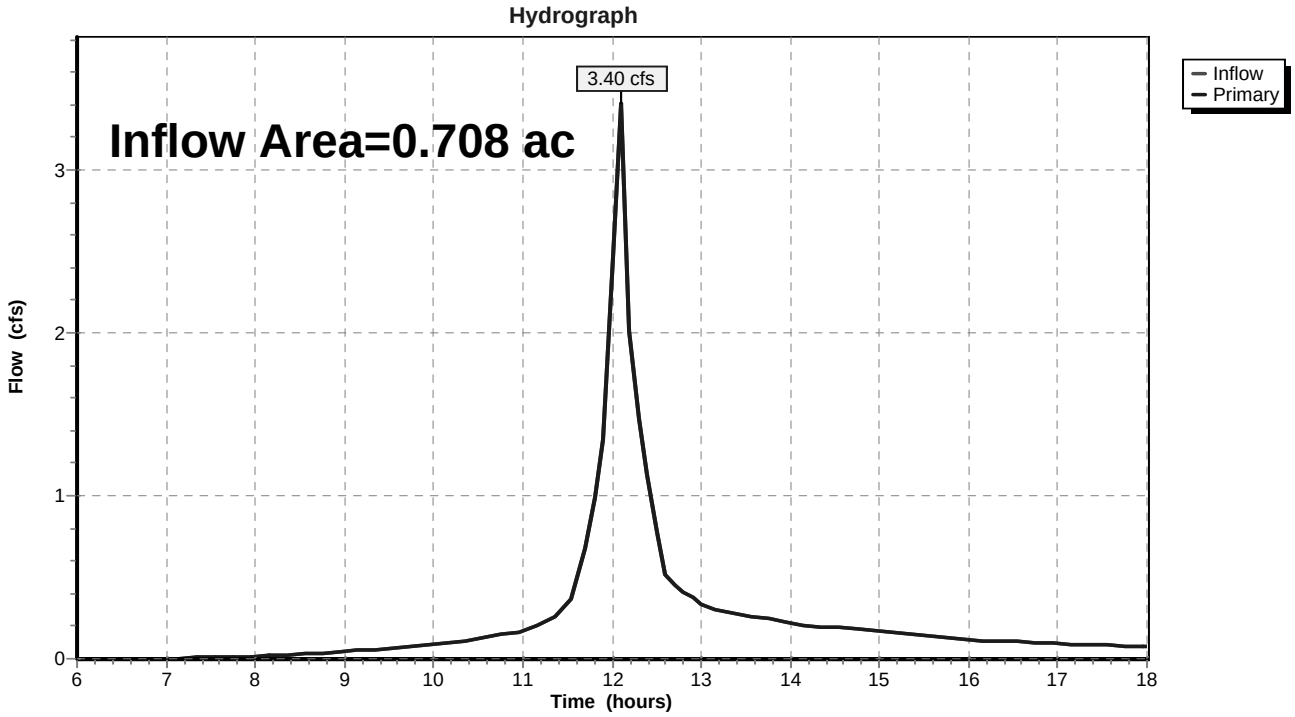


Summary for Pond 4P: Runoff to Existing Northern Swale

Inflow Area = 0.708 ac, 16.99% Impervious, Inflow Depth > 3.93" for 100-Year event
Inflow = 3.40 cfs @ 12.09 hrs, Volume= 0.232 af
Primary = 3.40 cfs @ 12.09 hrs, Volume= 0.232 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Runoff to Existing Northern Swale



Summary for Pond 5P: Detention Basin

Inflow Area =	2.300 ac, 14.68% Impervious, Inflow Depth > 3.92" for 100-Year event				
Inflow =	9.51 cfs @	12.14 hrs,	Volume=	0.751 af	
Outflow =	7.53 cfs @	12.26 hrs,	Volume=	0.704 af,	Atten= 21%, Lag= 7.1 min
Discarded =	0.03 cfs @	12.26 hrs,	Volume=	0.017 af	
Primary =	7.50 cfs @	12.26 hrs,	Volume=	0.687 af	

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 503.96' @ 12.26 hrs Surf.Area= 4,554 sf Storage= 6,873 cf

Plug-Flow detention time= 37.9 min calculated for 0.698 af (93% of inflow)
Center-of-Mass det. time= 21.8 min (789.3 - 767.5)

Volume	Invert	Avail.Storage	Storage Description
#1	501.00'	6,679 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
#2	500.00'	350 cf	**Custom Stage Data (Conic)** Listed below (Recalc) 875 cf Overall x 40.0% Voids
		7,029 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
501.00	875	0	0	875
502.00	1,725	1,276	1,276	1,734
503.00	2,710	2,199	3,475	2,733
504.00	3,725	3,204	6,679	3,768

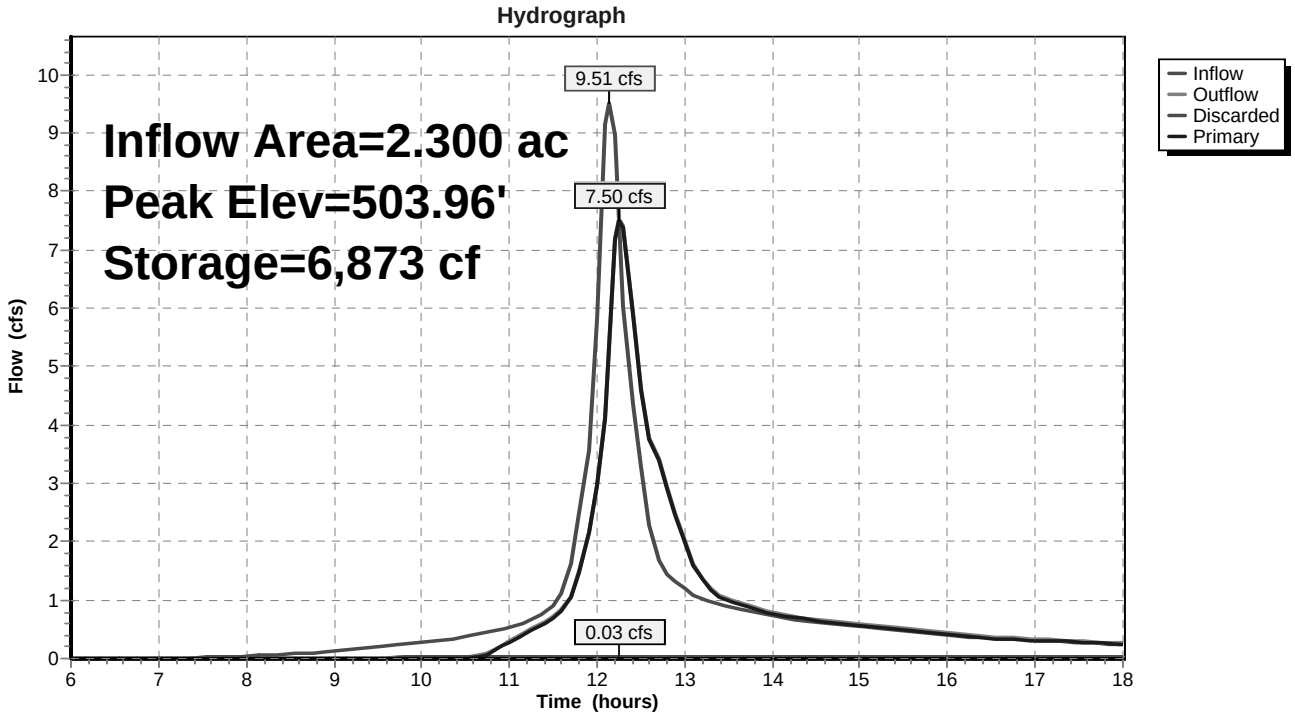
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
500.00	875	0	0	875
501.00	875	875	875	980

Device	Routing	Invert	Outlet Devices
#1	Discarded	500.00'	**0.300 in/hr Exfiltration over Wetted area**
#2	Primary	502.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	503.50'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	504.00'	**90.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 12.26 hrs HW=503.94' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=7.30 cfs @ 12.26 hrs HW=503.94' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 4.54 cfs @ 5.77 fps)
├─**3=Sharp-Crested Rectangular Weir** (Weir Controls 2.76 cfs @ 2.16 fps)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Detention Basin

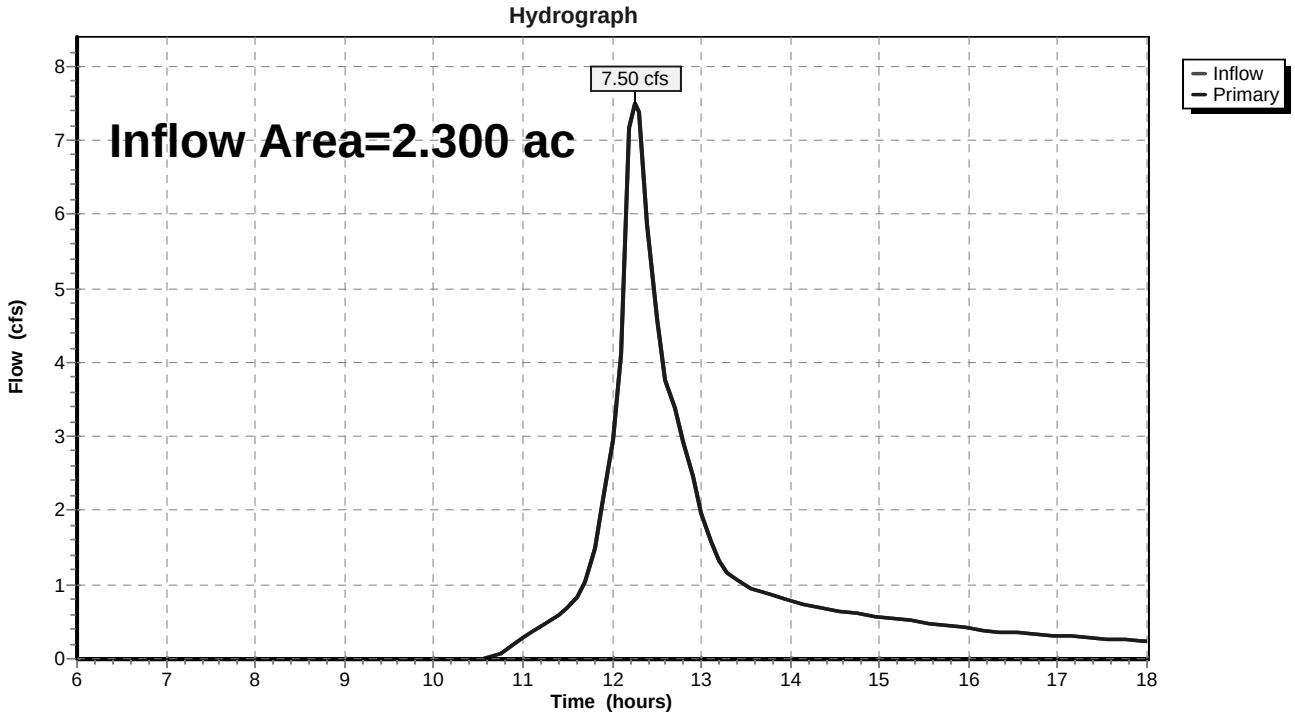


Summary for Pond 7P: Discharge to Existing Western Swale

Inflow Area = 2.300 ac, 14.68% Impervious, Inflow Depth > 3.59" for 100-Year event
Inflow = 7.50 cfs @ 12.26 hrs, Volume= 0.687 af
Primary = 7.50 cfs @ 12.26 hrs, Volume= 0.687 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Discharge to Existing Western Swale



Attachment C

Permanent BMP Calculations

CHAPLIN, CT

Pre-Development Areas

Watershed 1S:

	SF	AC	%
Total Area	72,766	1.67	-
Impervious Area	7,105	0.16	0.10
Pervious Area	65,661	1.51	0.90

Watershed 2S:

	SF	AC	%
Total Area	74,340	1.71	-
Impervious Area	5,236	0.12	0.07
Pervious Area	69,104	1.59	0.93

Watershed 3S:

	SF	AC	%
Total Area	33,909	0.78	-
Impervious Area	5,242	0.12	0.15
Pervious Area	28,667	0.66	0.85

Post-Development Areas

Watershed 1S:

	SF	AC	%
Total Area	55,189	1.27	-
Impervious Area	7,876	0.18	0.14
Pervious Area	47,313	1.09	0.86

Watershed 2S:

	SF	AC	%
Total Area	100,201	2.30	-
Impervious Area	14,711	0.34	0.15
Pervious Area	85,490	1.96	0.85

Watershed 3S:

	SF	AC	%
Total Area	30,850	0.71	-
Impervious Area	5,240	0.12	0.17
Pervious Area	25,610	0.59	0.83

Water Quality Volume (WQV)

WQV= [(1")(R)(A)]/12

WQV=water quality volume (ac-ft)

R=volumetric runoff coefficient =0.05 + 0.009(I)

I=Percent imperious cover

A=site area in acres

	I	R	A	WQV (ac-ft)
Watershed 1S	14	0.176	1.27	0.0186
Watershed 2S	15	0.185	2.30	0.0355
Watershed 3S	17	0.203	0.71	0.0120

Attachment D

Custom Soils Report

Hydrologic Soil Group—State of Connecticut
(Chaplin, CT Compressor Station)

Map Scale: 1:3,090 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: State of Connecticut
Survey Area Data: Version 11, Nov 19, 2013

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

Date(s) aerial images were photographed: Mar 28, 2011—May 12, 2011

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — State of Connecticut (CT600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
3	Ridgebury, Leicester, and Whitman soils, extremely stony	D	1.4	12.3%
47C	Woodbridge fine sandy loam, 2 to 15 percent slopes, extremely stony	C	1.9	16.0%
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	B	0.9	7.4%
62D	Canton and Charlton soils, 15 to 35 percent slopes, extremely stony	B	0.1	0.7%
85B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes, very stony	C	0.1	0.4%
86C	Paxton and Montauk fine sandy loams, 3 to 15 percent slopes, extremely stony	C	7.3	63.1%
Totals for Area of Interest			**11.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

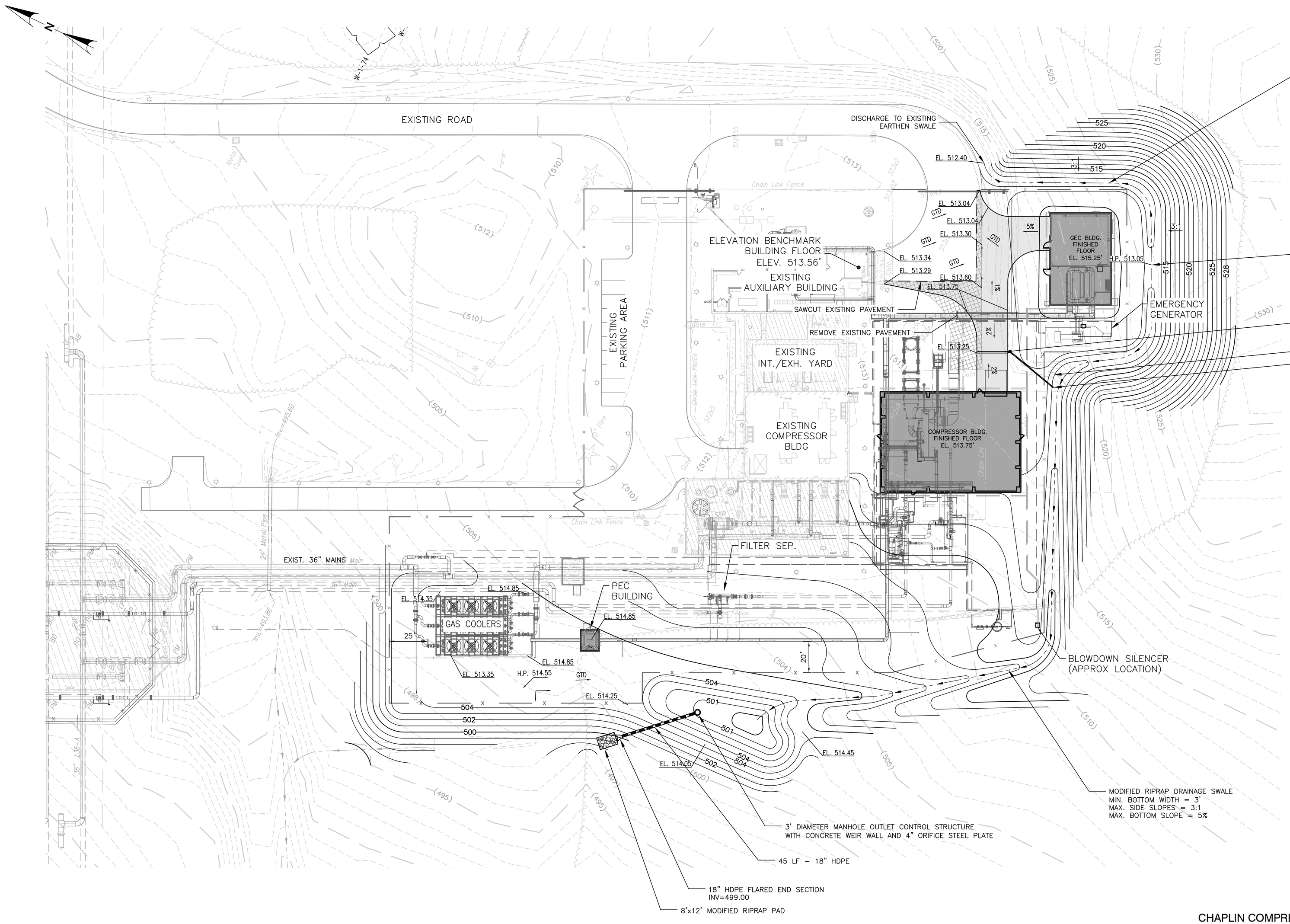
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher



LEGEND:

- TREE LINE
- 500 NEW MAJOR CONTOUR
- 502 NEW MINOR CONTOUR
- (502) EXIST. MINOR CONTOUR
- (500) EXIST. MAJOR CONTOUR
- EXIST. FENCE
- EXISTING BUILDING
- PROPOSED IMPERVIOUS SURFACE
- PROPOSED BUILDING
- REMOVE EXISTING PAVEMENT/BUILDING
- PROPOSED MODIFIED RIPRAP DRAINAGE SWALE

NOTES:

1. COORDINATES ARE CONNECTICUT STATE PLANE (NAD 1983).

30 15 0 30 60 90

SCALE: 1"=30'

CHAPLIN COMPRESSOR STATION

DWG. NO.	REFERENCE DWG.	REV	DSN	CK	DESCRIPTION

WBA, P.C.
2087 EAST 71ST STREET
TULSA, OKLAHOMA 74136
(918) 499-2724

ENGINEERING APPROVALS				
DRAWN BY:	BID		CONSTRUCTION	
TITLE	SIGNATURE	DATE	SIGNATURE	DATE

GRADING PLAN

LOC. CHAPLIN, CONNECTICUT

YEAR: 2015 | WBS:CE.000030.0020 | SCALE: 1" = 30' | DWG. | REV.

Spectra Energy Partners
Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

IG.# CHAP-B-3002

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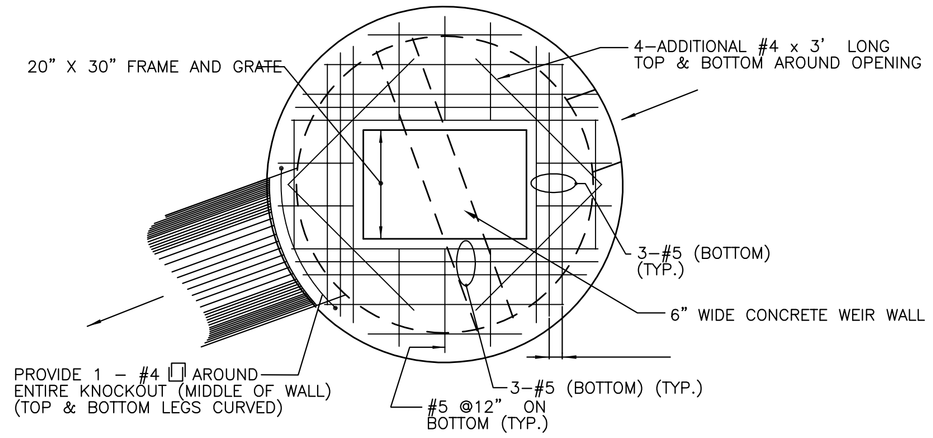
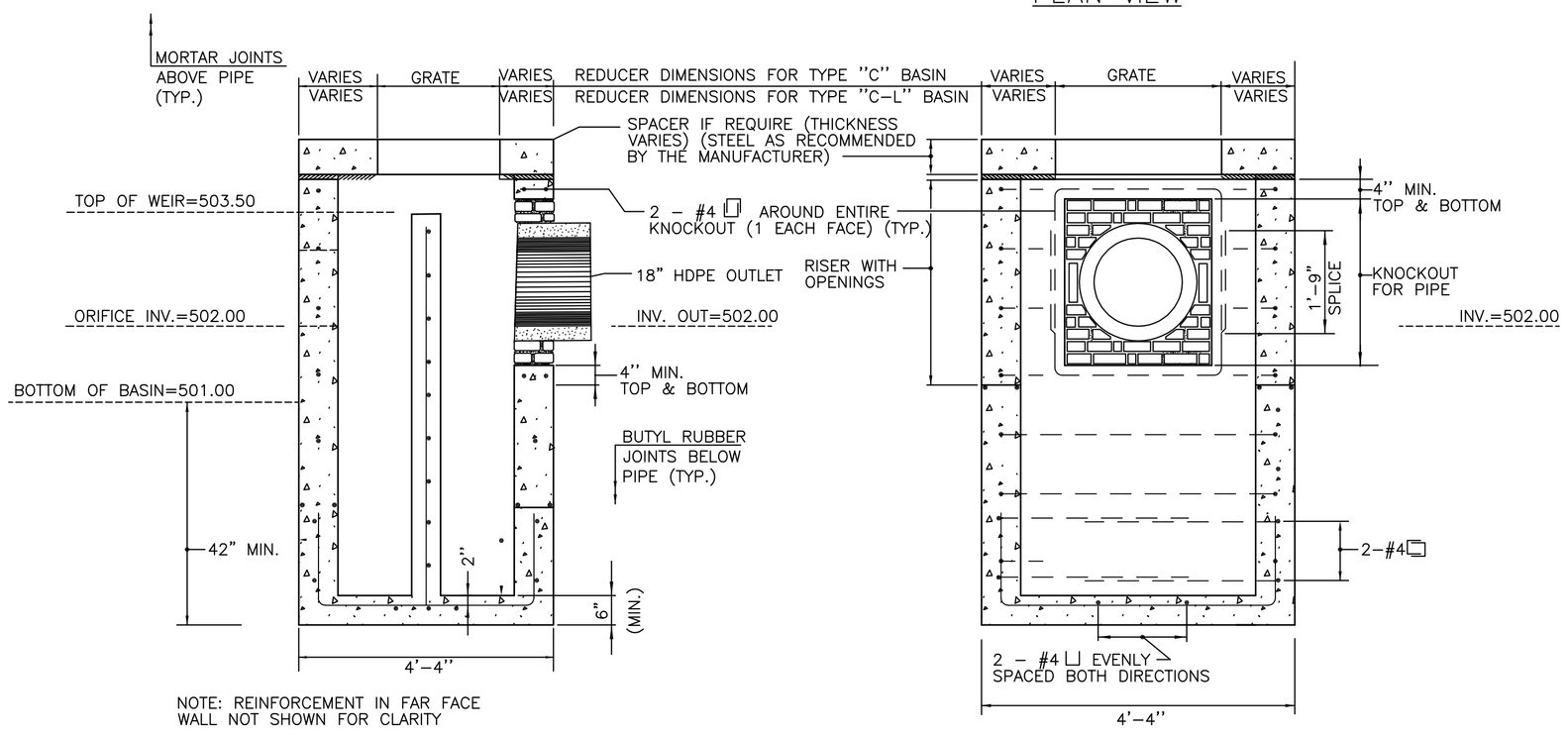
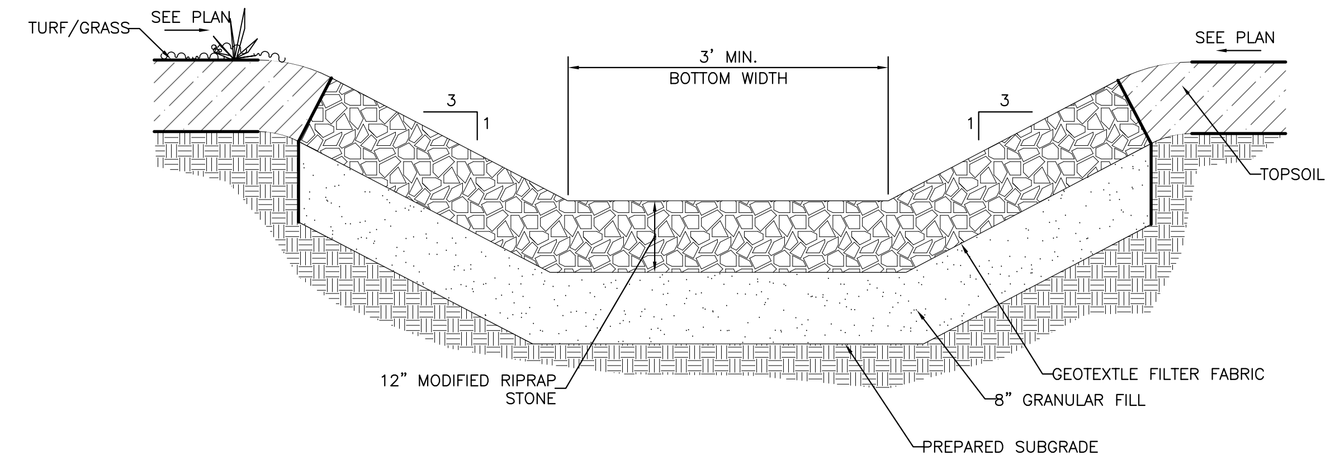


PLAN VIEW



PRECAST CONCRETE OUTLET CONTROL STRUCTURE WITH PRECAST WEIR WALL

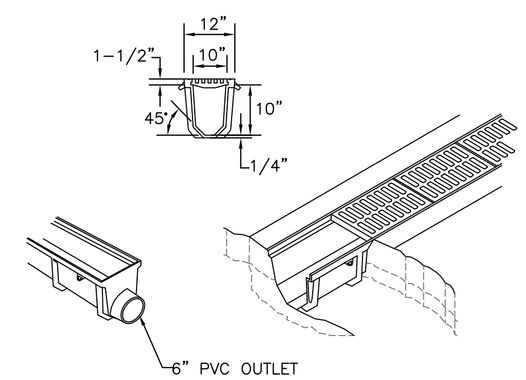
NOT TO SCALE



NOTE:
SEE GRADING PLAN FOR PLAN VIEW.

MODIFIED RIPRAP DRAINAGE SWALE

NOT TO SCALE



NOTE:
NEENAH R–4996–C WITH TYPE A GRATE, OR APPROVED EQUAL

12" WIDE CAST IRON TRENCH DRAIN

NOT TO SCALE

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Watermarker: KATE.WINTER

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IG.# CHAP-B-3002

DWG. NO.	REFERENCE DWG.	REV	DSN	CK	DESCRIPTION
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		△			
		△			

WBA, P.C.
2087 EAST 71ST STREET
TULSA, OKLAHOMA 74136
(918) 499–2724

ENGINEERING APPROVALS

DRAWN BY:	BID		CONSTRUCTION	
TITLE	SIGNATURE	DATE	SIGNATURE	DATE

CHAPLIN COMPRESSOR STATION

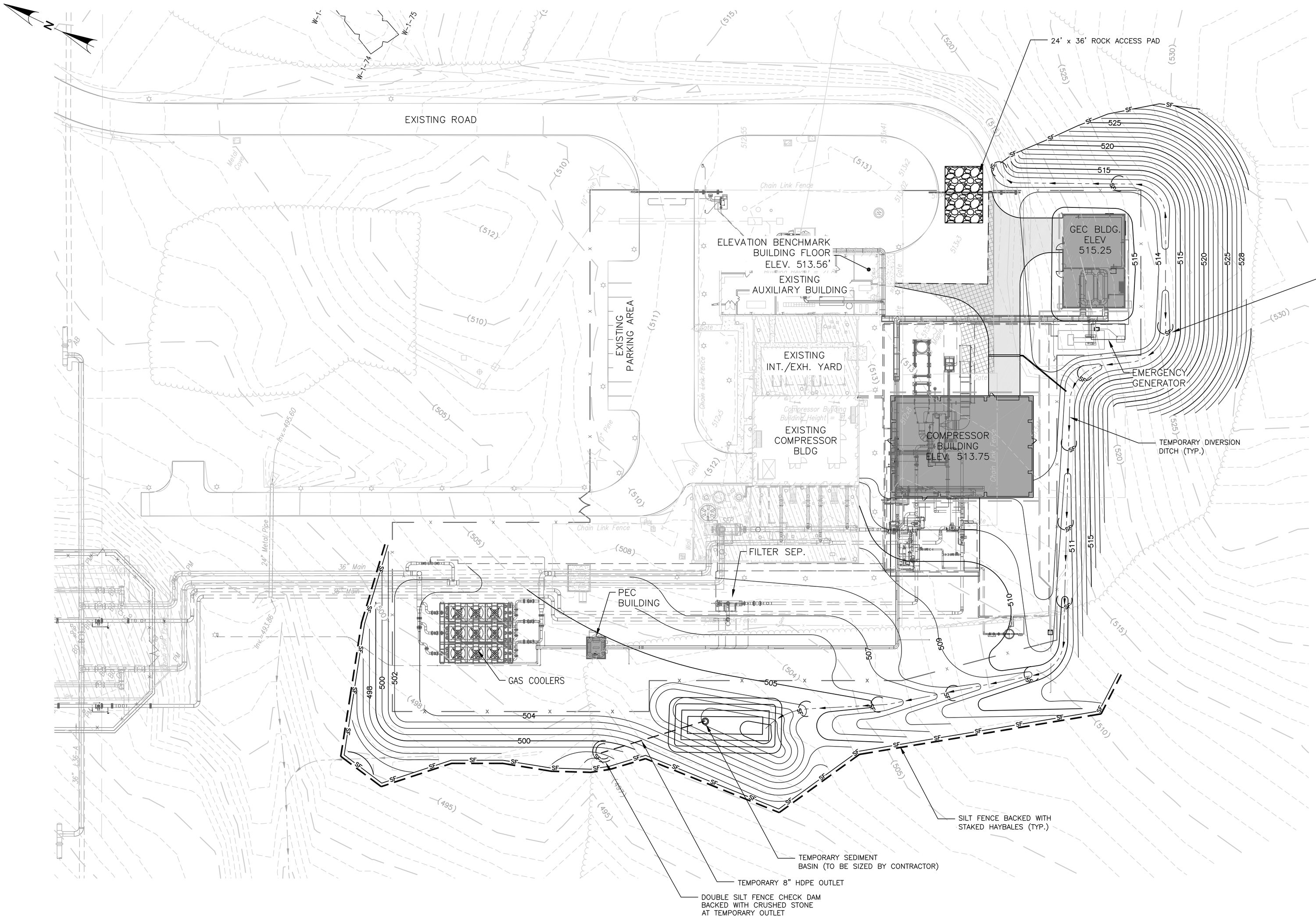
GRADING DETAILS

LOC. CHAPLIN, CONNECTICUT

YEAR: 2015 | WBS:CE.000030.0020 | SCALE: N/A | DWG. | REV.

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400



LEGEND:

- TREE LINE
- 500 NEW MAJOR CONTOUR
- 502 NEW MINOR CONTOUR
- (500) EXIST. MAJOR CONTOUR
- (502) EXIST. MINOR CONTOUR
- EXIST. FENCE
- EXISTING BUILDING
- PROPOSED IMPERVIOUS SURFACE
- PROPOSED BUILDING
- REMOVE EXISTING PAVEMENT/BUILDING
- ROCK ACCESS PAD
- TEMP. CHECK DAM
- HAY BALE PROTECTION
- SF SILT FENCE
- TEMP. DIVERSION DITCH

NOTES:

1. COORDINATES ARE CONNECTICUT STATE PLANE (NAD 1983).

30 15 0 30 60 90

SCALE: 1"=30'

CHAPLIN COMPRESSOR STATION

DWG. NO.	REFERENCE DWG.	REV	DSN	CK	DESCRIPTION

WBA, P.C.
2087 EAST 71ST STREET
TULSA, OKLAHOMA 74136
(918) 499-2724

ENGINEERING APPROVALS				
DRAWN BY:	BID		CONSTRUCTION	
TITLE	SIGNATURE	DATE	SIGNATURE	DATE

EROSION AND SEDIMENTATION CONTROL PLAN

LOC. CHAPLIN, CONNECTICUT

YEAR: 2015 | WBS:CE.000030.0020 | SCALE: 1" = 30' | DWG. | REV.

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

IG.# CHAP-B-3002

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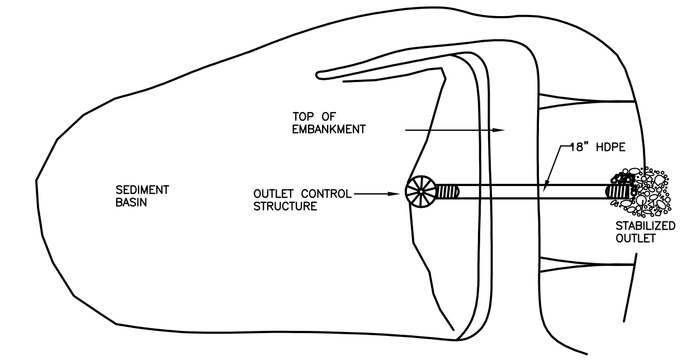
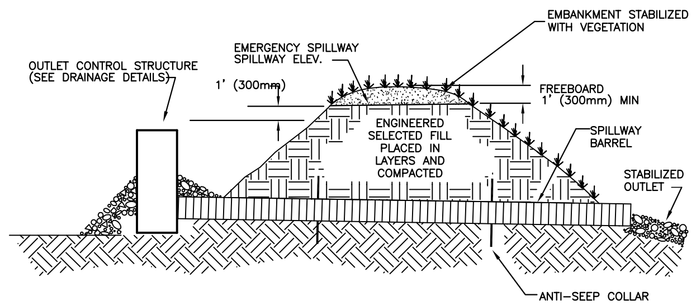
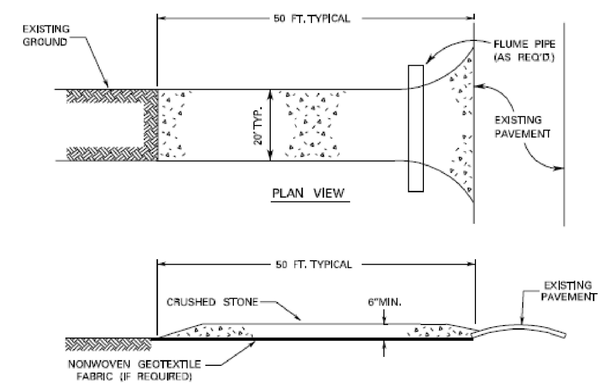


PLAN



SECTION

TEMPORARY SEDIMENT BASIN

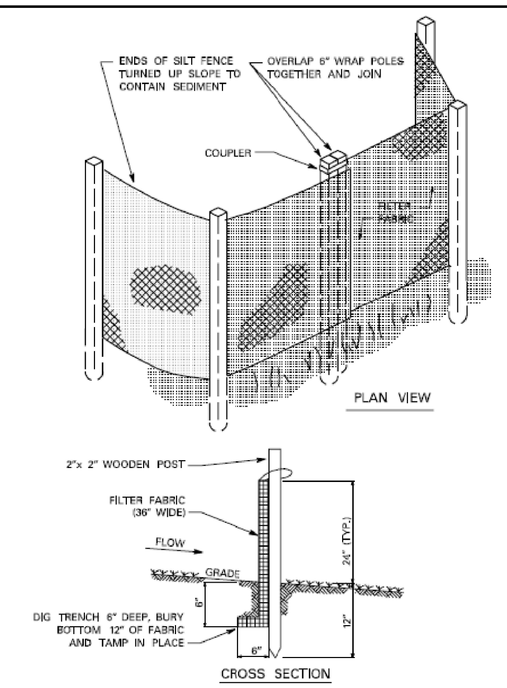


CONSTRUCTION SPECIFICATIONS:

1. STONE SIZE = 4" – 8" (AVG.) CRUSHED STONE
2. ALL STONE MUST BE PLACED ON NON-WOVEN GEOTEXILE FABRIC IF USED IN RESIDENTIAL OR ACTIVE AGRICULTURAL AREAS.
3. LENGTH – FIFTY (50) FOOT TYPICAL (IF SITE CONDITIONS ALLOW)
4. WIDTH – TWENTY (20) FOOT TYPICAL.
5. THICKNESS – SIX (6) INCHES MINIMUM.
6. ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A DRIVEABLE BERM OR OTHER TEMPORARY EROSION CONTROL DEVICE CAN BE USED.
7. THE ENTRANCE SHALL BE PERIODICALLY INSPECTED AND MAINTAINED IN A CONDITION THAT MINIMIZES TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. MAINTENANCE MAY INCLUDE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR THE REPAIR /CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ANY SEDIMENT THAT IS SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED AS SOON AS PRACTICAL.

ROCK ACCESS PAD INSTALLATION AND MAINTENANCE

FIGURE #5 DWG. ES-0005 REV.



INSTALLATION REQUIREMENTS:

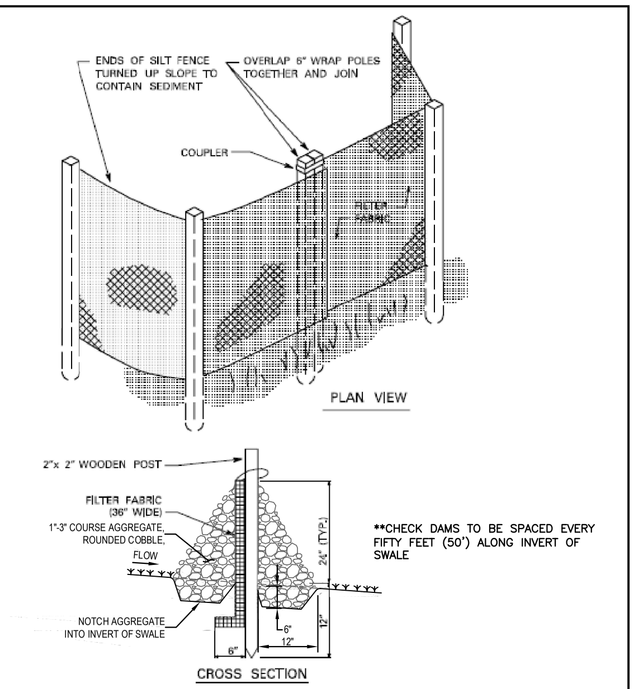
- WHEN USING SILT FENCE, PLACE IT:
  - BETWEEN DISTURBED AREAS AND DOWN-SLOPE ENVIRONMENTAL RESOURCE AREAS
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES
  - APPROXIMATELY 6 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT
- USE SANDBAGS OR BACKFILLING TO KEY IN THE BOTTOM OF THE FABRIC WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE ROOTS, ETC.)

MAINTENANCE REQUIREMENTS:

- INSPECT SILT FENCE:
  - DAILY IN AREAS OF ACTIVE CONSTRUCTION
  - WEEKLY IN AREAS WITH NO CONSTRUCTION
  - WITHIN 24 HOURS FOLLOWING EACH MAJOR STORM EVENT
- REPAIR OR REPLACE SILT FENCE AS NEEDED
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA AS NEEDED

SILT FENCE INSTALLATION AND MAINTENANCE

FIGURE #7 DWG. ES-0007 REV.



**CHECK DAMS TO BE SPACED EVERY FIFTY FEET (50') ALONG INVERT OF SWALE

INSTALLATION REQUIREMENTS:

- WHEN USING SILT FENCE, PLACE IT:
  - BETWEEN DISTURBED AREAS AND DOWN-SLOPE ENVIRONMENTAL RESOURCE AREAS
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES
  - APPROXIMATELY 6 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT
- USE SANDBAGS OR BACKFILLING TO KEY IN THE BOTTOM OF THE FABRIC WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE ROOTS, ETC.)

MAINTENANCE REQUIREMENTS:

- INSPECT SILT FENCE:
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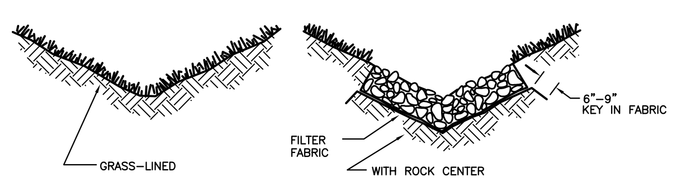
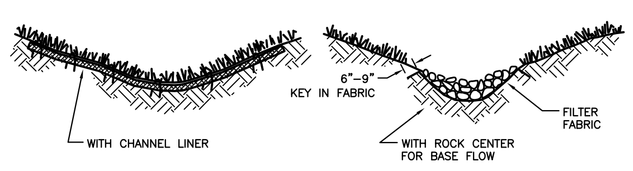
  - WEEKLY IN AREAS WITH NO CONSTRUCTION
  - WITHIN 24 HOURS FOLLOWING EACH MAJOR STORM EVENT
- REPAIR OR REPLACE SILT FENCE AS NEEDED
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA AS NEEDED

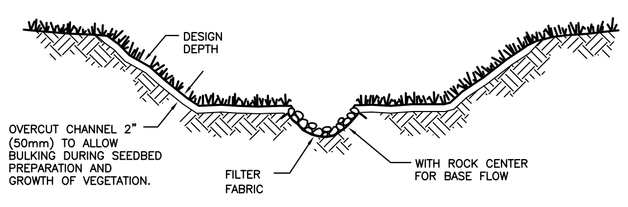
SILT FENCE CHECK DAM WITH CRUSHED STONE BACKING



TYPICAL V-SHAPED CHANNEL CROSS-SECTION

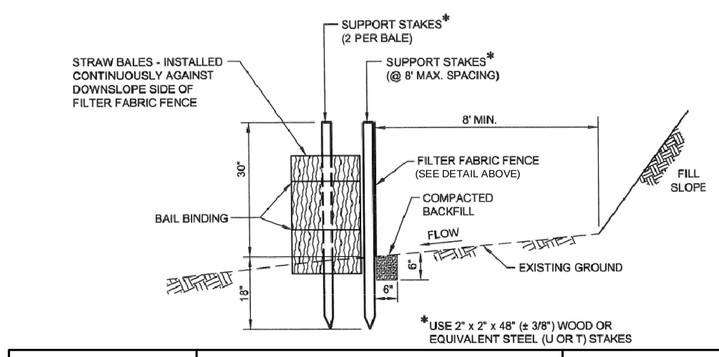


TYPICAL PARABOLIC CHANNEL CROSS-SECTION



TYPICAL TRAPEZOIDAL CHANNEL CROSS-SECTION

TEMPORARY DIVERSION DITCH (TYPICAL CROSS SECTIONS)



SILT FENCE BACKED WITH STACKED HAYBALES

CHAPLIN COMPRESSOR STATION

DWG. NO.	REFERENCE DWG.	REV	DSN	CK	DESCRIPTION

WBA, P.C.
2087 EAST 71ST STREET
TULSA, OKLAHOMA 74136
(918) 499-2724

ENGINEERING APPROVALS				
DRAWN BY:	BID		CONSTRUCTION	
TITLE	SIGNATURE	DATE	SIGNATURE	DATE

EROSION AND SEDIMENTATION CONTROL DETAILS

LOC. CHAPLIN, CONNECTICUT

YEAR: 2015 | WBS:CE.000030.0020 | SCALE: N/A | DWG. | REV.

Spectra Energy Partners

Algonquin Gas Transmission, LLC
5400 Westheimer Ct. Houston, TX 77056-5310 713 / 627-5400

IG.# CHAP-B-3002

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APPENDIX G

CROMWELL COMPRESSOR STATION DRAINAGE CALCULATIONS AND SITE PLAN

August 2014

POST CONSTRUCTION STORMWATER MANAGEMENT PLAN

for the

CROMWELL COMPRESSOR STATION

Town of Cromwell,

Middlesex County, Connecticut

Facility Owner/ Operator: Algonquin Gas Transmission, LLC

Prepared by:
Michael Baker Jr. Inc.
Rocky Hill, CT

Prepared for:
Basic Systems, Inc.
Cambridge, OH

Post Construction Stormwater Management Plan

Cromwell Compressor Station

Middlesex County, Connecticut

Basic Systems Inc.

June 2014

CERTIFICATION

I, _____, do hereby certify to the best of my knowledge, information and believe that the information contained in the accompanying plans, specifications, and reports has been prepared in accordance with accepted engineering practice, is true and correct, and is in conformance with the rules and regulations of the Connecticut Department of Energy and Environmental Protection.

_____ _____

Signature Date

Post Construction Stormwater Management Plan

Cromwell Compressor Station

Basic Systems Inc.

Middlesex County, Connecticut

May 2014

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A Project Site Maps
B Hydrologic (Precipitation) Data
C Pre-Development Drainage Calculations (HydroCAD)
D Post-Development Drainage Calculations (HydroCAD)
E Permanent BMP Calculations
F Custom Soils Resource Report (Soil Survey Map & Soils Description)
G Post Construction Stormwater Management Drawings

POST CONSTRUCTION STORMWATER/SITE RESTORATION PLAN

Basic Systems, Inc. is designing the compressor station expansion for Algonquin Gas Transmission, LLC's Cromwell, Connecticut Compress Station. Upon completion of the expansion project, Algonquin Gas Transmission, LLC will operate the compressor station.

Best management practices (BMPs) prepared for the compressor station addition project are in accordance with standards and specifications defined by the 2000 Connecticut Department of Transportation Drainage Manual, the Connecticut Department of Energy and Environmental Protection (CTDEEP) 2004 Connecticut Stormwater Quality Manual, and the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control.

i. Site Description and Analysis

The proposed project will construct an additional natural gas compressor station and auxiliary structure at Algonquin Gas Transmission, LLC's existing Cromwell, Connecticut compressor site. The proposed compressor will be constructed entirely within the existing Cromwell compressor station campus located at 252 Shunpike Road, Cromwell, Middlesex County, Connecticut. This narrative discusses the analysis and design of the post construction stormwater management BMPs planned as part of the compressor station site expansion.

Currently, the site is an operational natural gas transmission facility. This project includes the construction of an additional 80' x 50' gas compressor building, a 55' x 40' auxiliary structure, a paved access roadway, and post construction stormwater BMPs.

It is estimated that 1.49 acres of land will be disturbed for construction of new facilities to support the gas compressor project. Only minimal surface grading will be required to achieve positive drainage on the site. The proposed condition will mimic existing drainage patterns.

The project area is located within the Mattabesset River basin. See Figure 2 provided in Attachment A.

The site lies outside of the special flood hazard area, denoted as "Zone A". A portion of the relevant Flood Insurance Rate Maps (Panel Number 09007C0018G, Effective Date: August 28, 2008) has been included as Figure 3 provided in Attachment A.

Site topography varies across the project area. Generally, the slope of site contour is gentle to steep and ranges from approximately 0% to 50%. The Site Location Map prepared for the project is provided as Figure 1 in Attachment A. There is an existing storm drain network on-site.

This project will result in an increase of impervious area by approximately 11,000 SF. Therefore, stormwater BMPs will be required to mitigate runoff increases.

ii. Soil Types and Descriptions

Soil types within and around the project area have been determined using the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey. The Custom Soil Report identifies six soil types within the project area. The names of each soil type and

corresponding hydrologic soil group are defined in Table 1. The Custom Soils Resource Report prepared for the project is provided in Attachment F.

Table 1. NRCS Hydrologic Soil Group Summary

Map Unit Symbol	Map Unit Name	Hydrologic Soil Group	Percentage of Site
13	Walpole sandy loam	D	1.0%
15	Scarboro muck	D	2.6%
23A	Sudbury sandy loam, 0 to 5 percent slopes	B	9.9%
33A	Hartford sandy loam, 0 to 3 percent slopes	B	5.9%
33B	Hartford sandy loam, 3 to 8 percent slopes	B	14.1%
306	Udorthents-Urban land complex	B	66.4%

The existing site soils show moderate infiltration rates when thoroughly wet. No supplemental or additional soil analysis has been completed for the project; an assumed infiltration rate has been assigned for design purposes only. An infiltration test was performed August 6, 2014 in the vicinity of the proposed swale to verify the assumed infiltration rate and depth to ground water. A permeability rate of 6 inches per hour, based on testing, is used in the calculations for the proposed BMP.

iii. Pre- and Post-Development Drainage Conditions and Hydrology

A hydrologic and hydraulic analysis was conducted for this project. The watershed analysis for existing and proposed conditions was completed using the HydroCAD Software Solutions computer program. The HydroCAD program is based on NRCS TR-20 methods. The methods described in the NRCS TR-55 manual were followed to calculate the curve number and time of concentration input data for this model. The input parameters and calculations are summarized below.

Drainage Area(s)

The existing and proposed drainage areas for the project site were delineated using the site specific survey performed by LRC, Inc. Based on the available mapping, the total drainage area analyzed is 2.9 acres.

In the existing condition, the 2.9 acre area has been divided into three drainage watersheds, 1S, 2S and 3S. Drainage Area 1S is the largest area and drains the eastern portion of the site which includes the existing access driveway, paved storage area and a large grassed area. Drainage Area 2S drains the interior portion of the site and is primarily comprised of lawn area. Drainage Area 3S drains the western portion of the drainage watershed analyzed and includes the existing parking lot between the auxiliary building and office building. A steep slope exists between the office building and parking lot.

In the proposed condition, the 2.9 acre drainage shed has been divided into four drainage areas, 1S, 2S, 3S, and 4S. Existing Drainage Area 1S has been subdivided into two drainage areas, 1S and 4S. Drainage Areas 2S decreases in size and Drainage Area 3S does not change in the proposed condition. New Drainage Area 4S includes a majority of the proposed improvements and drains to the proposed post construction stormwater management grassed swale.

Drainage/land use maps for the existing and proposed condition have been provided in Attachment C (Pre-Development) and Attachment D (Post-Development) of this report.

Precipitation Data

Precipitation data for the area was obtained from Table 7-2 of the CTDEEP 2004 Connecticut Stormwater Quality Manual for Middlesex County for the 24-hour, 1 through 100-year storm events. This precipitation data has been provided in Attachment B, and is summarized below:

Table 2. Site Precipitation Summary (Middlesex County)

Storm Event (yr)	Precipitation (in)
1	2.70
2	3.30
5	4.20
10	5.00
25	5.60
50	6.30
100	7.10

Curve Number and Time of Concentration

For both the existing and proposed condition, the stormwater discharge from each watershed is analyzed at the point where it leaves the subject property; these locations are referred to as "Design Points". Calculating stormwater flows at a design point through the duration of a given storm event requires understanding the flow of runoff within the watershed. The time required for runoff to travel from the most distant point in the watershed to the design point is referred to as the "Time of Concentration". Time of Concentration (T.O.C.) is a function of distance and surface characteristics (curve number).

The NRCS TR-55 Methodology was used to calculate the curve number and time of concentration for the site. The curve number calculations are provided in Attachment C (Pre-Development) and Attachment D (Post-Development) of this report and are summarized below:

Table 3. Existing and Proposed Curve Number Summary

Existing CNs	
Drainage Area 1S	72
Drainage Area 2S	71
Drainage Area 3S	84
N/A	--

Proposed CNs	
Drainage Area 1S	73
Drainage Area 2S	74
Drainage Area 3S	84
Drainage Area 4S	77

Table 4. Time of Concentration Summary

Time of Concentration	
Existing	5.0 min.
Proposed	5.0 min.

iv. Water Quality and Quantity Control

The CTDEEP 2004 Connecticut Stormwater Quality Manual requires that designers reduce stormwater runoff, utilize site design techniques, maintain water quality through treatment or infiltration of stormwater runoff, and also to reduce the increase in peak rate of stormwater discharges and runoff volume associated with new impervious area.

A grassed swale with natural earthen weir has been selected as the primary post construction stormwater management BMP for this site. In addition to reducing peak discharge intensities from existing levels, evapotranspiration from the swale acts as a secondary means of reducing total volume and peak flow, while infiltration through the wetted perimeter reduces primary discharge and allows discharge velocity to be controlled and reduced. The earthen weir will be built directly into the southern end of the swale and set approximately 5 inches below the top of the swale. The 5.5' wide weir will control discharge for larger storms such as the 10, 50 and 100 year storms, to prevent overflow washout at the top of the swale.

Non-mechanical implements, such as grassed swales, are the preferred primary BMP of the CTDEEP, per the 2004 Stormwater Quality Manual, and offer an economy of maintenance and cost over underground structure-based BMPs. As a water quality measure, grassed swales allow suspended solids to be removed from discharge waters through settling.

Reduction of Runoff

HydroCAD Software was used to analyze the peak runoff flowrates for the existing and proposed condition. The table below summarizes the swale data:

Table 5. Grassed Swale Design

Swale Data	
Bottom Width (ft)	2
Bottom Length (ft)	240
Top Width (ft)	18
Side Slopes (H:V)	4:1
Total Depth (ft)	2

The existing and proposed peak runoff flowrate analyses, (including hydrographs), have been provided in Attachment C (Pre-Development) and Attachment D (Post-Development) of this report. The proposed stormwater BMPs will reduce the flowrates to existing conditions or less. Below is a summary of the results:

Table 6. Peak Runoff Flowrates (Drainage Area 1S)

Storm Event (yrs)	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2	2.13	4	(-0.86)
10	4.95	2.26	(-2.01)
50	7.33	3.32	(-2.97)
100	8.85	4.00	(-3.59)

Table 7. Peak Runoff Flowrates (Drainage Area 2S)

Storm Event (yrs)	Existing (cfs)	Proposed (cfs)	Difference (cfs)

2	0.45	0.14	(-0.31)
10	1.08	0.31	(-0.77)
50	1.62	0.45	(-1.17)
100	1.96	0.54	(-1.42)

Table 8. Peak Runoff Flowrates (Drainage Area 3S)

Storm Event (yrs)	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2	0.74	0.74	N/A
10	1.35	1.34	N/A
50	1.83	1.82	N/A
100	2.12	2.11	N/A

Table 9. Peak Runoff Flowrates (Drainage Area 4S)

Storm Event (yrs)	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2	2.13*	2.09	(-0.04)
10	4.95*	4.34	(-0.61)
50	7.33*	6.17	(-1.16)
100	8.85*	7.31	(-1.54)

*Drainage Area 1S Peak Runoff Flowrates

Table 10. Peak Runoff Flowrates (Combined Discharge) to Existing Wetland

Storm Event (yrs)	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2	2.13*	1.00**	(-1.13)
10	4.95*	2.59**	(-2.34)
50	7.33*	6.15**	(-1.18)
100	8.85*	8.54**	(-0.31)

*Drainage Area 1S Peak Runoff Flowrates
**Drainage Area 1S + 4S (routed through swale) Peak Runoff Flowrates

Table 11. Peak Runoff Flowrates (Combined Discharge) to Existing Conveyance System

Storm Event (yrs)	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2	1.19	0.88	(-0.31)
10	2.44	1.65	(-0.79)
50	3.45	2.27	(-1.18)
100	4.08	2.65	(-1.43)

Water Quality, Quantity and Volume

The post construction stormwater management/site restoration BMPs proposed for this project have been designed to meet stormwater runoff volume, rate and quality requirements. Their location and type are discussed below.

Permanent Stabilization

- All disturbed areas outside of proposed pavement will be scarified, fertilized, seeded, limed and mulched upon completion of the earth moving activities. This re-vegetation will be achieved via seed and nutrient application at optimum moisture conditions to promote the development of a uniform 70 percent perennial vegetative cover that will hold the soil in place while controlling and filtering the sediment.

- Pavement on the site will include both aggregate and bituminous surfaces. Aggregate will be used around the building and pavement areas. Bituminous paving will be used on the relocated access driveway.

Structural BMPs

Runoff from a majority of the proposed paved areas will be collected by grassed swale which will treat and convey stormwater. The grassed swale is designed to manage increases in the site's stormwater runoff rate and volume through infiltration and a rate control outlet structure (attenuation). Additional water quality benefits through the removal of suspended solids, total phosphorous and nitrates will be provided through filtering and evapotranspiration. Calculations have been provided in Attachment E. Plan and drawings have been provided in Attachment G.

v. Additional Stormwater Impacts/Benefits

Thermal Impacts

Thermal impacts have been avoided, minimized and/or mitigated as possible. The post-construction stormwater management system selected and designed for this site minimizes permanent pool, and avoids riprapping and concrete channels.

Riparian Buffer

The post-construction stormwater management system selected and designed for this site allows discharge stormwater to enter the existing on-site wetland via the existing slope and riparian buffer for additional cooling.

Anti-degradation Techniques

Anti-degradation techniques have been employed as part of the project BMP design. This project utilizes a portion of the existing compressor station site which significantly reduces environmental impacts associated with locating the expanded facility on another possible site Therefore, a detailed Alternative Siting Analysis has not been completed. Through plan layout and recommended construction sequencing, this project will limit, to the extent possible, the amount of disturbed area and duration of disturbance activities. Further, infiltration techniques through the use of a grassed swale will be employed.

vi. BMP Installation Sequence

Below is the recommended construction sequence of the post construction stormwater management facilities associated with this site:

1. Once the pavements have been installed and 70 percent uniform perennial vegetative cover is established in non-paved areas, the contractor will begin post construction stormwater BMP construction.
2. Construction will begin with the stormwater management facilities (grassed swale) by ensuring that all perimeter controls (filter sock / silt fence) area in place and in good condition.
3. Construct grassed swales, starting at the downstream end, and vegetate.

Site inspection shall occur once the post construction stormwater management BMPs have been constructed. The inspection should verify that the swale has been constructed according to the approved

plans, including storage volume, elevations and other features that could inhibit the BMP to function as designed.

vii. Operation and Maintenance

The operation and maintenance of the grassed swales will be the responsibility of Algonquin Gas Transmission, LLC.

Inspection

The grassed swales will be inspected four times per year and after rain event of one-inch or more. The procedure for inspection is as follows:

1. Inspect swale for damage to vegetation, erosion and debris.
2. Inspect for and remove litter.
3. Document inspection process.

Maintenance

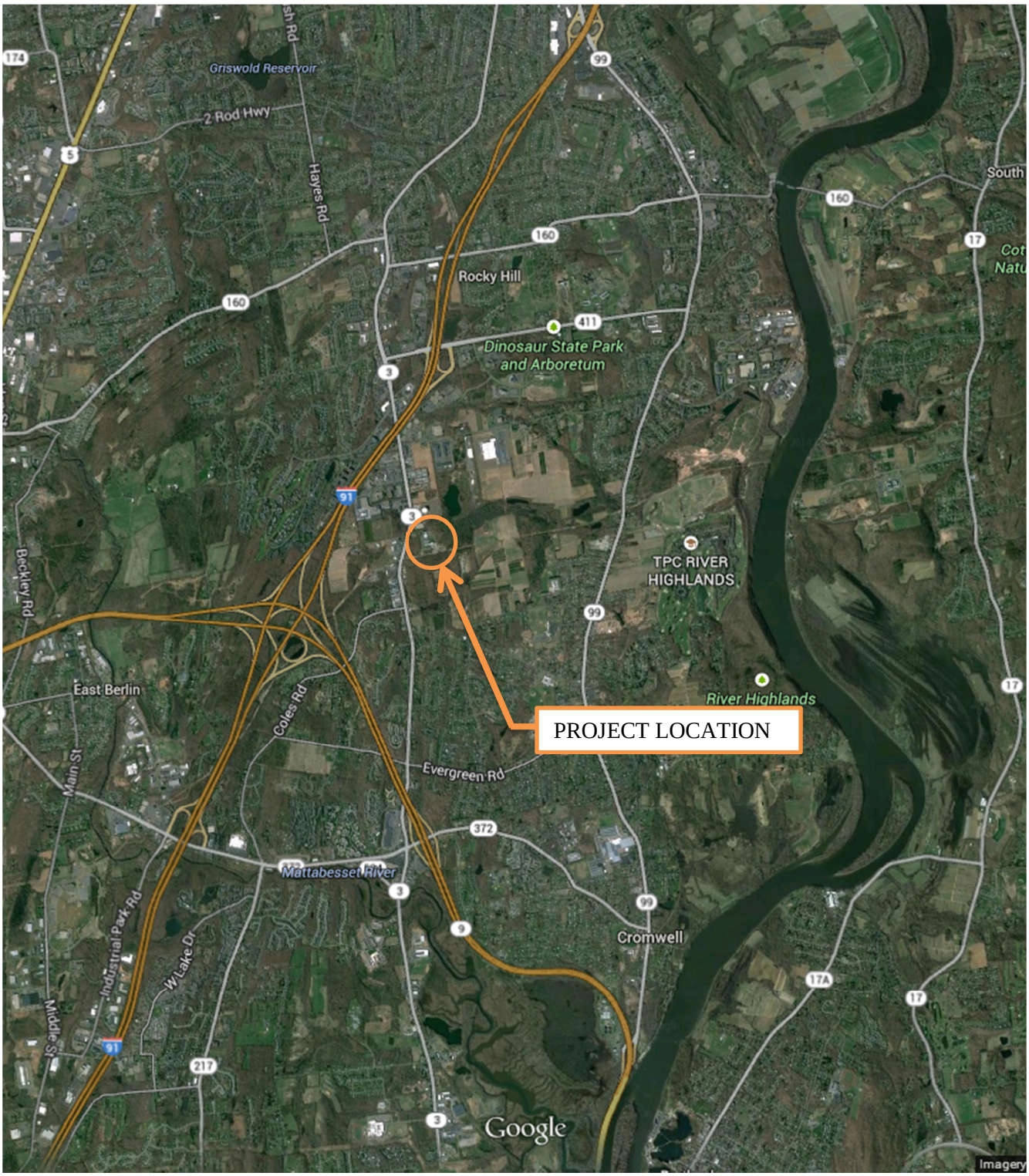
The grassed swale will need to be cleaned and maintained periodically. After inspections are performed according to the schedule described above, maintenance will be performed at the discretion of individuals responsible for the post-construction stormwater management. Maintenance practices area as follows:

BMP Device	Maintenance Practice	Schedule
Grassed Swale	Restore grade to original design	As needed
	Mow vegetation for safety and to maintain operation	As needed
	Water vegetation	As needed

Additionally, accumulated sediment may need to be removed when it begins to impact vegetative growth or normal surface water flow.

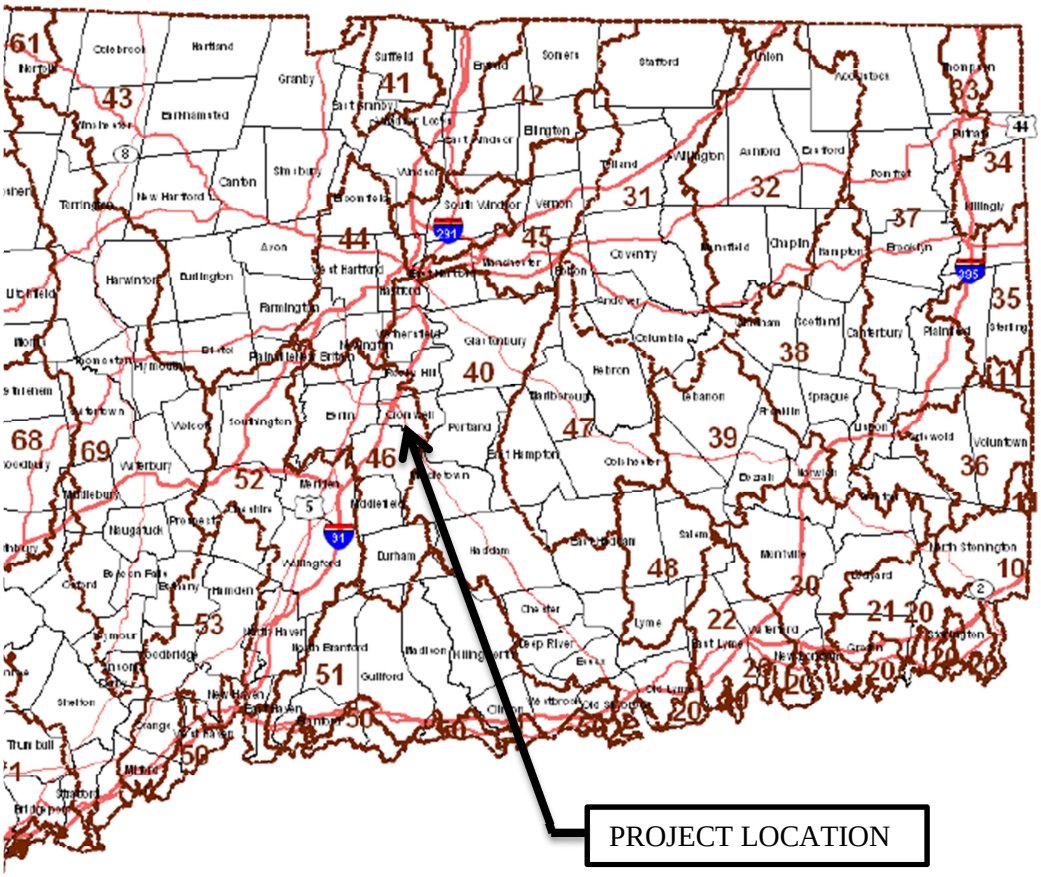
Attachment A

Project Site Maps

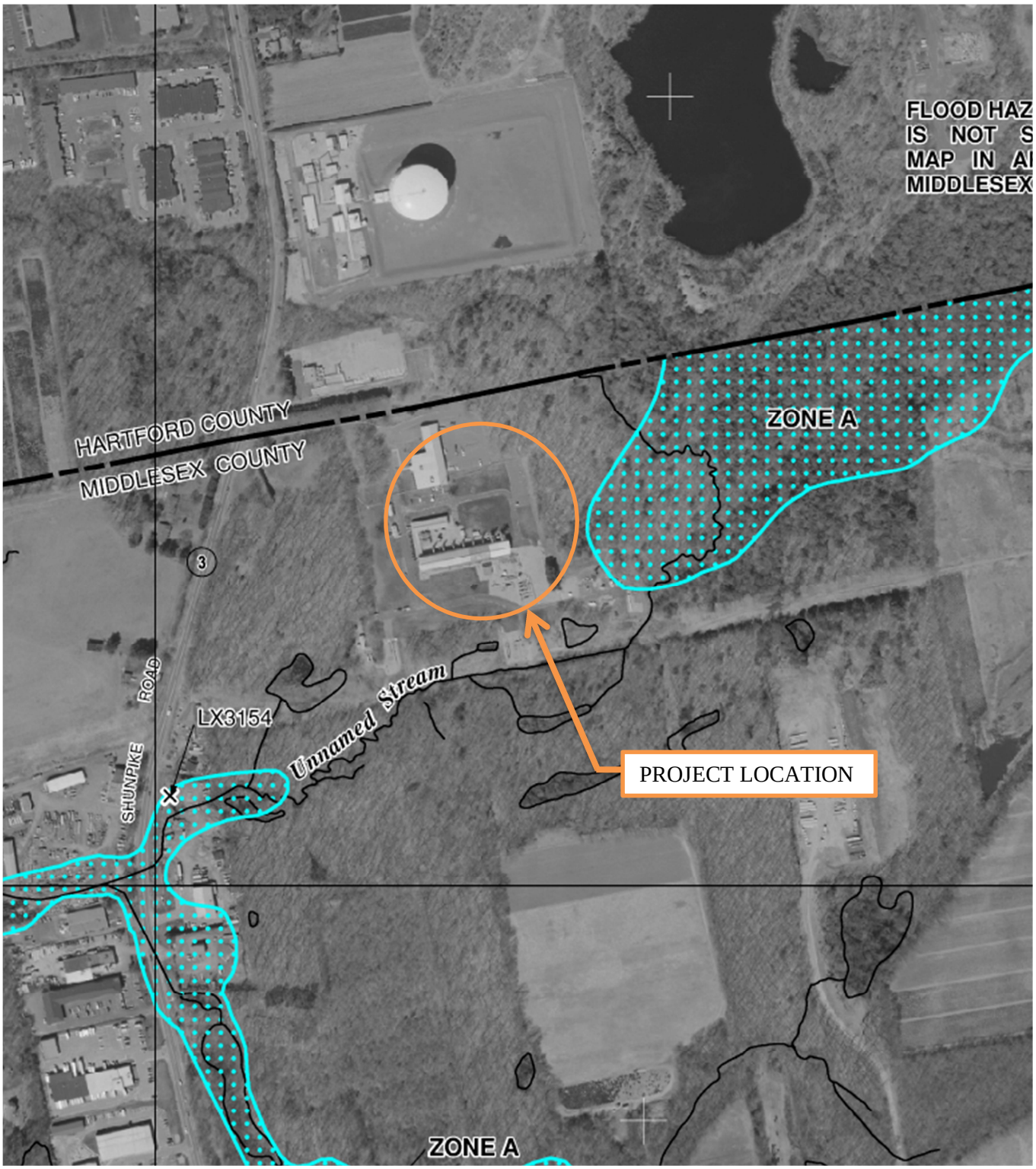


Site Location Map **Cromwell Compressor Station** **Basic Systems, Inc.**	**Figure 1** Reference: Google Maps
Town of Cromwell Middlesex County, Connecticut	Baker SCALE: Not to Scale

Number	Regional Name
10	Pawcatuck Main Stem
11	Wood
20	Southeast Shoreline
21	Southeast Eastern Complex
22	Southeast Western Complex
30	Thames Main Stem
31	Willimantic
32	Natchaug
33	French
34	Fivemile
35	Moosup
36	Pachaug
37	Quinebaug
38	Shetucket
39	Yantic
40	Connecticut Main Stem
41	Stony Brook
42	Scantic
43	Farmington
44	Park
45	Hockanum
46	Mattabesset
47	Salmon
48	Eightmile
50	South Central Shoreline
51	South Central Eastern Complex
52	Quinnipiac
53	South Central Western Complex
60	Housatonic Main Stem
61	Blackberry
62	Hollenbeck
63	Tenmile
64	Candlewood
65	Aspetuck
66	Still
67	Shepaug
68	Pomperaug
69	Naugatuck
70	Southwest Shoreline
71	Southwest Eastern
72	Saugatuck
73	Norwalk
74	Southwest Western Complex
81	Croton



Connecticut River and Lake Basins Index **Cromwell Compressor Station** **Basic Systems, Inc.**	**Figure 2** Reference: CT Integrated Water Quality Report 2010
Town of Cromwell Middlesex County, Connecticut	Baker SCALE: Not to Scale



Flood Insurance Rate Map (FIRM) **Cromwell Compressor Station** **Basic Systems, Inc.**	**Figure 3** Reference: FIRM
Town of Cromwell Middlesex County, Connecticut	Baker SCALE: Not to Scale

Attachment B

Hydrologic Data

Some of the sizing criteria presented in this chapter may not be practical to meet due to space limitations, soil conditions, and other site constraints which are common in redevelopment or retrofit applications. Treatment practices sized for smaller treatment volumes/flows or exemptions from certain criteria may be appropriate in these situations, at the discretion of the review authority. Conditions where the recommended sizing criteria may not be applicable are identified in the following sections.

7.3 Criteria Summary

Table 7-1 summarizes the hydrologic sizing criteria for stormwater treatment practices in Connecticut. As indicated in **Table 7-1**, the sizing criteria are based on stormwater runoff generated by 24-hour duration storms of various return frequencies (i.e., design storms). **Table 7-2** lists 24-hour design rainfall depths for each county in Connecticut. The rationale for and application of these criteria are described in the following sections.

Table 7-2
Design Rainfall Amounts By County

	24-Hour Rainfall Amount (inches)				
County	1-yr	2-yr	10-yr	25-yr	100-yr
Fairfield	2.7	3.3	5.0	5.7	7.2
Hartford	2.6	3.2	4.7	5.5	6.9
Litchfield	2.6	3.2	4.7	5.5	7.0
Middlesex	2.7	3.3	5.0	5.6	7.1
New Haven	2.7	3.3	5.0	5.6	7.1
New London	2.7	3.4	5.0	5.7	7.1
Tolland	2.6	3.2	4.8	5.5	6.9
Windham	2.6	3.2	4.8	5.5	6.9

Source: TP-40, Department of Commerce, Weather Bureau, May 1961; NWS Hydro-35, Department of Commerce, National Weather Service, June 1977.

7.4 Pollutant Reduction

The pollutant reduction criterion is designed to improve the water quality of stormwater discharges by treating a prescribed water quality volume or associated peak flow, referred to as the water quality flow. Most treatment practices described in this Manual use a volume-based sizing criterion. The exceptions are grass drainage channels, proprietary stormwater treatment devices, and flow diversion structures, where a peak flow rate is utilized.

7.4.1 Water Quality Volume (WQV)

Description

The water quality volume (WQV) is the amount of stormwater runoff from any given storm that should be captured and treated in order to remove a majority of stormwater pollutants on an average annual basis. The recommended WQV, which results in the capture and treatment of the entire runoff volume for 90 percent of the average annual storm events, is equivalent to the runoff associated with the first one-inch of rainfall. The WQV is calculated using the following equation:

$$WQV = \frac{(1'')(R)(A)}{12}$$

where:
- WQV = water quality volume (ac-ft)
- R = volumetric runoff coefficient = 0.05+0.009(I)
- I = percent impervious cover
- A = site area in acres

- *The volumetric runoff coefficient R can also be determined from commonly available tabulated values for various land use, vegetative cover, soil, and ground slope conditions. However, the use of the above equation is recommended since it is directly related to the amount of impervious cover at a site, thereby providing incentive to reduce site imperviousness and the required runoff treatment volume. Reducing impervious cover using the site planning and design techniques described in Chapter Four can significantly reduce the WQV.*
- *Impervious cover should be measured from the site plan and includes all impermeable surfaces that are directly connected to the stormwater treatment practice such as paved and gravel roads, rooftops, driveways, parking lots, sidewalks, pools, patios and decks. In the absence of site-specific information or for large residential developments, impervious cover may be estimated based on average impervious coverage values for various parcel sizes listed in **Table 7-3**. The values shown in **Table 7-3** were derived from research by the University of Connecticut, Cooperative Extension System NEMO Project (Prisloe et al.,).*
- *The WQV should be treated by an acceptable stormwater treatment practice or group of practices described in this Manual. The WQV should be used for the design of the stormwater treatment practices described in this Manual, except grass drainage channels and proprietary stormwater treatment devices (e.g., hydrodynamic separators, catch basin inserts, and media filters), which should be designed based on the water quality flow (WQF).*

Appendix B - Rainfall

RAINFALL – DURATION – FREQUENCY RELATIONSHIPS FOR CONNECTICUT

DURATION	RETURN FREQUENCY (Years)					
	2	5	10	25	50	100
Min	RAINFALL IN MM (INCHES)					
5	9.1(0.36)	11.4(0.45)	13.0(0.51)	15.2(0.60)	17.2(0.67)	18.5(0.73)
15	18.3(0.72)	22.6(0.89)	25.9(1.02)	30.5(1.20)	34.0(1.34)	37.6(1.48)
60	33.0(1.3)	43.2(1.7)	50.8(2.00)	58.4(2.30)	65.3(2.57)	71.1(2.80)
Hrs						
2	40.6(1.60)	54.6(2.15)	63.5(2.50)	72.4(2.85)	82.6(3.25)	91.4(3.60)
3	44.5(1.75)	61.0(2.40)	69.9(2.75)	82.6(3.25)	90.2(3.55)	101.6(4.00)
6	59.7(2.35)	74.9(2.95)	87.6(3.45)	101.6(4.00)	115.6(4.55)	127.0(5.00)
12	69.9(2.75)	90.2(3.55)	101.6(4.00)	123.2(4.85)	135.9(5.35)	152.4(6.00)
24	82.6(3.25)	106.7(4.20)	125.7(4.95)	146.1(5.75)	161.3(6.35)	177.8(7.00)
	24 HOUR RAINFALL BY COUNTY					
Fairfield	83.8(3.3)	109.2(4.3)	127.0(5.0)	144.8(5.7)	162.6(6.4)	182.9(7.2)
Hartford	81.3(3.2)	104.1(4.1)	119.4(4.7)	139.7(5.5)	157.5(6.2)	175.3(6.9)
Litchfield	81.3(3.2)	104.1(4.1)	119.4(4.7)	139.7(5.5)	157.5(6.2)	177.8(7.0)
Middlesex	83.8(3.3)	106.7(4.2)	127.0(5.0)	142.2(5.6)	160.0(6.3)	180.3(7.1)
New Haven	83.8(3.3)	106.7(4.2)	127.0(5.0)	142.2(5.6)	160.0(6.3)	180.3(7.1)
New London	86.4(3.4)	109.2(4.3)	127.0(5.0)	144.8(5.7)	160.0(6.3)	180.3(7.1)
Tolland	81.3(3.2)	104.1(4.1)	121.9(4.8)	139.7(5.5)	157.5(6.2)	175.3(6.9)
Windham	81.3(3.2)	106.7(4.2)	121.9(4.8)	139.7(5.5)	157.5(6.2)	175.3(6.9)

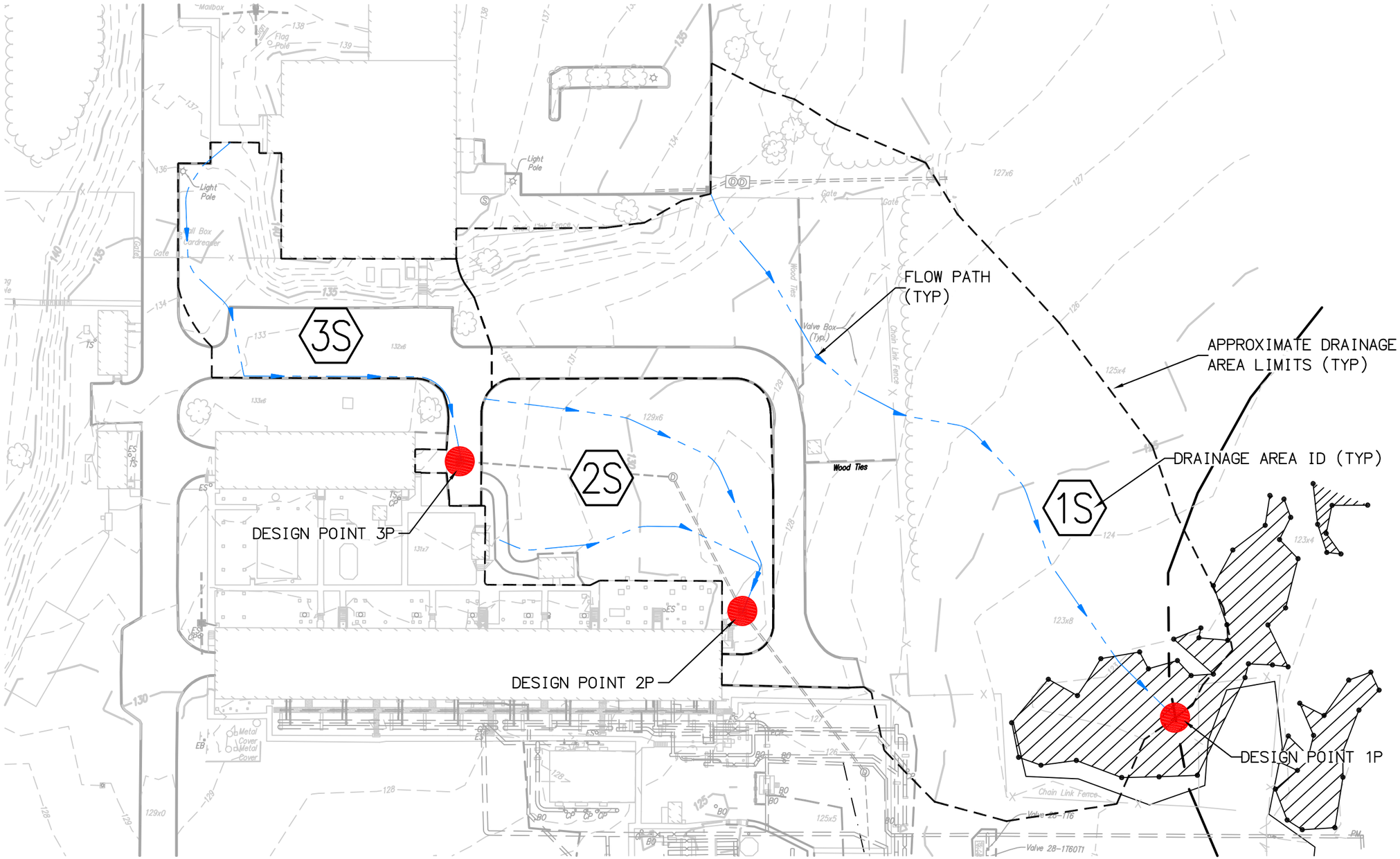
Sources:

1. "Rainfall Frequency Atlas of the United States", Technical Paper No. 40, U.S. Department of Commerce, Weather Bureau.
2. NOAA Technical Memorandum "NWS Hydro-35", June 1977, U.S. Department of Commerce, National Weather Service.

Table B-1

Attachment C

Pre-Development Drainage Calculations



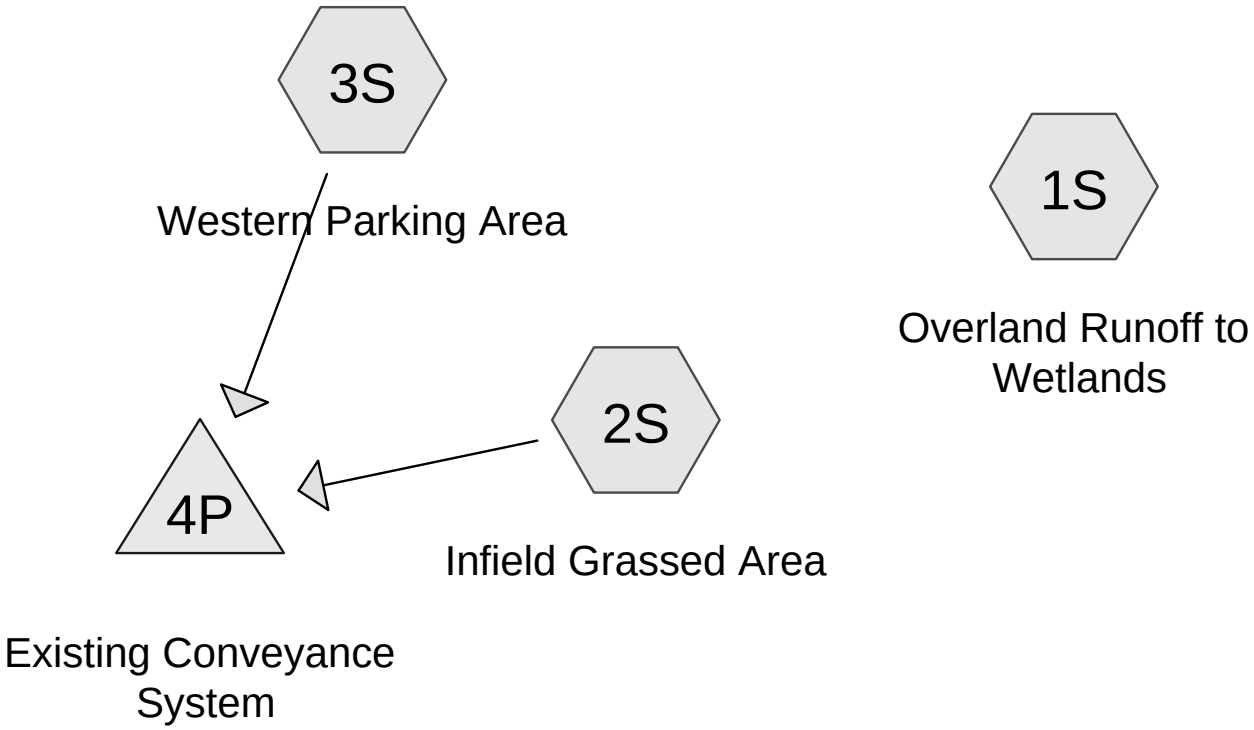
Pre-Development Drainage Area

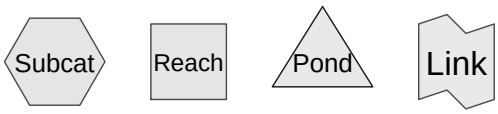
0 60 120

SCALE:1"=60'

Michael Baker INTERNATIONAL

500 ENTERPRISE DRIVE, SUITE 2B
ROCKY HILL, CT 06067
(860) 563-3044





Routing Diagram for existing drainage 2014 08 15
Prepared by Michael Baker Corporation, Printed 8/15/2014
HydroCAD® 10.00 s/n 06697 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.170	98	access road and paved areas (1S)
0.637	70	grassed area (2S, 3S)
1.875	70	grassed/wooded area (1S)
0.019	98	impervious (2S)
0.189	98	paved area (3S)
2.890	**74**	**TOTAL AREA**

Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Overland Runoff to Runoff Area=89,089 sf 8.32% Impervious Runoff Depth>0.84"
Tc=5.0 min CN=72 Runoff=2.13 cfs 0.144 af

Subcatchment 2S: Infield Grassed Area Runoff Area=20,285 sf 4.15% Impervious Runoff Depth>0.80"
Tc=5.0 min CN=71 Runoff=0.45 cfs 0.031 af

Subcatchment 3S: Western Parking Area Runoff Area=16,520 sf 49.83% Impervious Runoff Depth>1.57"
Tc=5.0 min CN=84 Runoff=0.74 cfs 0.050 af

Pond 4P: Existing Conveyance System Inflow=1.19 cfs 0.080 af
Primary=1.19 cfs 0.080 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.224 af Average Runoff Depth = 0.93"
86.91% Pervious = 2.512 ac 13.09% Impervious = 0.378 ac

Summary for Subcatchment 1S: Overland Runoff to Wetlands

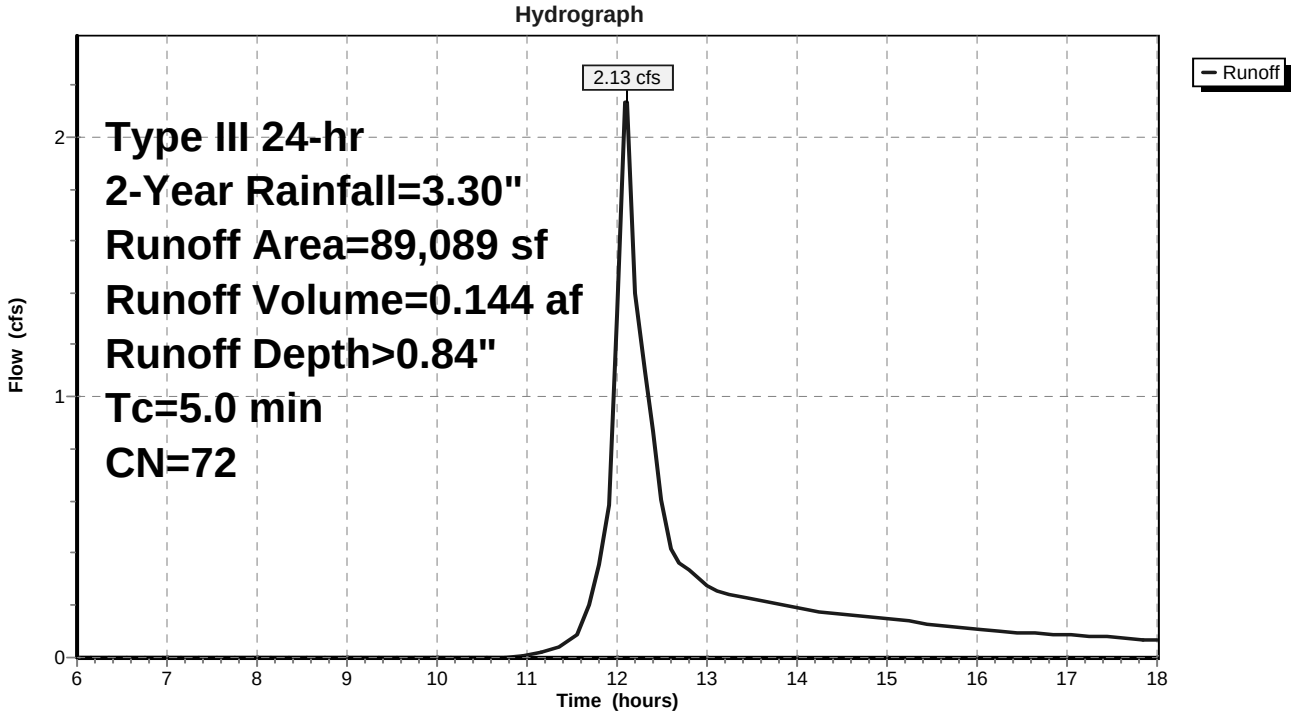
Runoff = 2.13 cfs @ 12.10 hrs, Volume= 0.144 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	7,410	98	access road and paved areas
*	81,679	70	grassed/wooded area
	89,089	72	Weighted Average
	81,679		91.68% Pervious Area
	7,410		8.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Overland Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

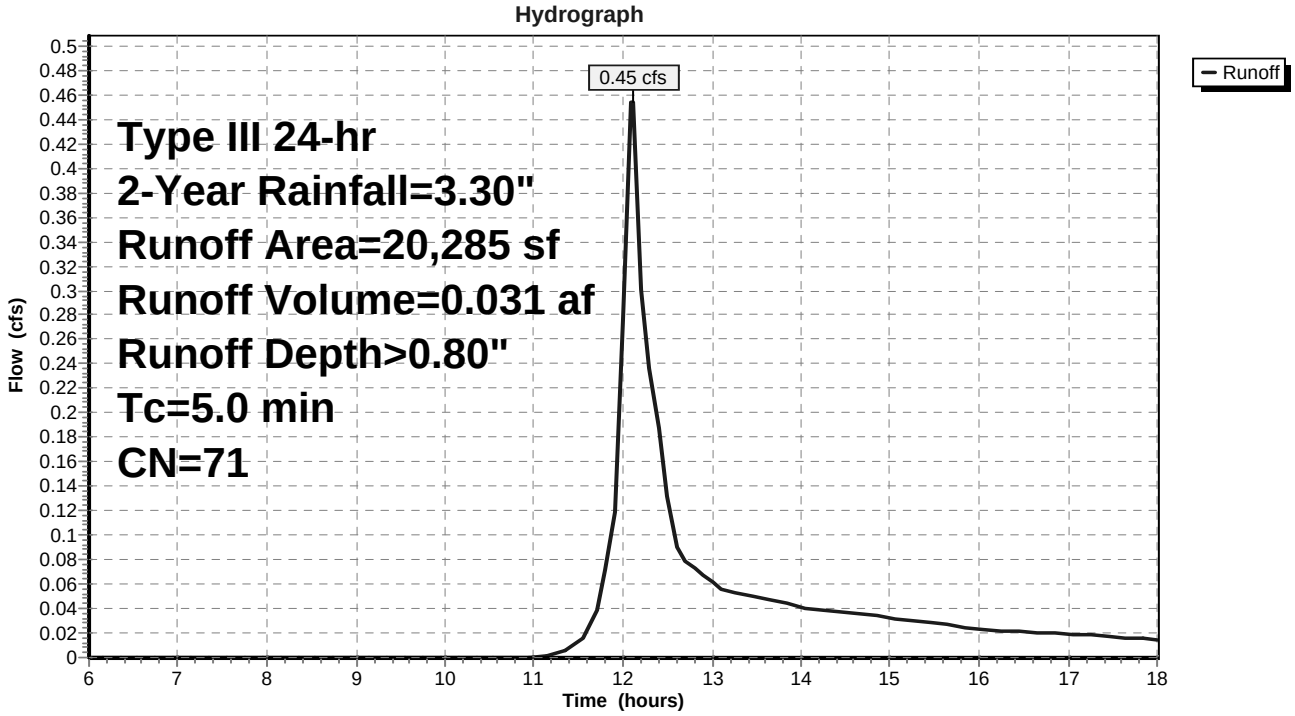
Runoff = 0.45 cfs @ 12.10 hrs, Volume= 0.031 af, Depth> 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	842	98	impervious
*	19,443	70	grassed area
	20,285	71	Weighted Average
	19,443		95.85% Pervious Area
	842		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

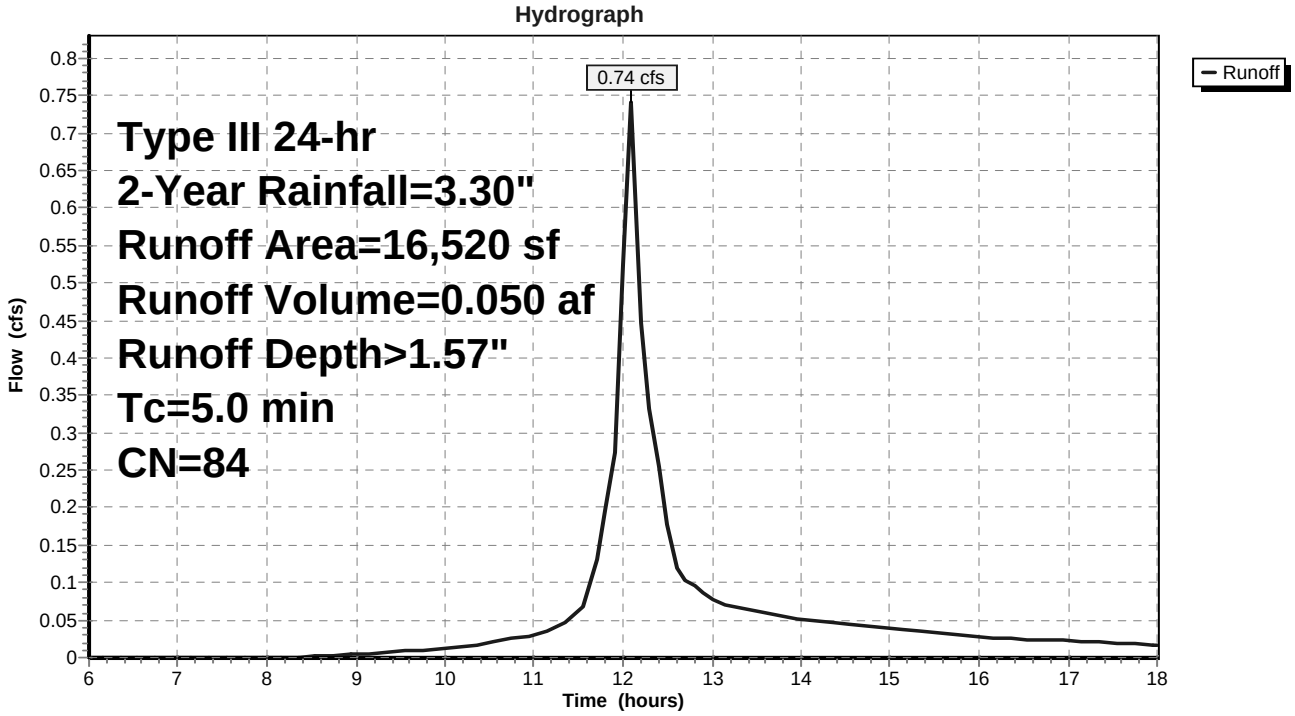
Runoff = 0.74 cfs @ 12.09 hrs, Volume= 0.050 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	8,232	98	paved area
*	8,288	70	grassed area
	16,520	84	Weighted Average
	8,288		50.17% Pervious Area
	8,232		49.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area

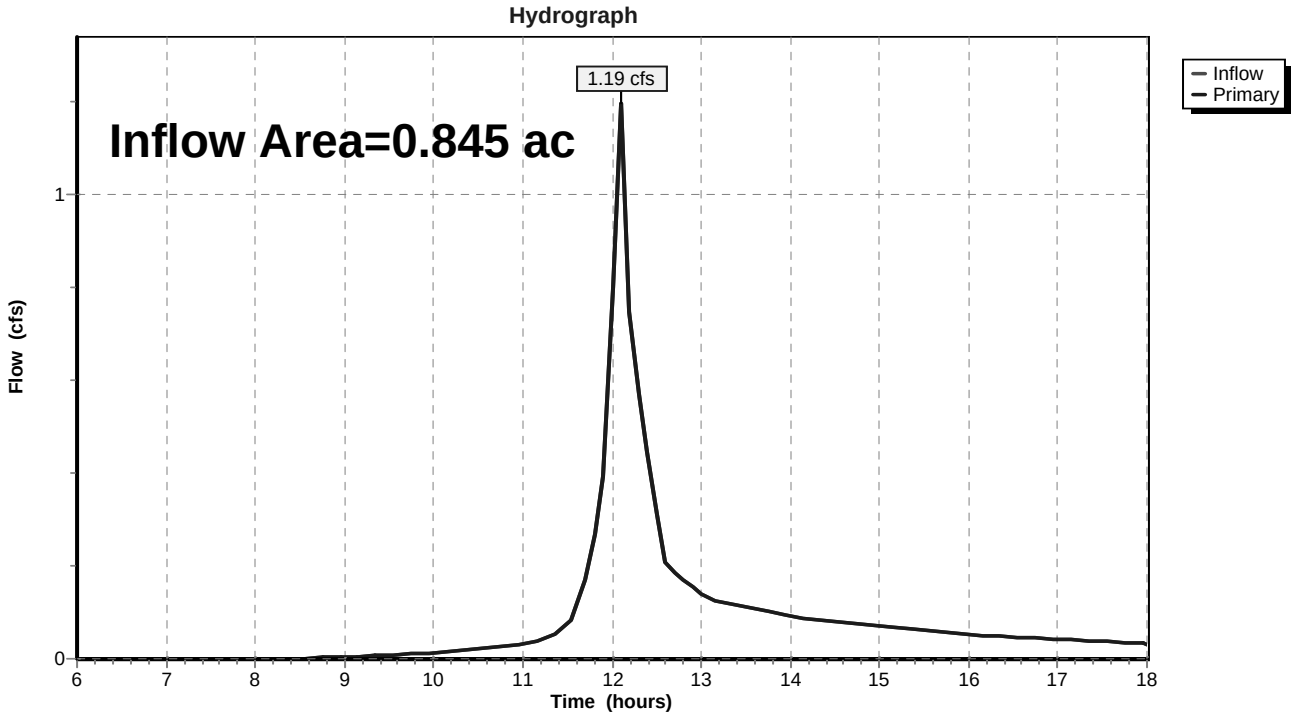


Summary for Pond 4P: Existing Conveyance System

Inflow Area = 0.845 ac, 24.65% Impervious, Inflow Depth > 1.14" for 2-Year event
Inflow = 1.19 cfs @ 12.10 hrs, Volume= 0.080 af
Primary = 1.19 cfs @ 12.10 hrs, Volume= 0.080 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Existing Conveyance System



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Overland Runoff to Runoff Area=89,089 sf 8.32% Impervious Runoff Depth>1.39"
Tc=5.0 min CN=72 Runoff=3.57 cfs 0.236 af

Subcatchment 2S: Infield Grassed Area Runoff Area=20,285 sf 4.15% Impervious Runoff Depth>1.32"
Tc=5.0 min CN=71 Runoff=0.77 cfs 0.051 af

Subcatchment 3S: Western Parking Area Runoff Area=16,520 sf 49.83% Impervious Runoff Depth>2.28"
Tc=5.0 min CN=84 Runoff=1.06 cfs 0.072 af

Pond 4P: Existing Conveyance System Inflow=1.84 cfs 0.123 af
Primary=1.84 cfs 0.123 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.360 af Average Runoff Depth = 1.49"
86.91% Pervious = 2.512 ac 13.09% Impervious = 0.378 ac

Summary for Subcatchment 1S: Overland Runoff to Wetlands

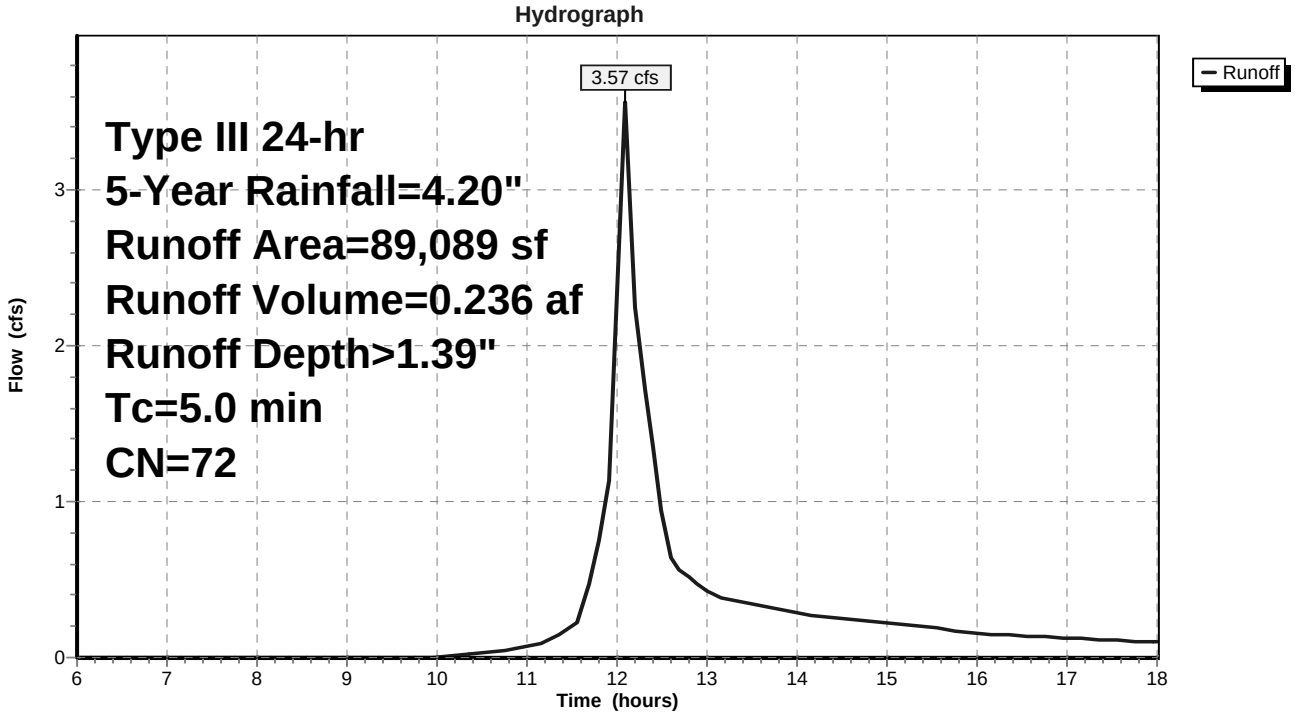
Runoff = 3.57 cfs @ 12.10 hrs, Volume= 0.236 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 5-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	7,410	98	access road and paved areas
*	81,679	70	grassed/wooded area
	89,089	72	Weighted Average
	81,679		91.68% Pervious Area
	7,410		8.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Overland Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

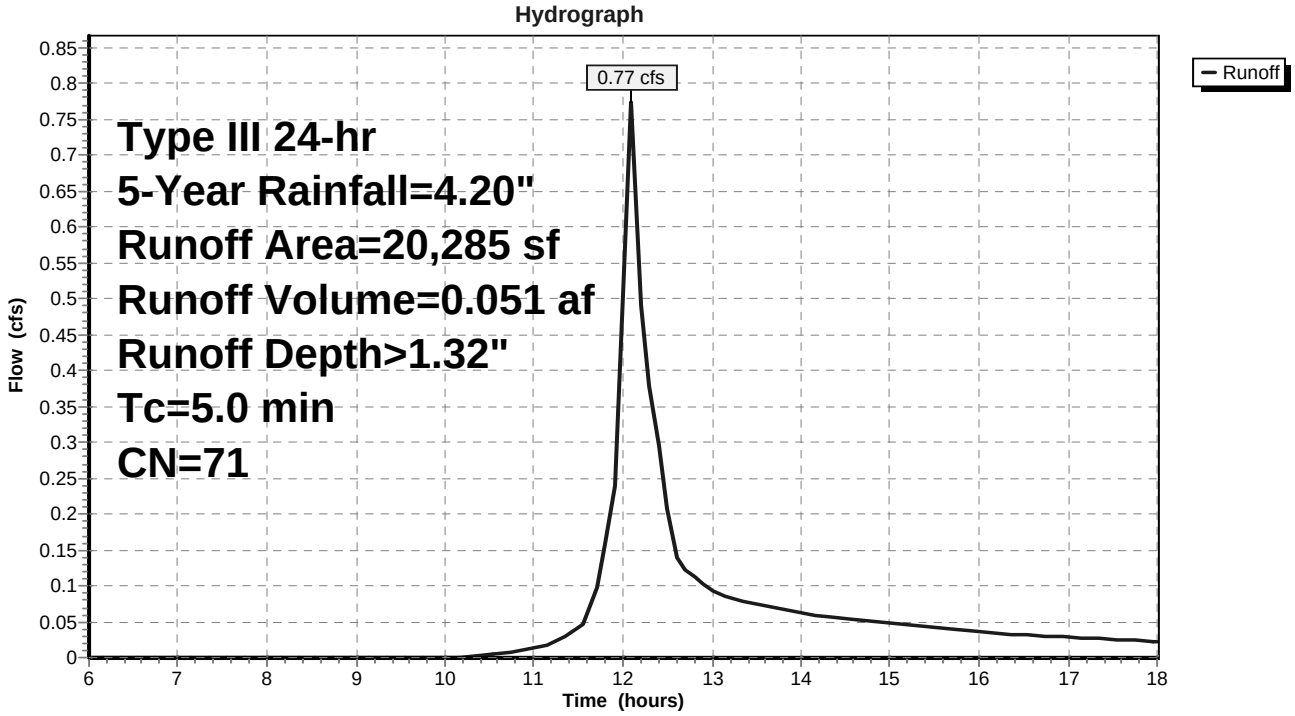
Runoff = 0.77 cfs @ 12.10 hrs, Volume= 0.051 af, Depth> 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 5-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	842	98	impervious
*	19,443	70	grassed area
	20,285	71	Weighted Average
	19,443		95.85% Pervious Area
	842		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

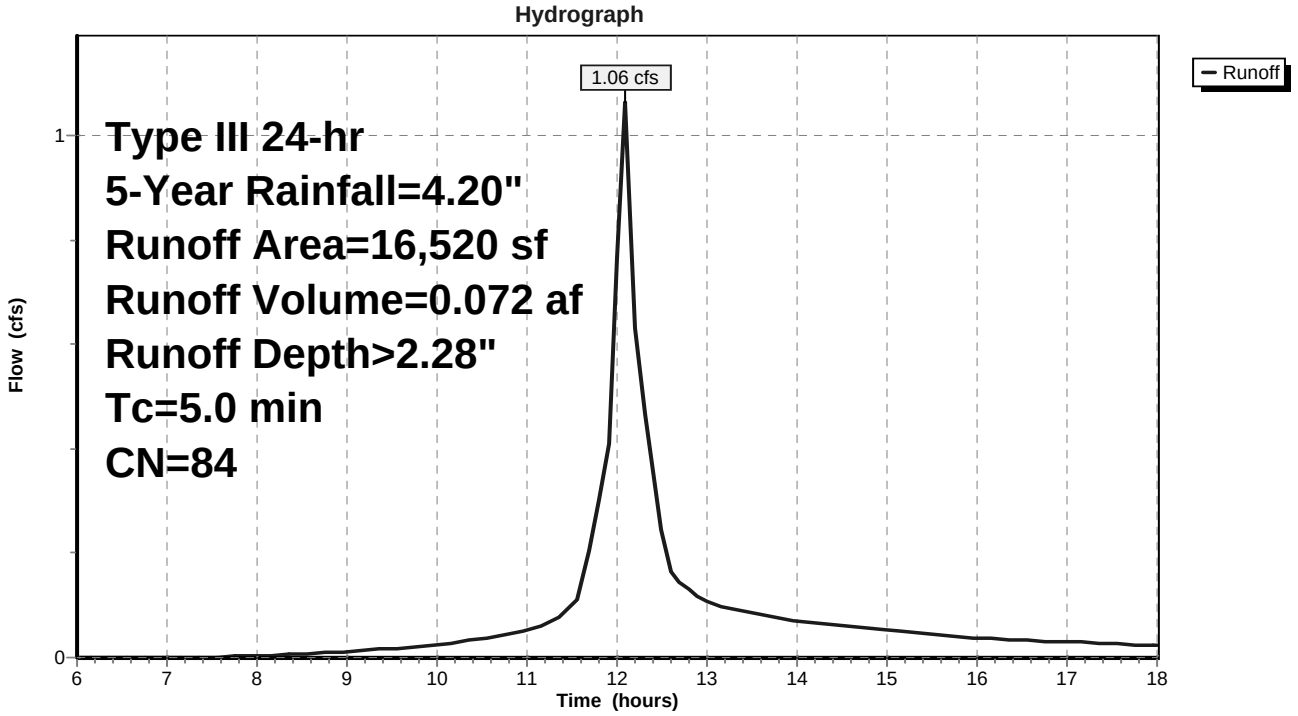
Runoff = 1.06 cfs @ 12.09 hrs, Volume= 0.072 af, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 5-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	8,232	98	paved area
*	8,288	70	grassed area
	16,520	84	Weighted Average
	8,288		50.17% Pervious Area
	8,232		49.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area

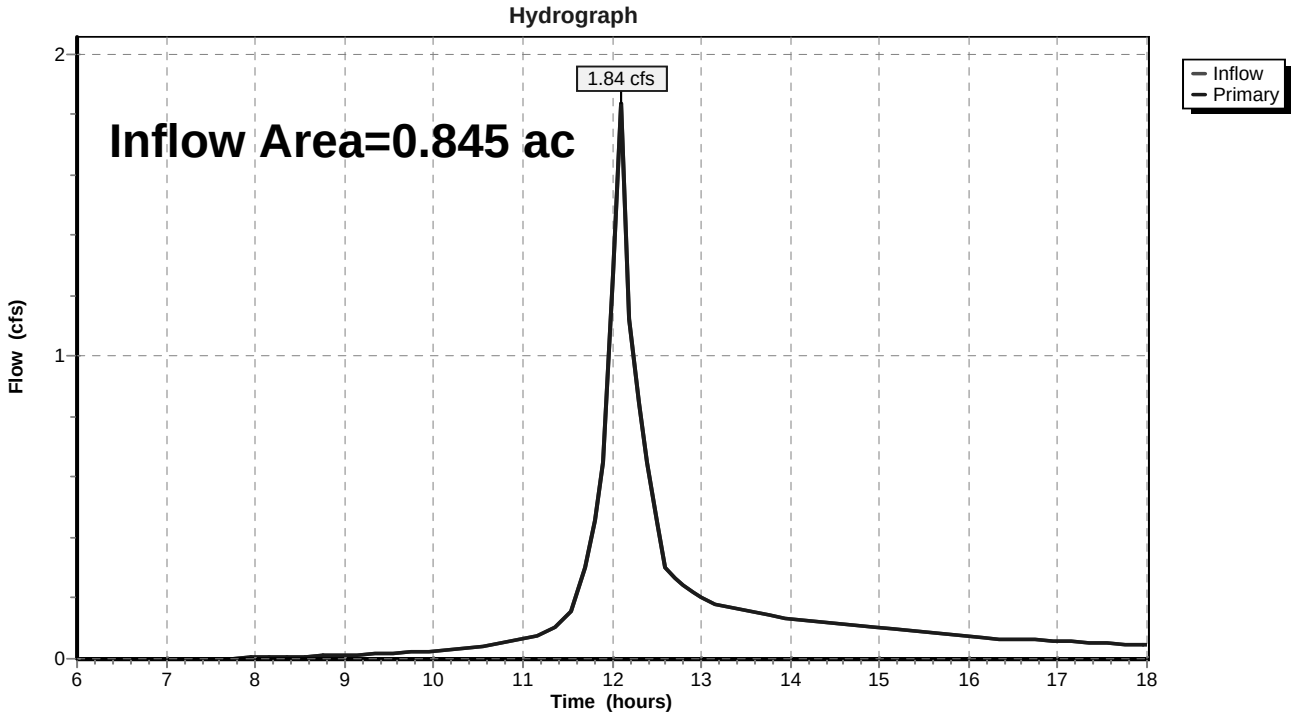


Summary for Pond 4P: Existing Conveyance System

Inflow Area = 0.845 ac, 24.65% Impervious, Inflow Depth > 1.75" for 5-Year event
Inflow = 1.84 cfs @ 12.09 hrs, Volume= 0.123 af
Primary = 1.84 cfs @ 12.09 hrs, Volume= 0.123 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Existing Conveyance System



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Overland Runoff to Runoff Area=89,089 sf 8.32% Impervious Runoff Depth>1.92"
Tc=5.0 min CN=72 Runoff=4.95 cfs 0.328 af

Subcatchment 2S: Infield Grassed Area Runoff Area=20,285 sf 4.15% Impervious Runoff Depth>1.85"
Tc=5.0 min CN=71 Runoff=1.08 cfs 0.072 af

Subcatchment 3S: Western Parking Area Runoff Area=16,520 sf 49.83% Impervious Runoff Depth>2.94"
Tc=5.0 min CN=84 Runoff=1.35 cfs 0.093 af

Pond 4P: Existing Conveyance System Inflow=2.44 cfs 0.165 af
Primary=2.44 cfs 0.165 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.492 af Average Runoff Depth = 2.04"
86.91% Pervious = 2.512 ac 13.09% Impervious = 0.378 ac

Summary for Subcatchment 1S: Overland Runoff to Wetlands

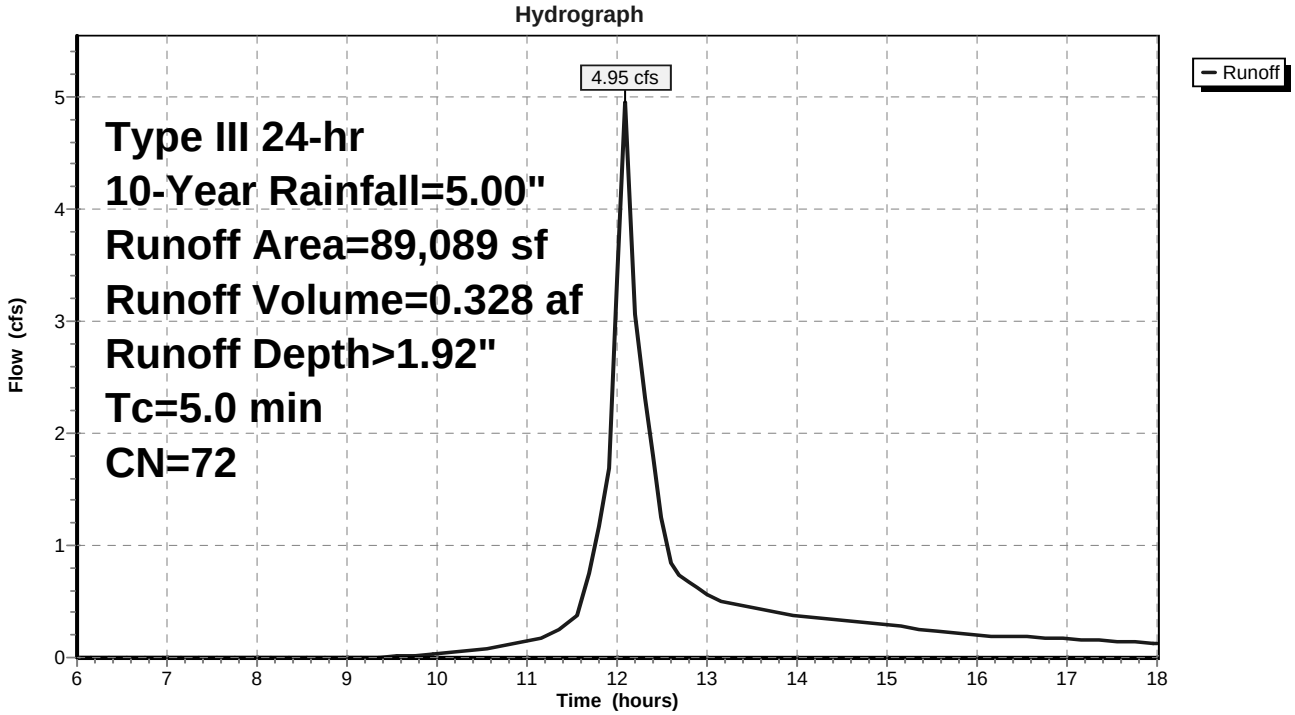
Runoff = 4.95 cfs @ 12.10 hrs, Volume= 0.328 af, Depth> 1.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	7,410	98	access road and paved areas
*	81,679	70	grassed/wooded area
	89,089	72	Weighted Average
	81,679		91.68% Pervious Area
	7,410		8.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Overland Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

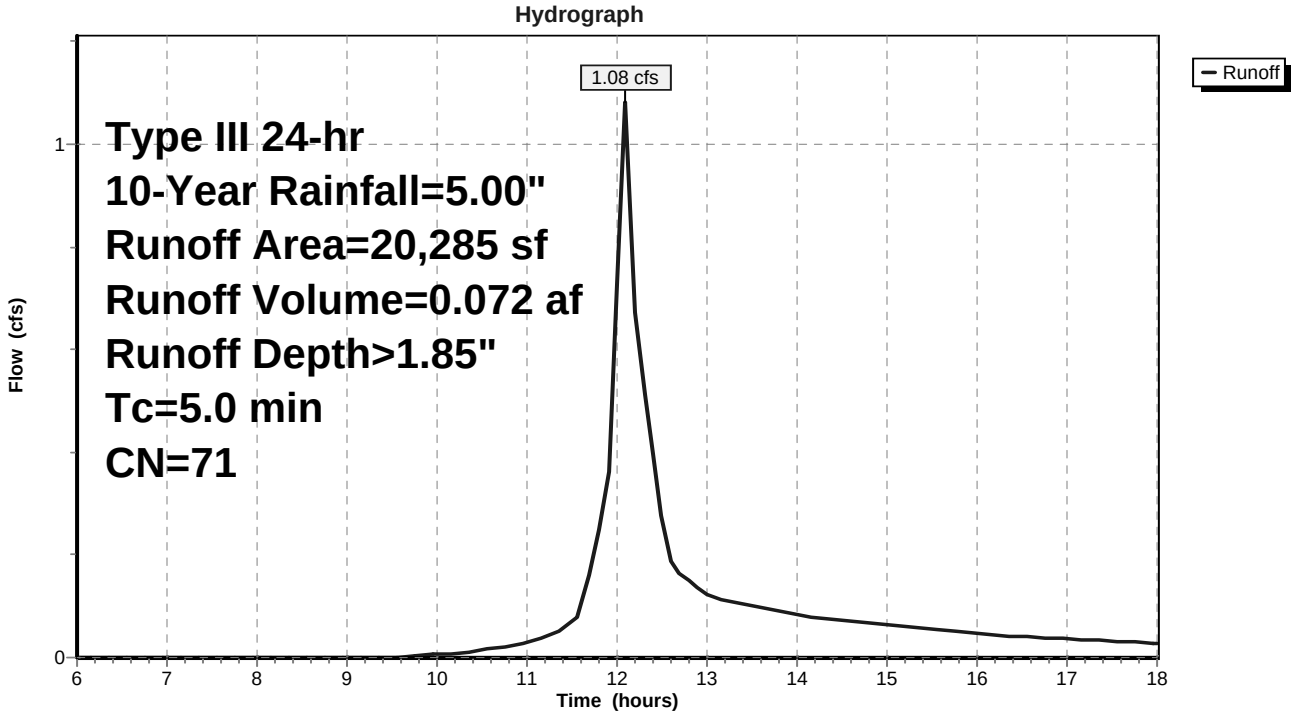
Runoff = 1.08 cfs @ 12.10 hrs, Volume= 0.072 af, Depth> 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	842	98	impervious
*	19,443	70	grassed area
	20,285	71	Weighted Average
	19,443		95.85% Pervious Area
	842		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

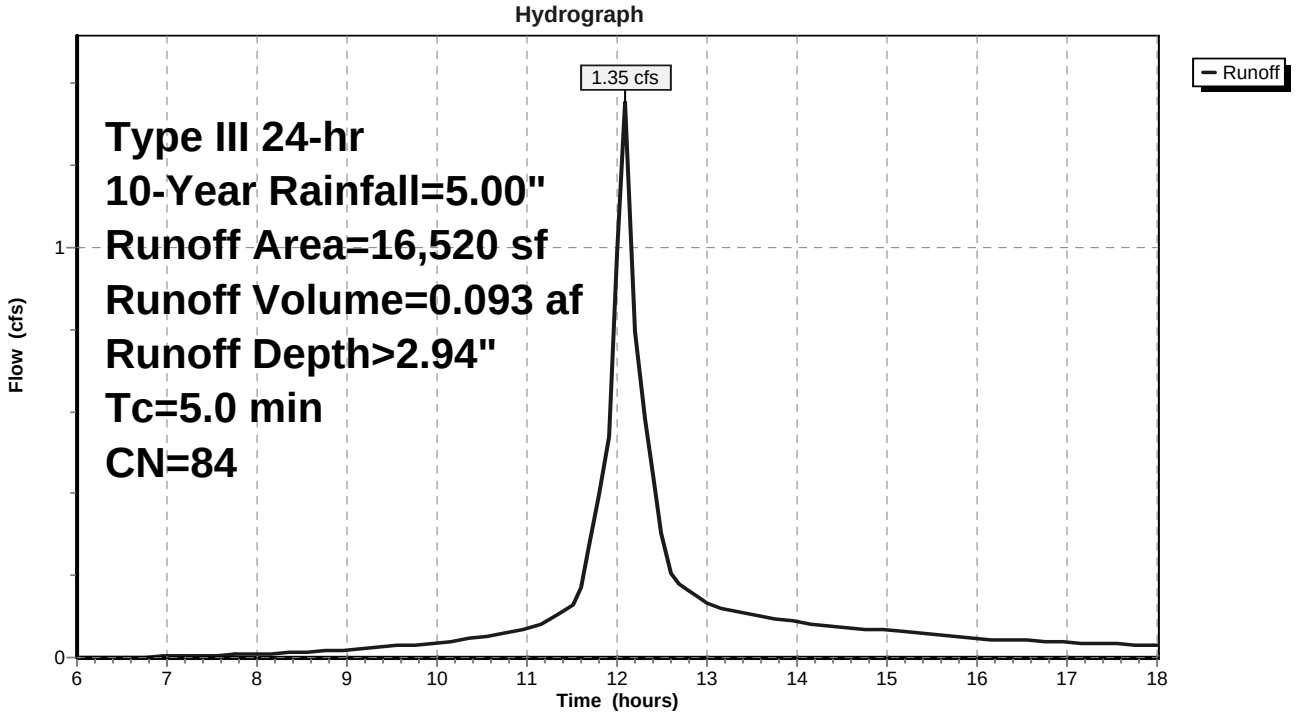
Runoff = 1.35 cfs @ 12.09 hrs, Volume= 0.093 af, Depth> 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	8,232	98	paved area
*	8,288	70	grassed area
	16,520	84	Weighted Average
	8,288		50.17% Pervious Area
	8,232		49.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area

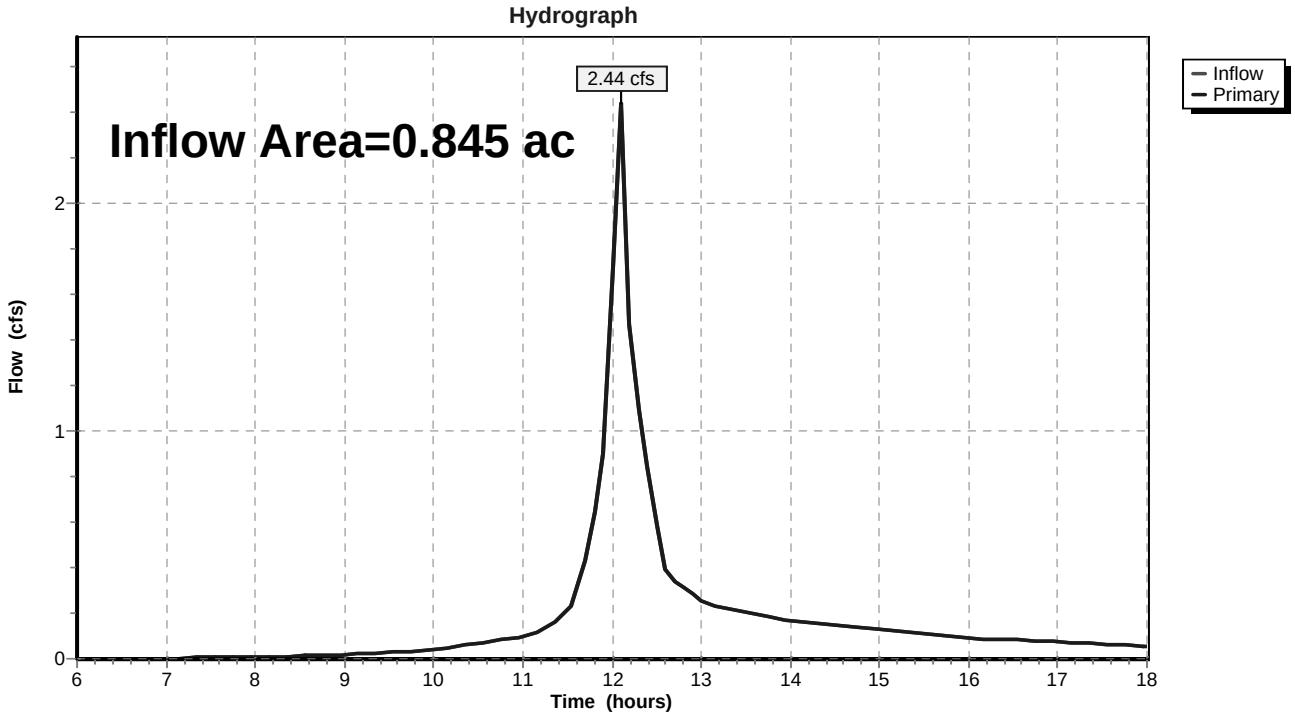


Summary for Pond 4P: Existing Conveyance System

Inflow Area = 0.845 ac, 24.65% Impervious, Inflow Depth > 2.34" for 10-Year event
Inflow = 2.44 cfs @ 12.09 hrs, Volume= 0.165 af
Primary = 2.44 cfs @ 12.09 hrs, Volume= 0.165 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Existing Conveyance System



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Overland Runoff to Runoff Area=89,089 sf 8.32% Impervious Runoff Depth>2.35"
Tc=5.0 min CN=72 Runoff=6.04 cfs 0.400 af

Subcatchment 2S: Infield Grassed Area Runoff Area=20,285 sf 4.15% Impervious Runoff Depth>2.26"
Tc=5.0 min CN=71 Runoff=1.33 cfs 0.088 af

Subcatchment 3S: Western Parking Area Runoff Area=16,520 sf 49.83% Impervious Runoff Depth>3.45"
Tc=5.0 min CN=84 Runoff=1.57 cfs 0.109 af

Pond 4P: Existing Conveyance System Inflow=2.90 cfs 0.197 af
Primary=2.90 cfs 0.197 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.597 af Average Runoff Depth = 2.48"
86.91% Pervious = 2.512 ac 13.09% Impervious = 0.378 ac

Summary for Subcatchment 1S: Overland Runoff to Wetlands

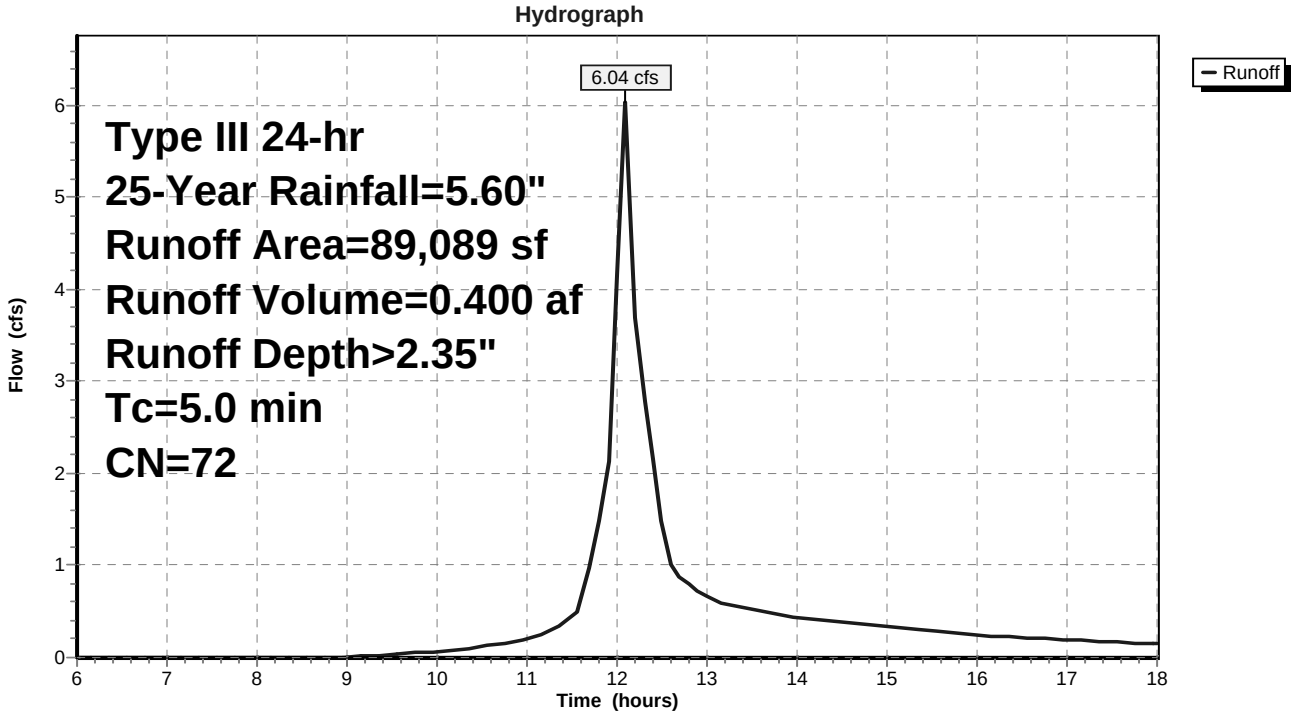
Runoff = 6.04 cfs @ 12.09 hrs, Volume= 0.400 af, Depth> 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	7,410	98	access road and paved areas
*	81,679	70	grassed/wooded area
	89,089	72	Weighted Average
	81,679		91.68% Pervious Area
	7,410		8.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Overland Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

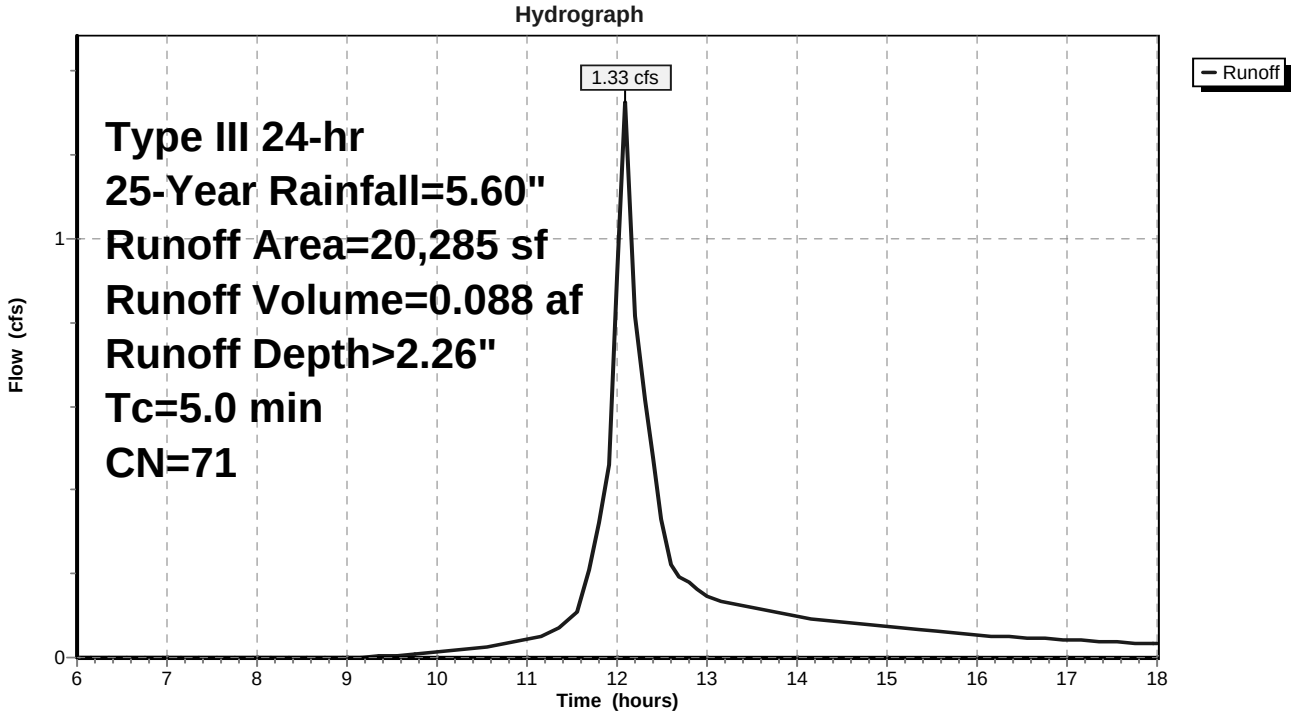
Runoff = 1.33 cfs @ 12.09 hrs, Volume= 0.088 af, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	842	98	impervious
*	19,443	70	grassed area
	20,285	71	Weighted Average
	19,443		95.85% Pervious Area
	842		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

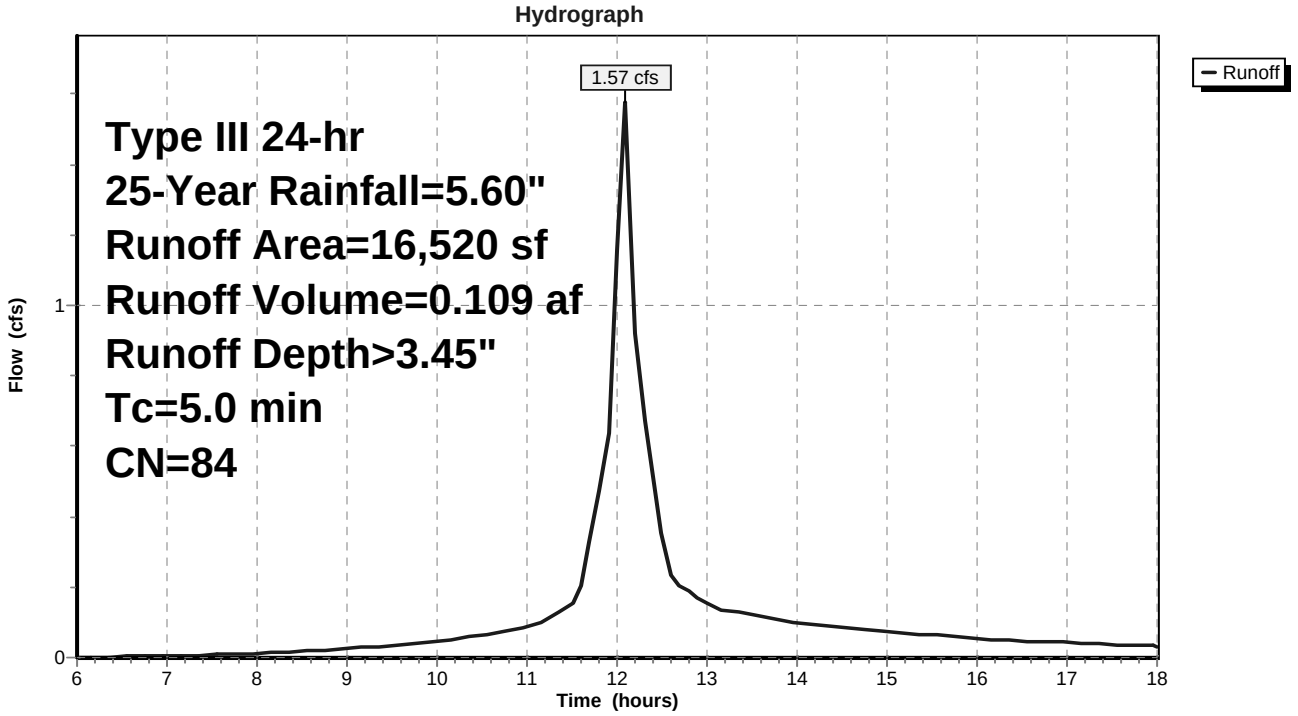
Runoff = 1.57 cfs @ 12.09 hrs, Volume= 0.109 af, Depth> 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	8,232	98	paved area
*	8,288	70	grassed area
	16,520	84	Weighted Average
	8,288		50.17% Pervious Area
	8,232		49.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area

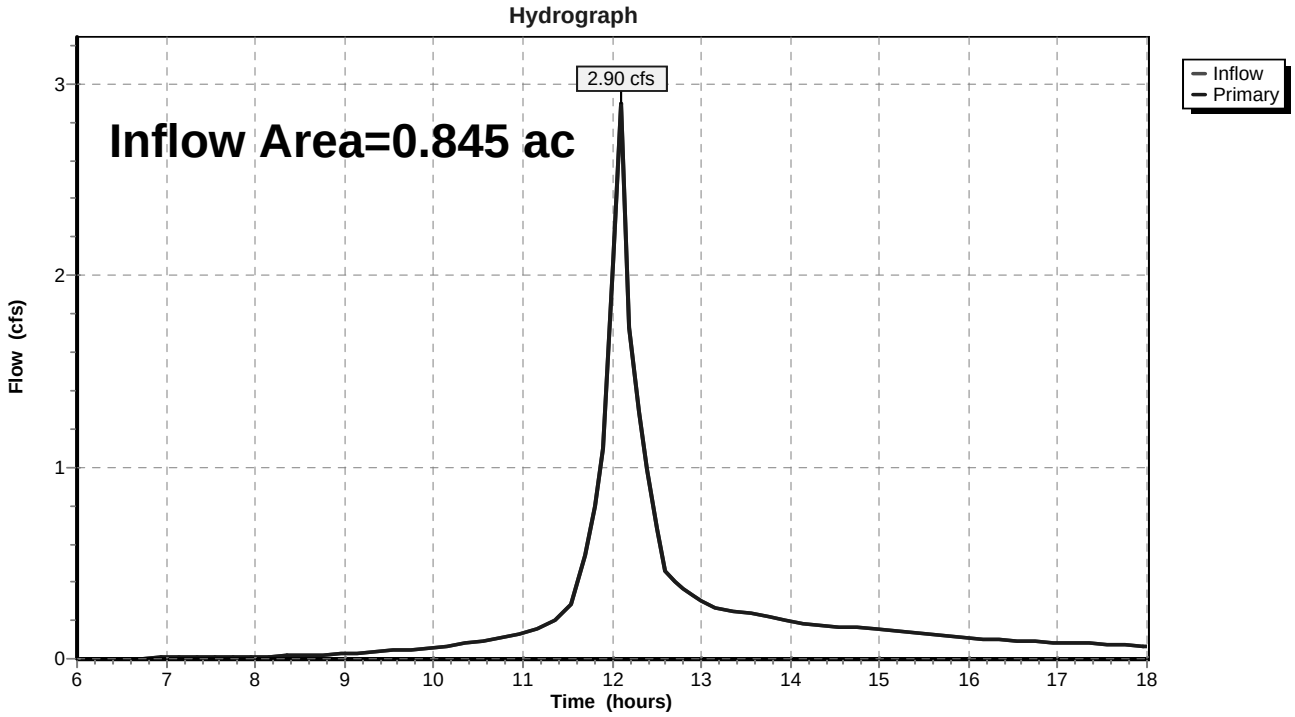


Summary for Pond 4P: Existing Conveyance System

Inflow Area = 0.845 ac, 24.65% Impervious, Inflow Depth > 2.80" for 25-Year event
Inflow = 2.90 cfs @ 12.09 hrs, Volume= 0.197 af
Primary = 2.90 cfs @ 12.09 hrs, Volume= 0.197 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Existing Conveyance System



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Overland Runoff to Runoff Area=89,089 sf 8.32% Impervious Runoff Depth>2.87"
Tc=5.0 min CN=72 Runoff=7.33 cfs 0.488 af

Subcatchment 2S: Infield Grassed Area Runoff Area=20,285 sf 4.15% Impervious Runoff Depth>2.77"
Tc=5.0 min CN=71 Runoff=1.62 cfs 0.108 af

Subcatchment 3S: Western Parking Area Runoff Area=16,520 sf 49.83% Impervious Runoff Depth>4.05"
Tc=5.0 min CN=84 Runoff=1.83 cfs 0.128 af

Pond 4P: Existing Conveyance System Inflow=3.45 cfs 0.236 af
Primary=3.45 cfs 0.236 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.724 af Average Runoff Depth = 3.01"
86.91% Pervious = 2.512 ac 13.09% Impervious = 0.378 ac

Summary for Subcatchment 1S: Overland Runoff to Wetlands

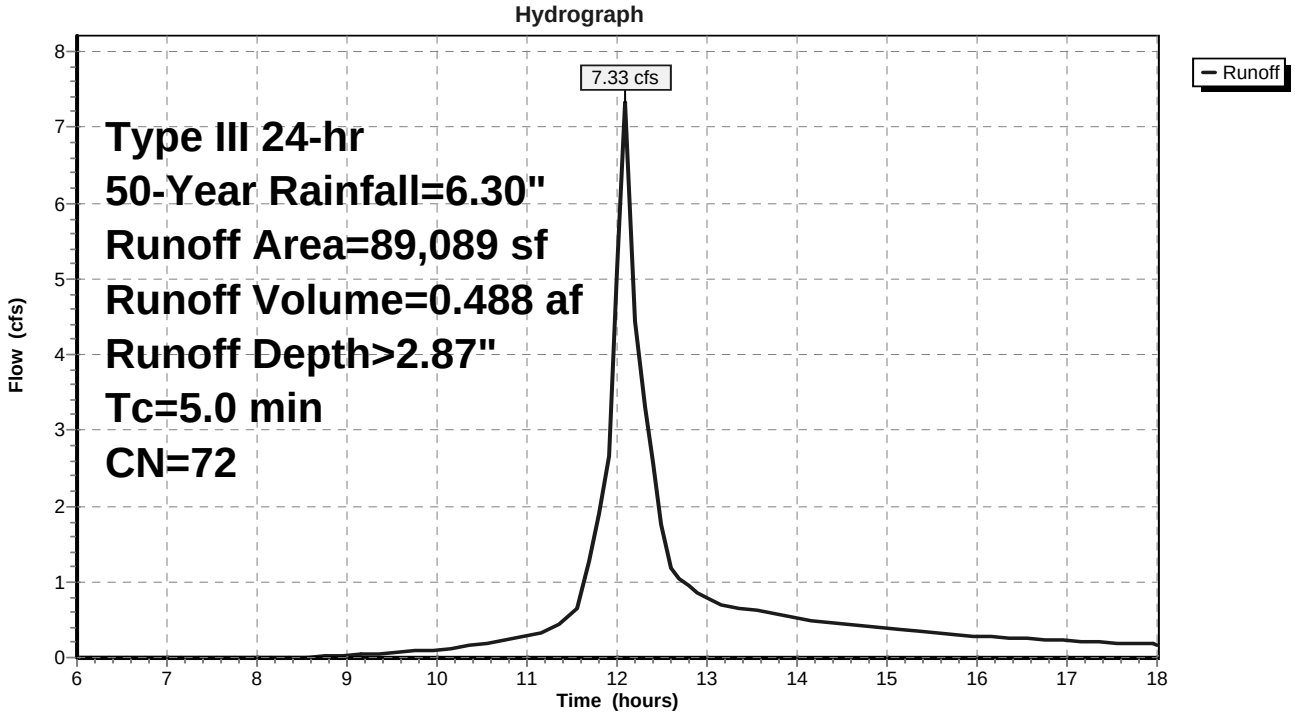
Runoff = 7.33 cfs @ 12.09 hrs, Volume= 0.488 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 50-Year Rainfall=6.30"

	Area (sf)	CN	Description
*	7,410	98	access road and paved areas
*	81,679	70	grassed/wooded area
	89,089	72	Weighted Average
	81,679		91.68% Pervious Area
	7,410		8.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Overland Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

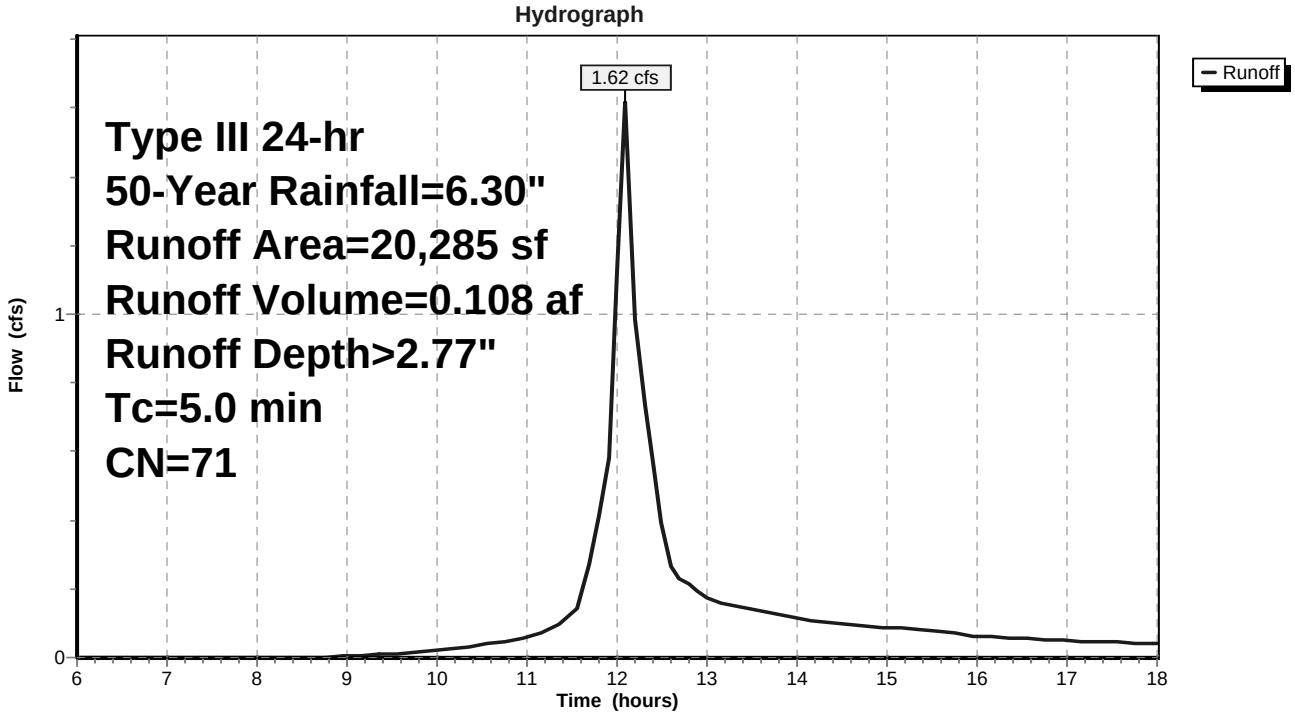
Runoff = 1.62 cfs @ 12.09 hrs, Volume= 0.108 af, Depth> 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 50-Year Rainfall=6.30"

	Area (sf)	CN	Description
*	842	98	impervious
*	19,443	70	grassed area
	20,285	71	Weighted Average
	19,443		95.85% Pervious Area
	842		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

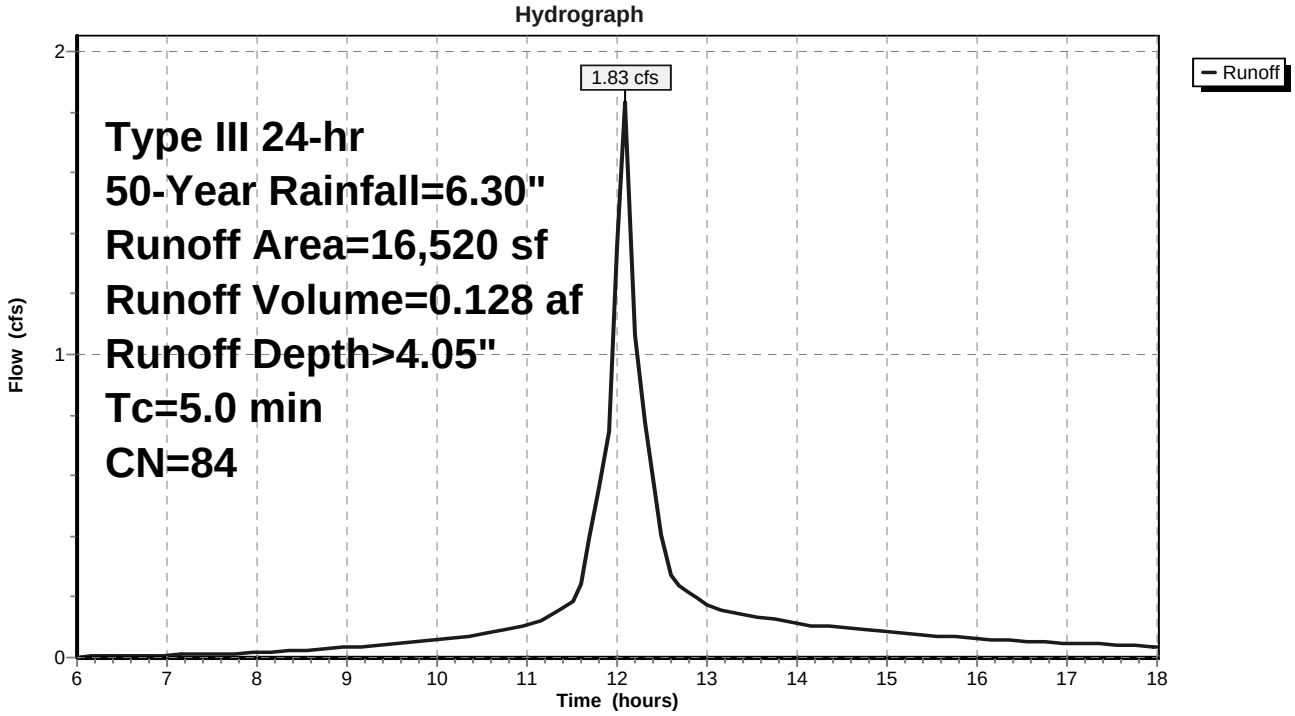
Runoff = 1.83 cfs @ 12.09 hrs, Volume= 0.128 af, Depth> 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 50-Year Rainfall=6.30"

	Area (sf)	CN	Description
*	8,232	98	paved area
*	8,288	70	grassed area
	16,520	84	Weighted Average
	8,288		50.17% Pervious Area
	8,232		49.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area

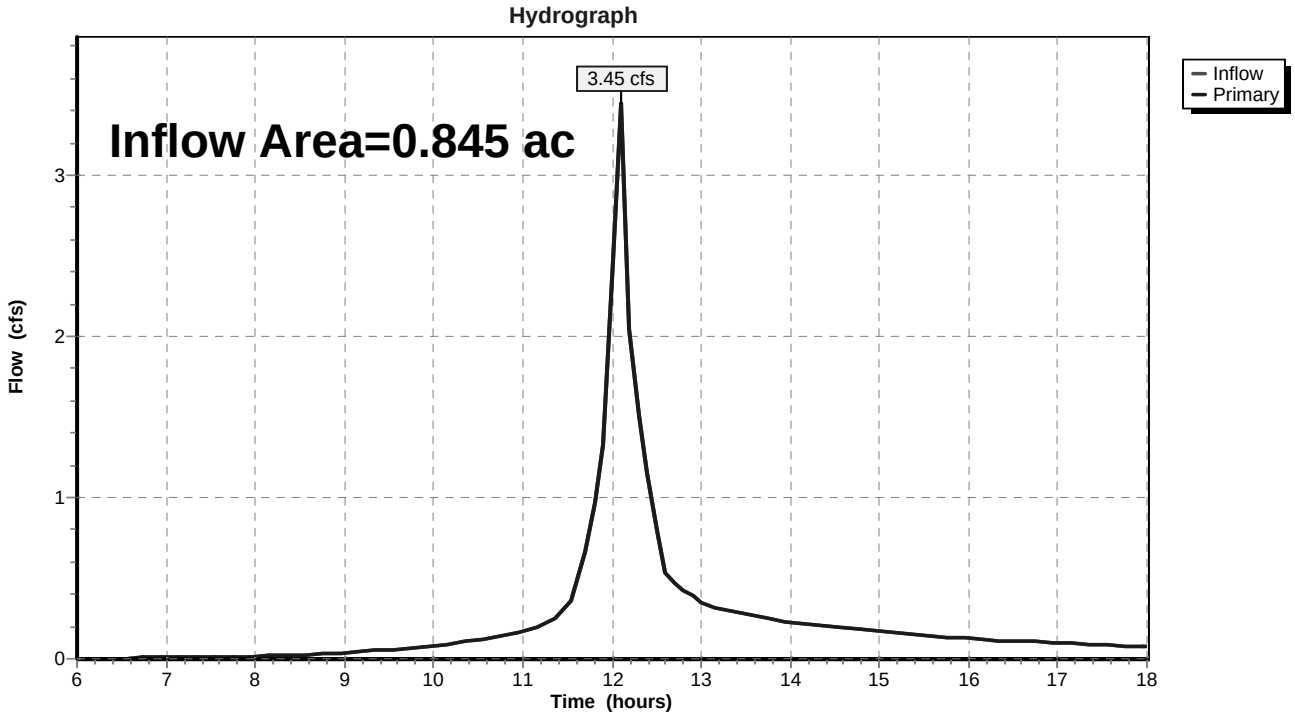


Summary for Pond 4P: Existing Conveyance System

Inflow Area = 0.845 ac, 24.65% Impervious, Inflow Depth > 3.35" for 50-Year event
Inflow = 3.45 cfs @ 12.09 hrs, Volume= 0.236 af
Primary = 3.45 cfs @ 12.09 hrs, Volume= 0.236 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Existing Conveyance System



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Overland Runoff to Runoff Area=89,089 sf 8.32% Impervious Runoff Depth>3.48"
Tc=5.0 min CN=72 Runoff=8.85 cfs 0.593 af

Subcatchment 2S: Infield Grassed Area Runoff Area=20,285 sf 4.15% Impervious Runoff Depth>3.38"
Tc=5.0 min CN=71 Runoff=1.96 cfs 0.131 af

Subcatchment 3S: Western Parking Area Runoff Area=16,520 sf 49.83% Impervious Runoff Depth>4.74"
Tc=5.0 min CN=84 Runoff=2.12 cfs 0.150 af

Pond 4P: Existing Conveyance System Inflow=4.08 cfs 0.281 af
Primary=4.08 cfs 0.281 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.874 af Average Runoff Depth = 3.63"
86.91% Pervious = 2.512 ac 13.09% Impervious = 0.378 ac

Summary for Subcatchment 1S: Overland Runoff to Wetlands

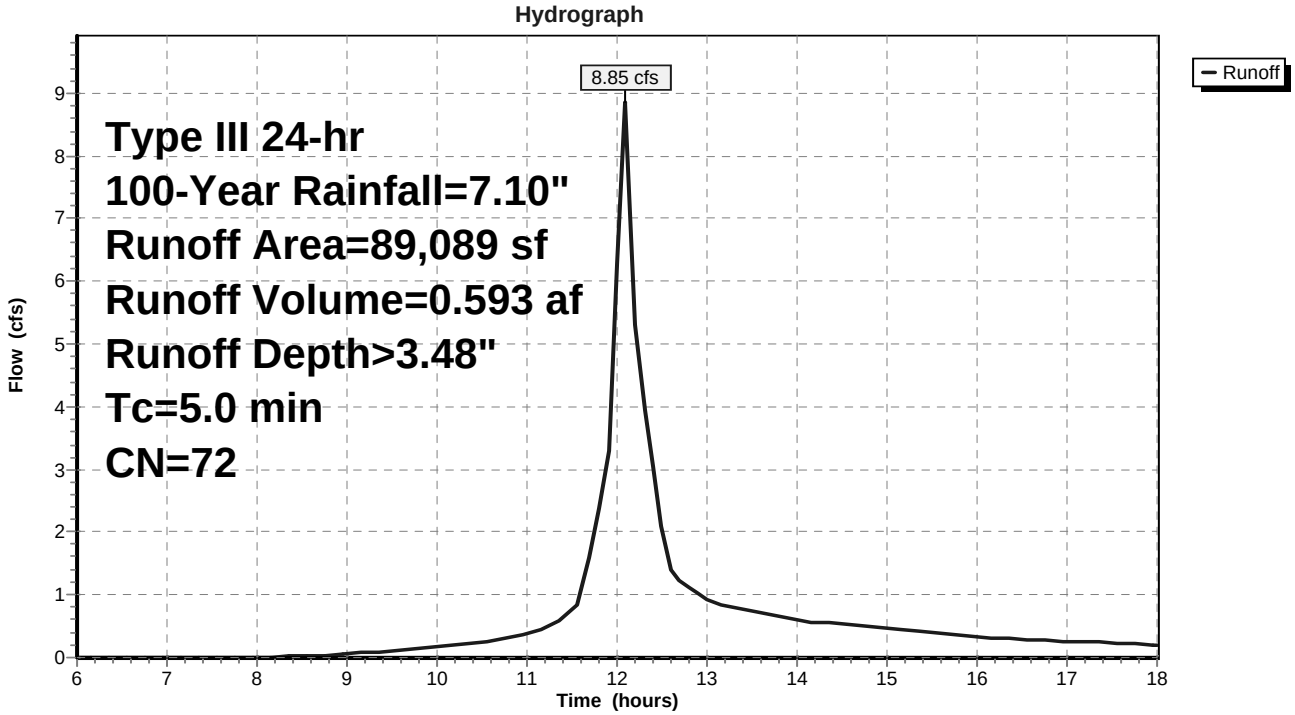
Runoff = 8.85 cfs @ 12.09 hrs, Volume= 0.593 af, Depth> 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	7,410	98	access road and paved areas
*	81,679	70	grassed/wooded area
	89,089	72	Weighted Average
	81,679		91.68% Pervious Area
	7,410		8.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Overland Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

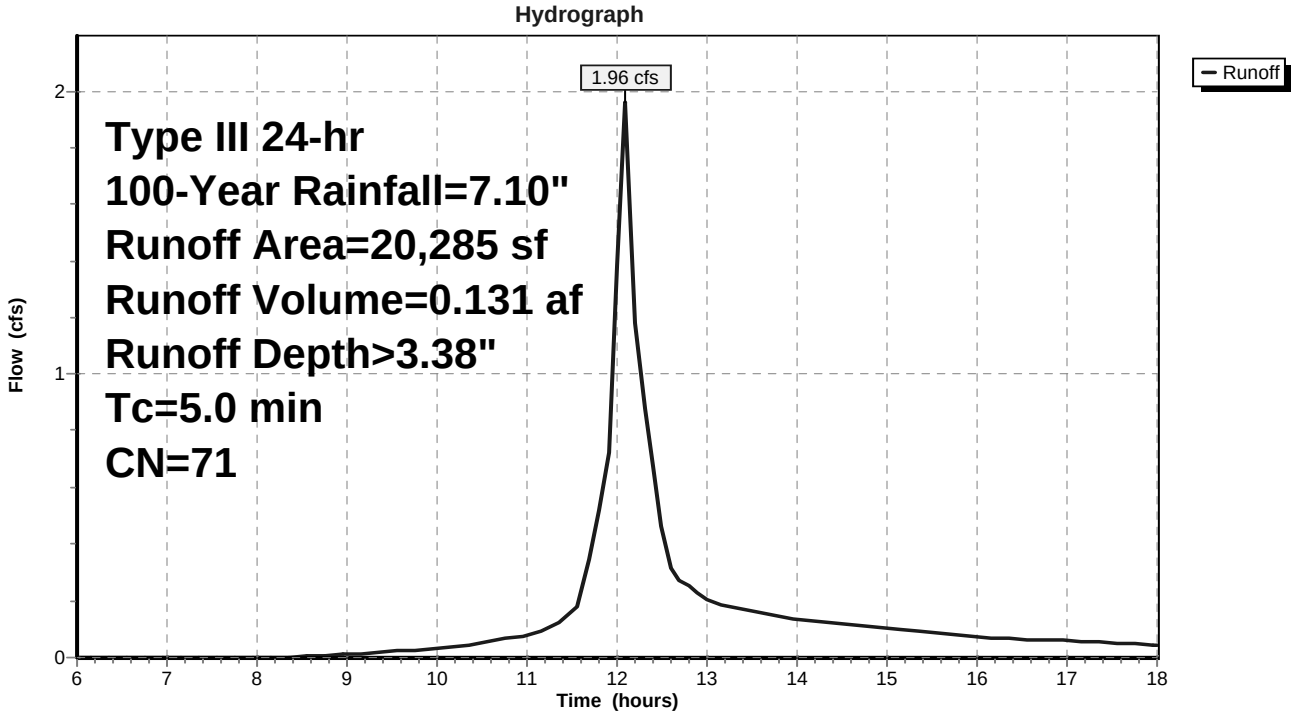
Runoff = 1.96 cfs @ 12.09 hrs, Volume= 0.131 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	842	98	impervious
*	19,443	70	grassed area
	20,285	71	Weighted Average
	19,443		95.85% Pervious Area
	842		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

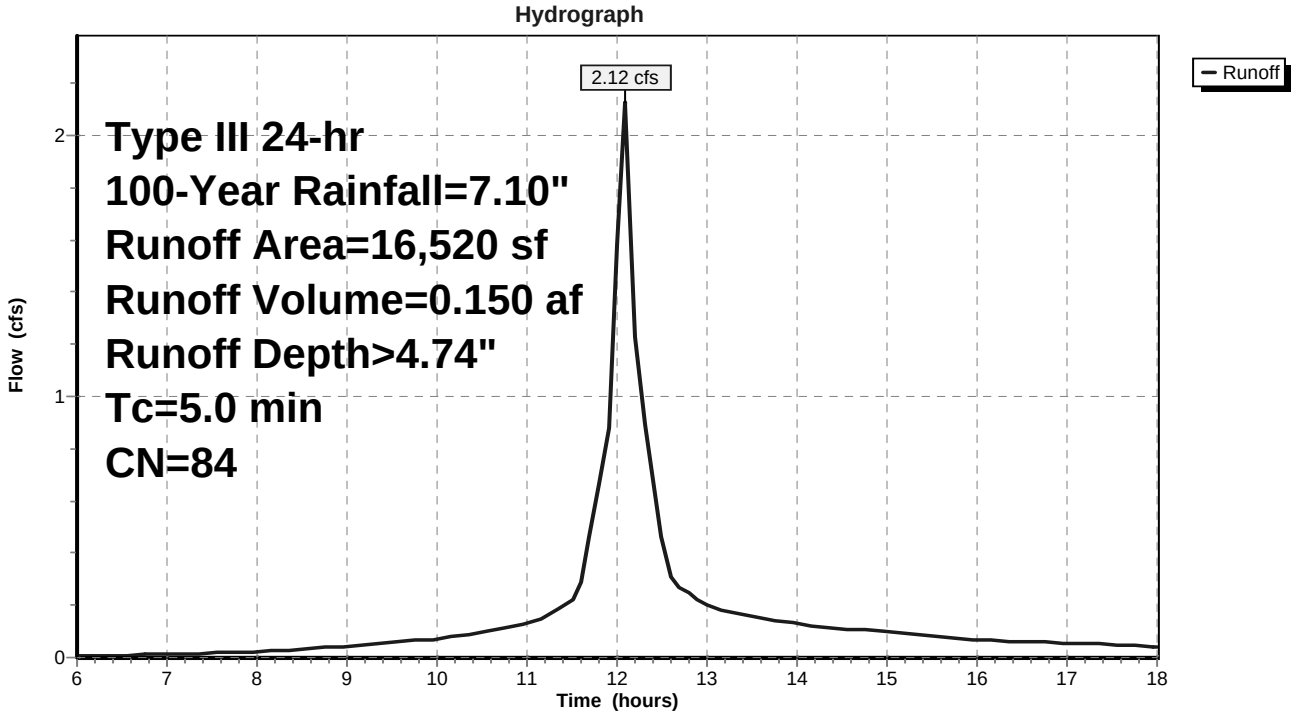
Runoff = 2.12 cfs @ 12.09 hrs, Volume= 0.150 af, Depth> 4.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	8,232	98	paved area
*	8,288	70	grassed area
	16,520	84	Weighted Average
	8,288		50.17% Pervious Area
	8,232		49.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area

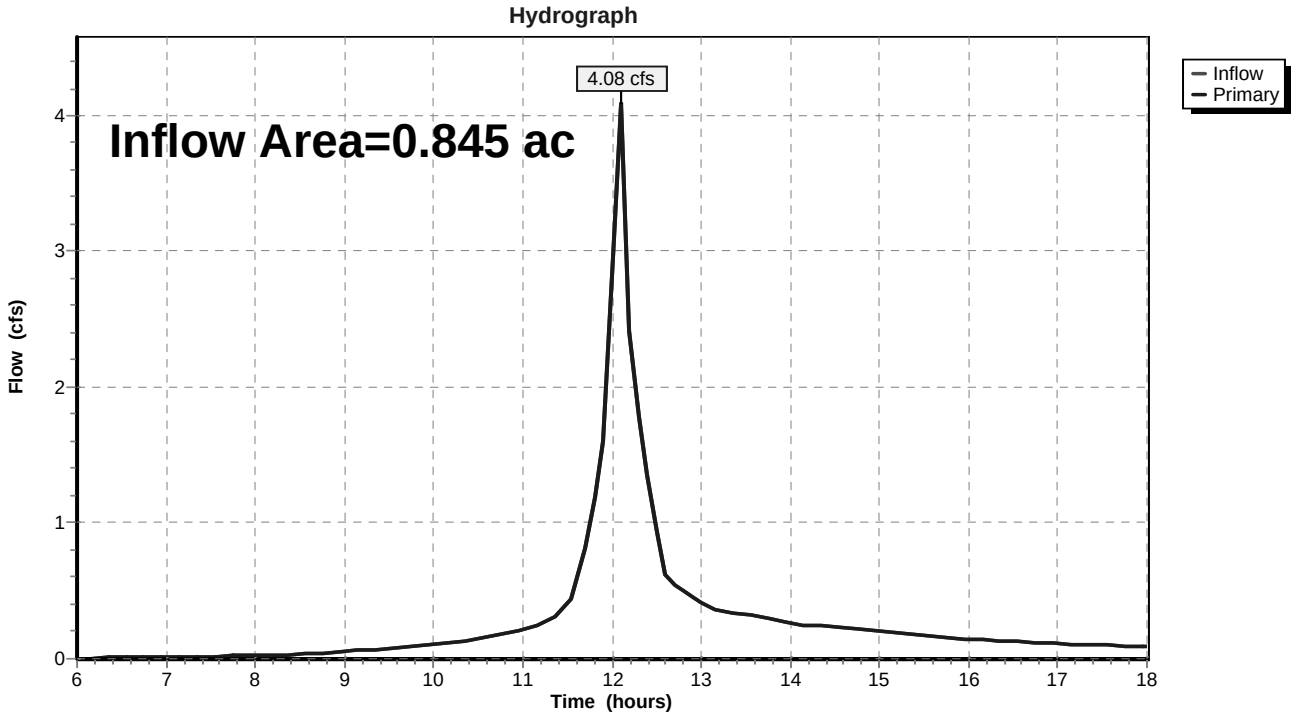


Summary for Pond 4P: Existing Conveyance System

Inflow Area = 0.845 ac, 24.65% Impervious, Inflow Depth > 3.99" for 100-Year event
Inflow = 4.08 cfs @ 12.09 hrs, Volume= 0.281 af
Primary = 4.08 cfs @ 12.09 hrs, Volume= 0.281 af, Atten= 0%, Lag= 0.0 min

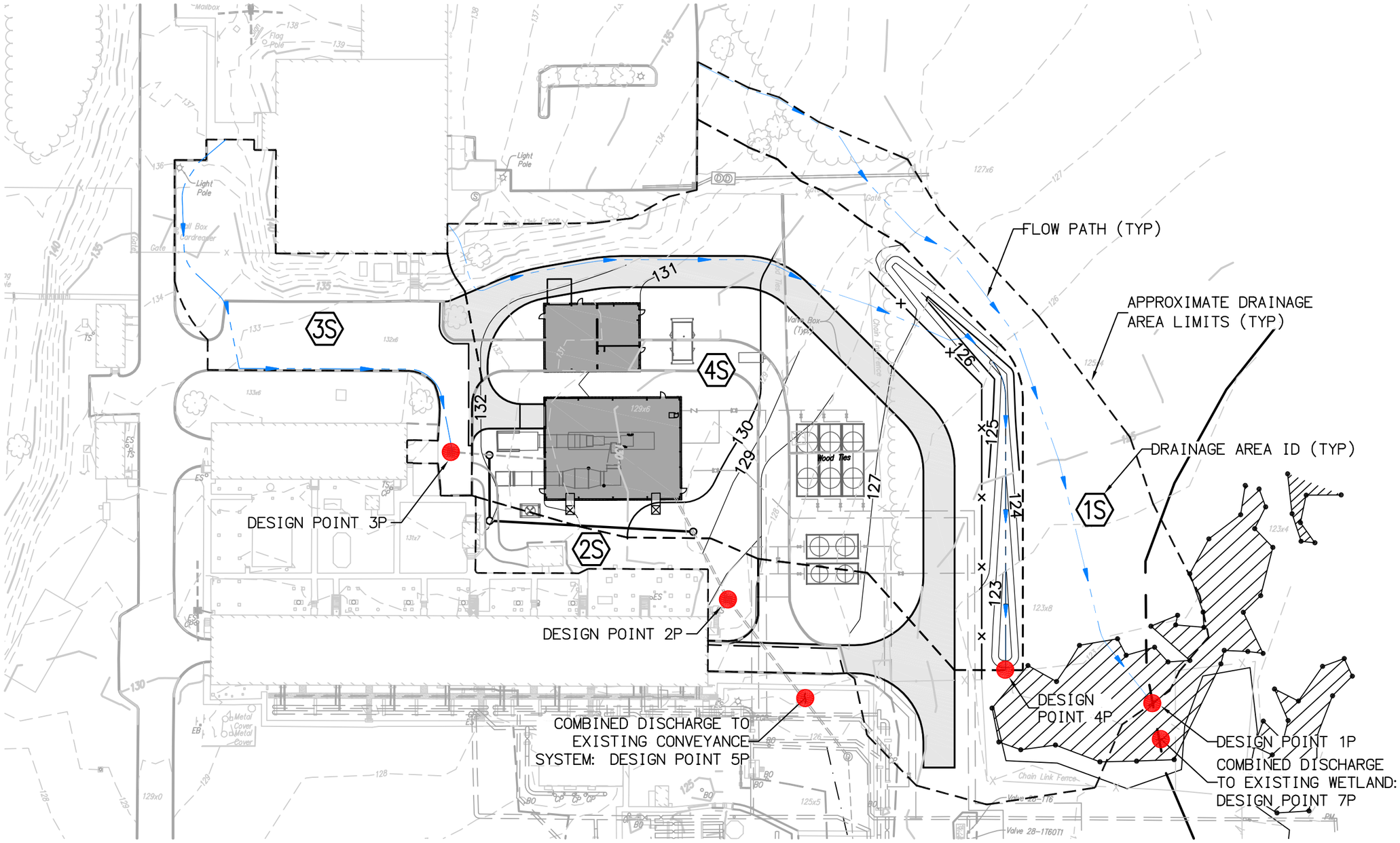
Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 4P: Existing Conveyance System



Attachment D

Post-Development Drainage Calculations

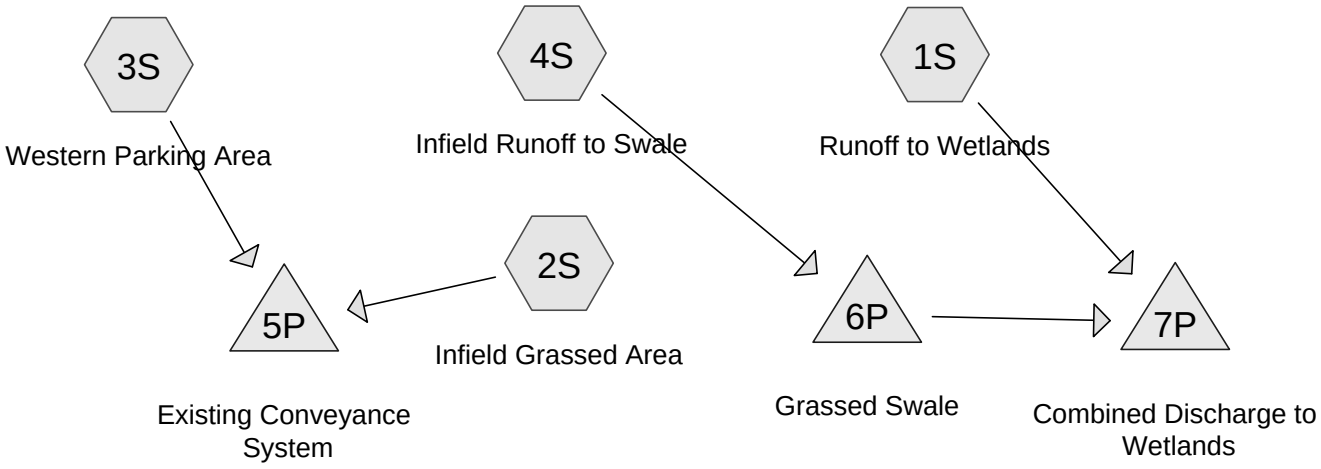


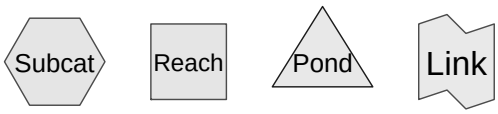
Post-Development Drainage Area

0 60 120

SCALE:1"=60'

Michael Baker INTERNATIONAL
500 ENTERPRISE DRIVE, SUITE 2B
ROCKY HILL, CT 06067
(860) 563-3044





Routing Diagram for proposed drainage 2014 08 15
Prepared by Michael Baker Corporation, Printed 8/15/2014
HydroCAD® 10.00 s/n 06697 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.118	70	grassed aea (4S)
0.810	70	grassed and wooded areas (1S)
0.190	70	grassed area (3S)
0.103	70	grassed areas (2S)
0.186	98	paved area (3S)
0.015	98	paved areas (2S)
0.378	98	paved areas, buildings (4S)
0.090	98	pavement (1S)
2.890	**76**	**TOTAL AREA**

Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Wetlands Runoff Area=39,187 sf 9.97% Impervious Runoff Depth>0.90"
Tc=5.0 min CN=73 Runoff=1.00 cfs 0.067 af

Subcatchment 2S: Infield Grassed Area Runoff Area=5,156 sf 12.57% Impervious Runoff Depth>0.95"
Tc=5.0 min CN=74 Runoff=0.14 cfs 0.009 af

Subcatchment 3S: Western Parking Area Runoff Area=16,403 sf 49.51% Impervious Runoff Depth>1.57"
Tc=5.0 min CN=84 Runoff=0.74 cfs 0.049 af

Subcatchment 4S: Infield Runoff to Swale Runoff Area=65,145 sf 25.26% Impervious Runoff Depth>1.11"
Tc=5.0 min CN=77 Runoff=2.09 cfs 0.139 af

Pond 5P: Existing Conveyance System Inflow=0.88 cfs 0.059 af
Primary=0.88 cfs 0.059 af

Pond 6P: Grassed Swale Peak Elev=123.26' Storage=0.050 af Inflow=2.09 cfs 0.139 af
Discarded=0.43 cfs 0.138 af Primary=0.00 cfs 0.000 af Outflow=0.43 cfs 0.138 af

Pond 7P: Combined Discharge to Wetlands Inflow=1.00 cfs 0.067 af
Primary=1.00 cfs 0.067 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.264 af Average Runoff Depth = 1.10"
76.86% Pervious = 2.221 ac 23.14% Impervious = 0.669 ac

Summary for Subcatchment 1S: Runoff to Wetlands

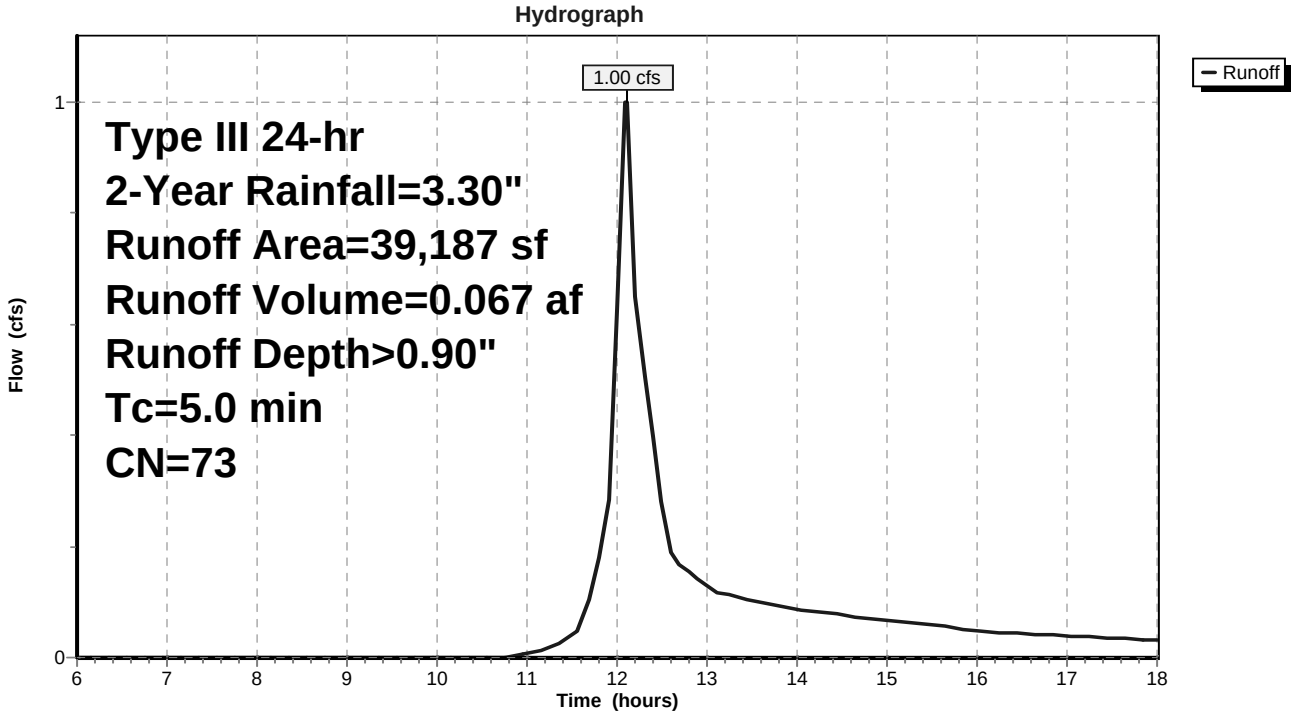
Runoff = 1.00 cfs @ 12.10 hrs, Volume= 0.067 af, Depth> 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	3,906	98	pavement
*	35,281	70	grassed and wooded areas
	39,187	73	Weighted Average
	35,281		90.03% Pervious Area
	3,906		9.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

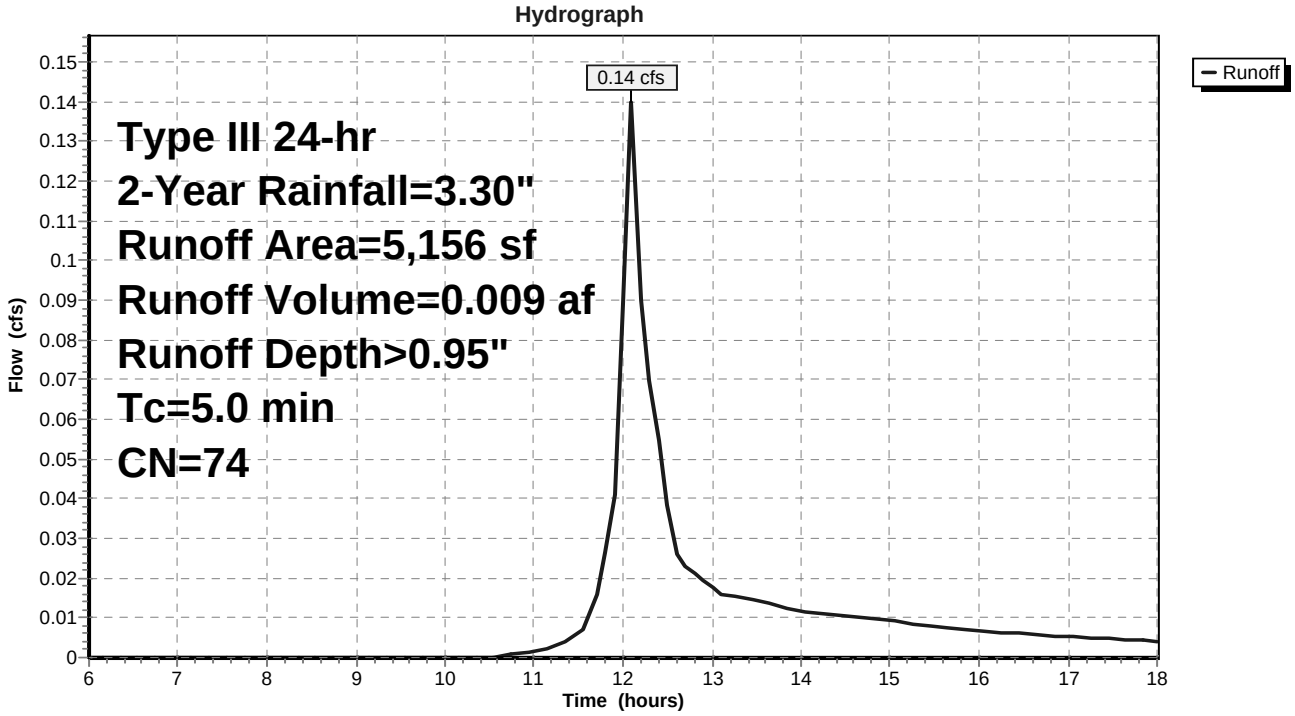
Runoff = 0.14 cfs @ 12.10 hrs, Volume= 0.009 af, Depth> 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	648	98	paved areas
*	4,508	70	grassed areas
	5,156	74	Weighted Average
	4,508		87.43% Pervious Area
	648		12.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

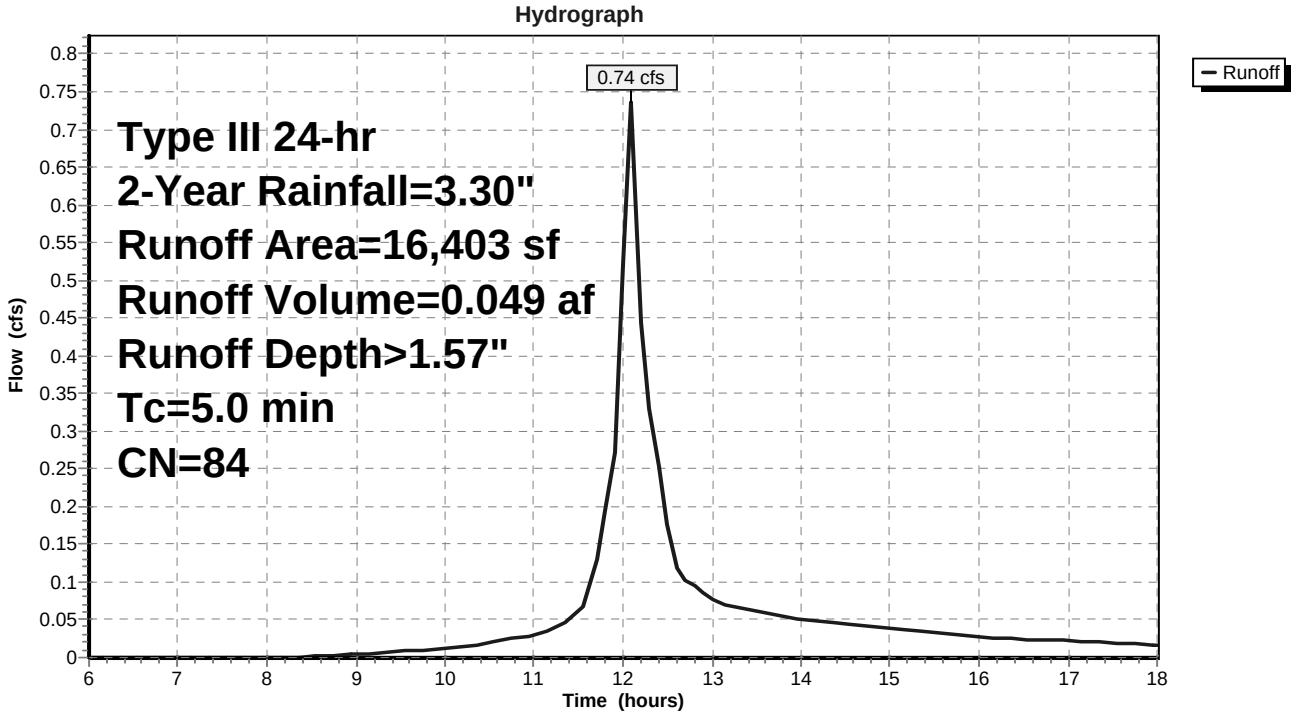
Runoff = 0.74 cfs @ 12.09 hrs, Volume= 0.049 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	8,121	98	paved area
*	8,282	70	grassed area
	16,403	84	Weighted Average
	8,282		50.49% Pervious Area
	8,121		49.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area



Summary for Subcatchment 4S: Infield Runoff to Swale

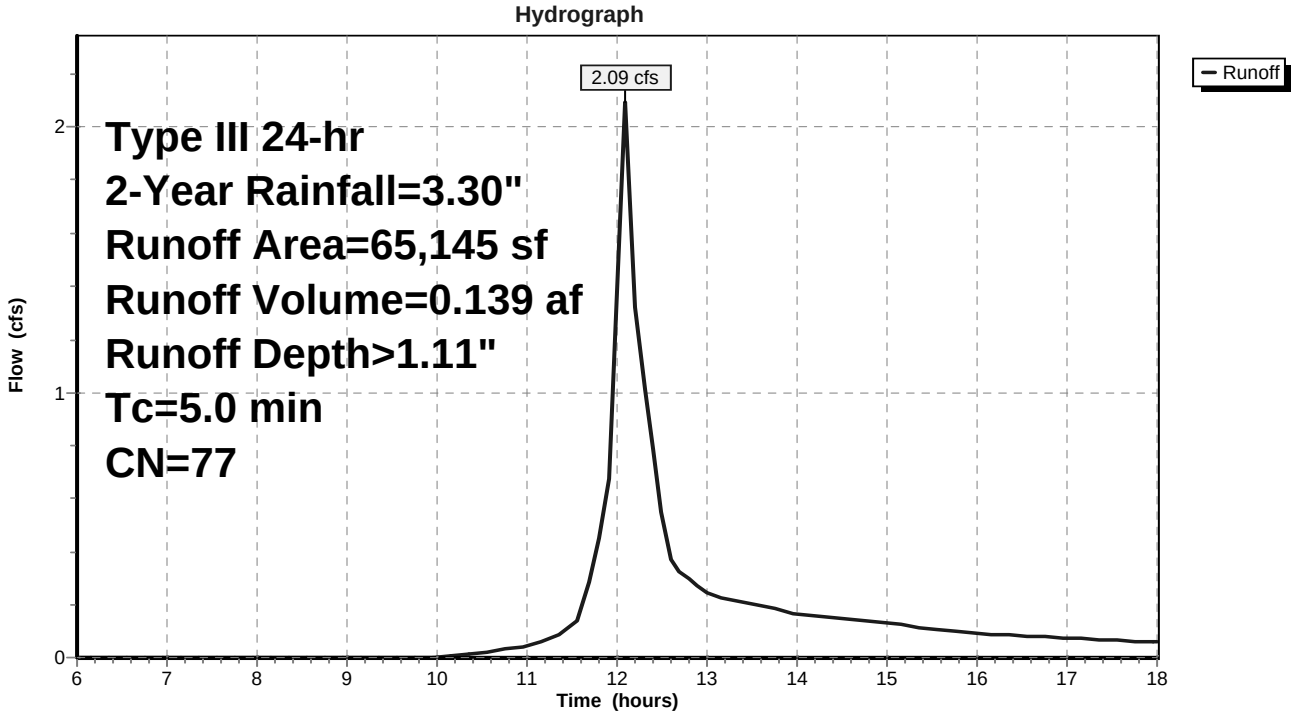
Runoff = 2.09 cfs @ 12.10 hrs, Volume= 0.139 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	16,453	98	paved areas, buildings
*	48,692	70	grassed aea
	65,145	77	Weighted Average
	48,692		74.74% Pervious Area
	16,453		25.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Infield Runoff to Swale

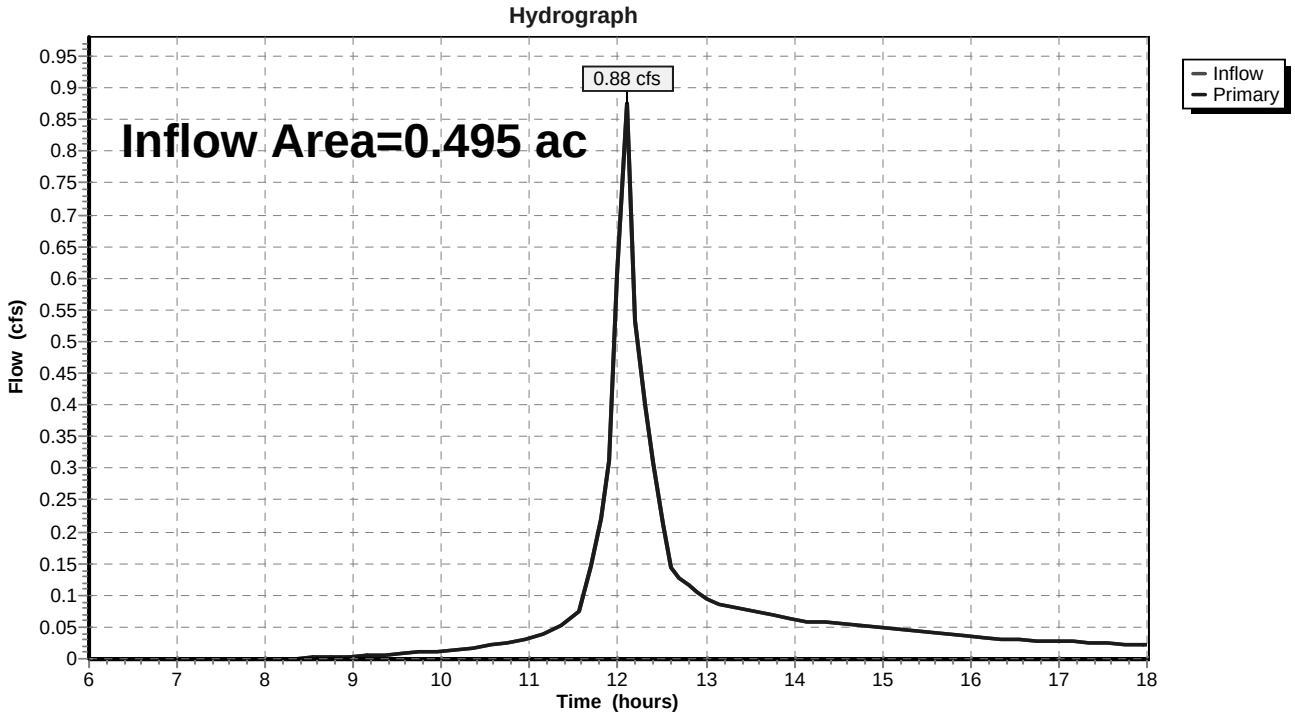


Summary for Pond 5P: Existing Conveyance System

Inflow Area = 0.495 ac, 40.67% Impervious, Inflow Depth > 1.42" for 2-Year event
Inflow = 0.88 cfs @ 12.09 hrs, Volume= 0.059 af
Primary = 0.88 cfs @ 12.09 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 5P: Existing Conveyance System



Summary for Pond 6P: Grassed Swale

Inflow Area =	1.496 ac, 25.26% Impervious, Inflow Depth > 1.11" for 2-Year event				
Inflow =	2.09 cfs @	12.10 hrs,	Volume=	0.139 af	
Outflow =	0.43 cfs @	12.58 hrs,	Volume=	0.138 af,	Atten= 79%, Lag= 28.7 min
Discarded =	0.43 cfs @	12.58 hrs,	Volume=	0.138 af	
Primary =	0.00 cfs @	6.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 123.26' @ 12.58 hrs Surf.Area= 0.069 ac Storage= 0.050 af

Plug-Flow detention time= 56.8 min calculated for 0.137 af (99% of inflow)
Center-of-Mass det. time= 55.7 min (844.7 - 789.1)

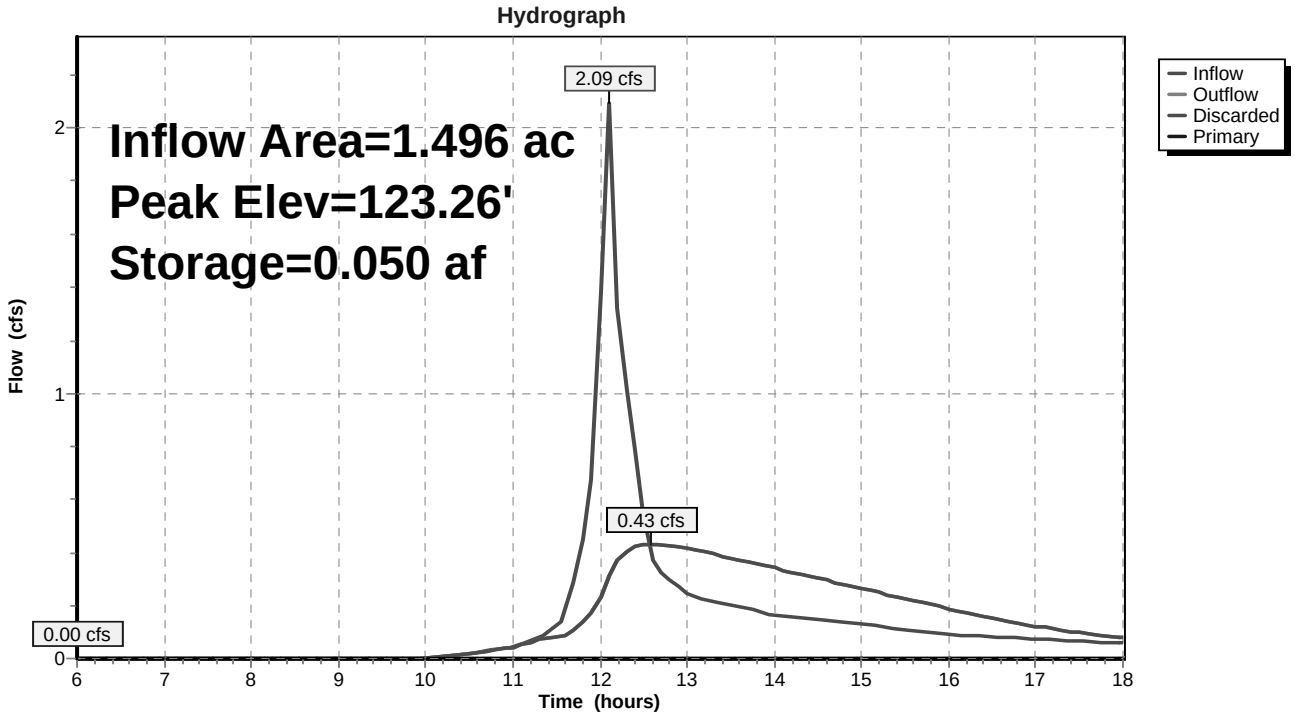
Volume	Invert	Avail.Storage	Storage Description
#1	122.00'	0.115 af	**2.00'W x 240.00'L x 2.00'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	122.00'	**6.000 in/hr Exfiltration over Wetted area**
#2	Primary	123.55'	**5.5' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.43 cfs @ 12.58 hrs HW=123.26' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=0.00 cfs @ 6.00 hrs HW=122.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Grassed Swale

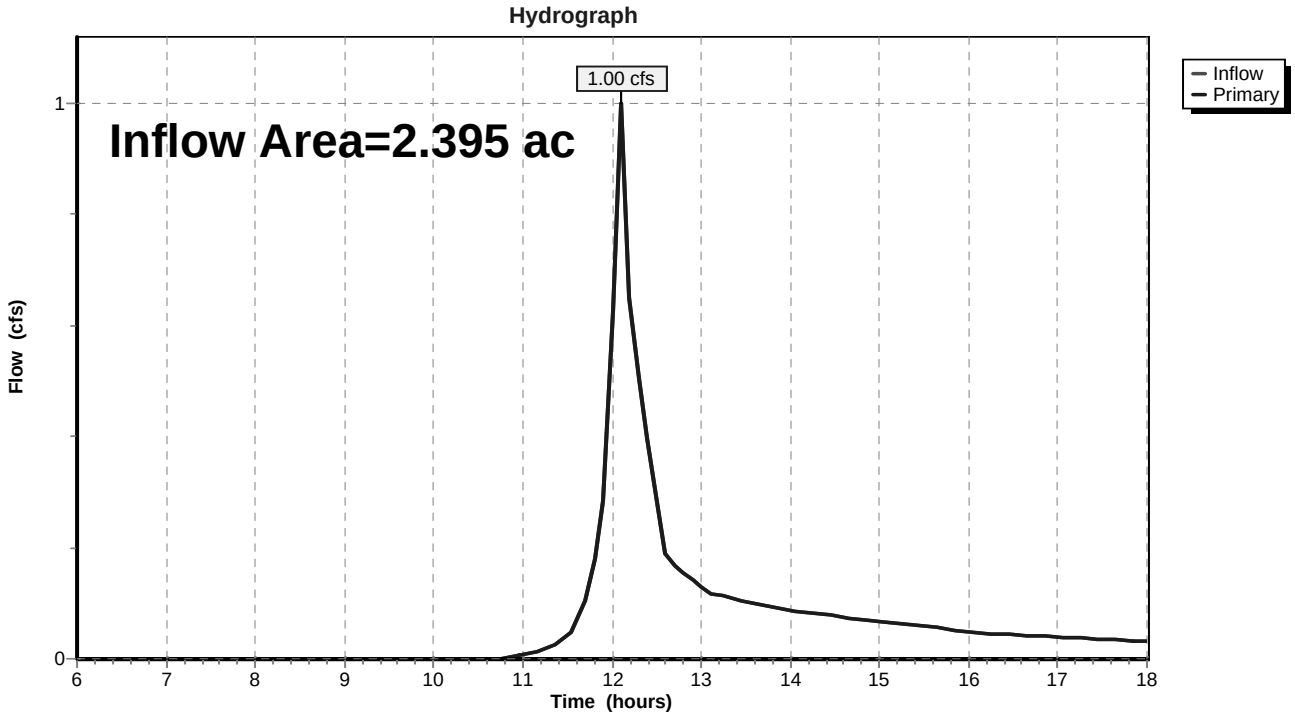


Summary for Pond 7P: Combined Discharge to Wetlands

Inflow Area = 2.395 ac, 19.51% Impervious, Inflow Depth > 0.34" for 2-Year event
Inflow = 1.00 cfs @ 12.10 hrs, Volume= 0.067 af
Primary = 1.00 cfs @ 12.10 hrs, Volume= 0.067 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Combined Discharge to Wetlands



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Wetlands Runoff Area=39,187 sf 9.97% Impervious Runoff Depth>2.00"
Tc=5.0 min CN=73 Runoff=2.26 cfs 0.150 af

Subcatchment 2S: Infield Grassed Area Runoff Area=5,156 sf 12.57% Impervious Runoff Depth>2.08"
Tc=5.0 min CN=74 Runoff=0.31 cfs 0.021 af

Subcatchment 3S: Western Parking Area Runoff Area=16,403 sf 49.51% Impervious Runoff Depth>2.94"
Tc=5.0 min CN=84 Runoff=1.34 cfs 0.092 af

Subcatchment 4S: Infield Runoff to Swale Runoff Area=65,145 sf 25.26% Impervious Runoff Depth>2.32"
Tc=5.0 min CN=77 Runoff=4.34 cfs 0.290 af

Pond 5P: Existing Conveyance System Inflow=1.65 cfs 0.113 af
Primary=1.65 cfs 0.113 af

Pond 6P: Grassed Swale Peak Elev=123.77' Storage=0.092 af Inflow=4.34 cfs 0.290 af
Discarded=0.59 cfs 0.228 af Primary=1.49 cfs 0.052 af Outflow=2.08 cfs 0.280 af

Pond 7P: Combined Discharge to Wetlands Inflow=2.59 cfs 0.202 af
Primary=2.59 cfs 0.202 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.552 af Average Runoff Depth = 2.29"
76.86% Pervious = 2.221 ac 23.14% Impervious = 0.669 ac

Summary for Subcatchment 1S: Runoff to Wetlands

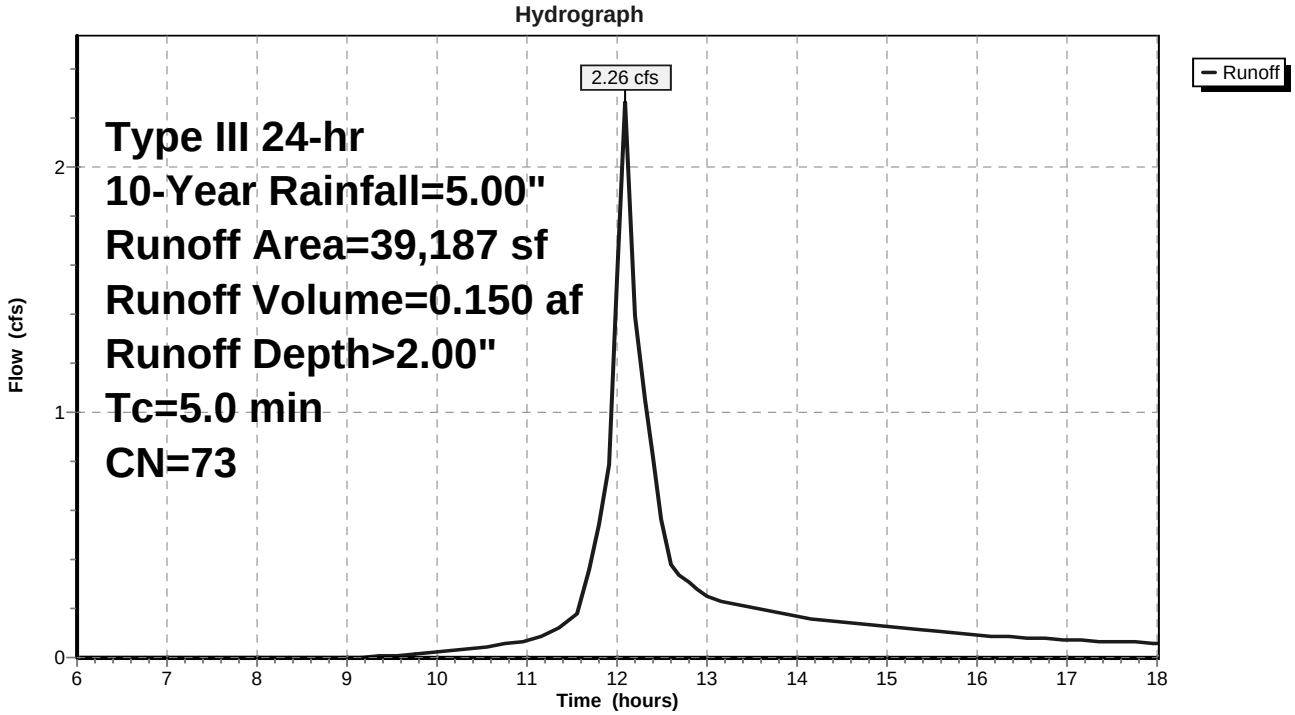
Runoff = 2.26 cfs @ 12.10 hrs, Volume= 0.150 af, Depth> 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	3,906	98	pavement
*	35,281	70	grassed and wooded areas
	39,187	73	Weighted Average
	35,281		90.03% Pervious Area
	3,906		9.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

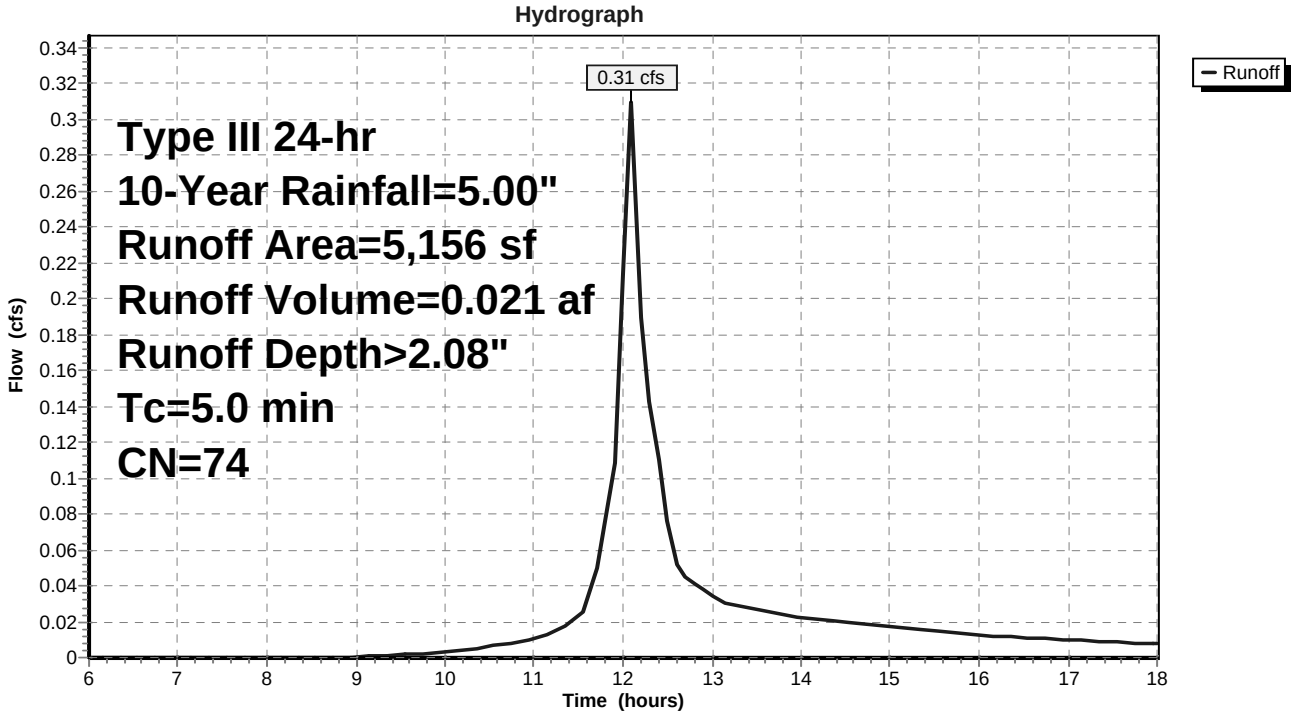
Runoff = 0.31 cfs @ 12.09 hrs, Volume= 0.021 af, Depth> 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	648	98	paved areas
*	4,508	70	grassed areas
	5,156	74	Weighted Average
	4,508		87.43% Pervious Area
	648		12.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

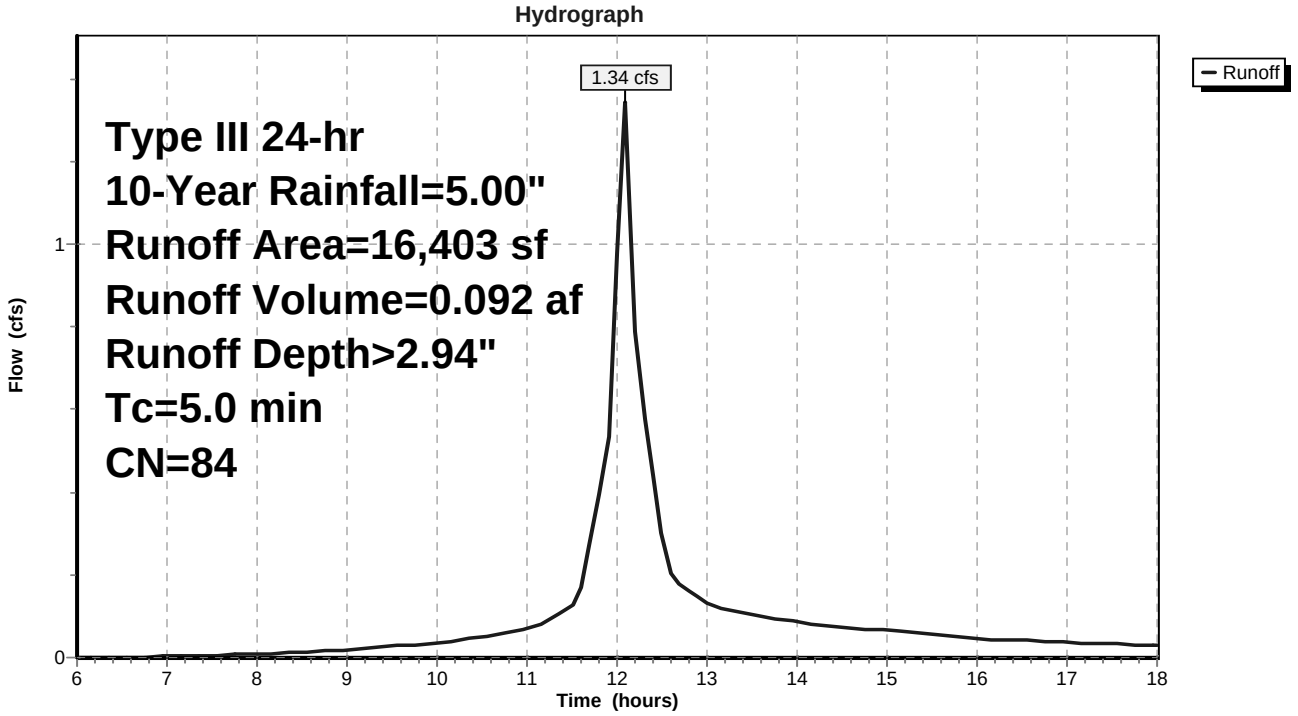
Runoff = 1.34 cfs @ 12.09 hrs, Volume= 0.092 af, Depth> 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	8,121	98	paved area
*	8,282	70	grassed area
	16,403	84	Weighted Average
	8,282		50.49% Pervious Area
	8,121		49.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area



Summary for Subcatchment 4S: Infield Runoff to Swale

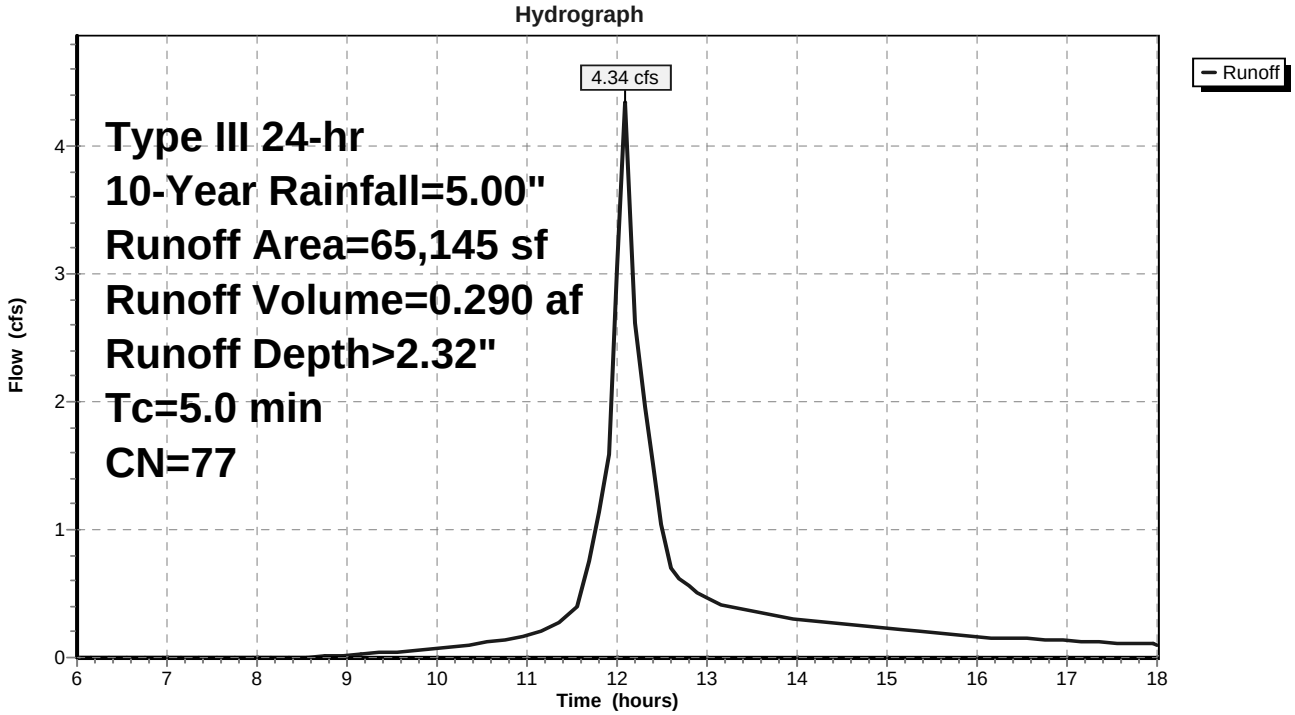
Runoff = 4.34 cfs @ 12.09 hrs, Volume= 0.290 af, Depth> 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	16,453	98	paved areas, buildings
*	48,692	70	grassed aea
	65,145	77	Weighted Average
	48,692		74.74% Pervious Area
	16,453		25.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Infield Runoff to Swale

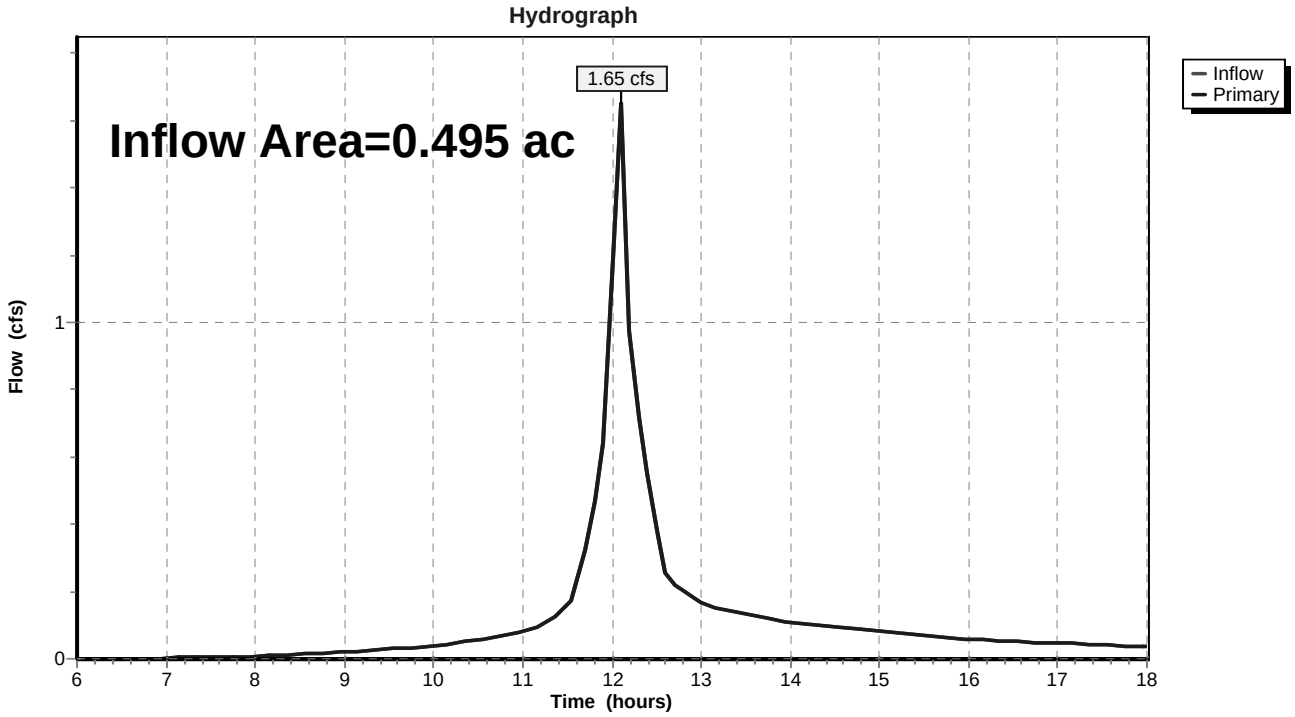


Summary for Pond 5P: Existing Conveyance System

Inflow Area = 0.495 ac, 40.67% Impervious, Inflow Depth > 2.73" for 10-Year event
Inflow = 1.65 cfs @ 12.09 hrs, Volume= 0.113 af
Primary = 1.65 cfs @ 12.09 hrs, Volume= 0.113 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 5P: Existing Conveyance System



Summary for Pond 6P: Grassed Swale

Inflow Area =	1.496 ac, 25.26% Impervious, Inflow Depth > 2.32" for 10-Year event				
Inflow =	4.34 cfs @	12.09 hrs,	Volume=	0.290 af	
Outflow =	2.08 cfs @	12.31 hrs,	Volume=	0.280 af,	Atten= 52%, Lag= 13.1 min
Discarded =	0.59 cfs @	12.31 hrs,	Volume=	0.228 af	
Primary =	1.49 cfs @	12.31 hrs,	Volume=	0.052 af	

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 123.77' @ 12.31 hrs Surf.Area= 0.095 ac Storage= 0.092 af

Plug-Flow detention time= 62.4 min calculated for 0.280 af (97% of inflow)
Center-of-Mass det. time= 53.3 min (828.2 - 774.9)

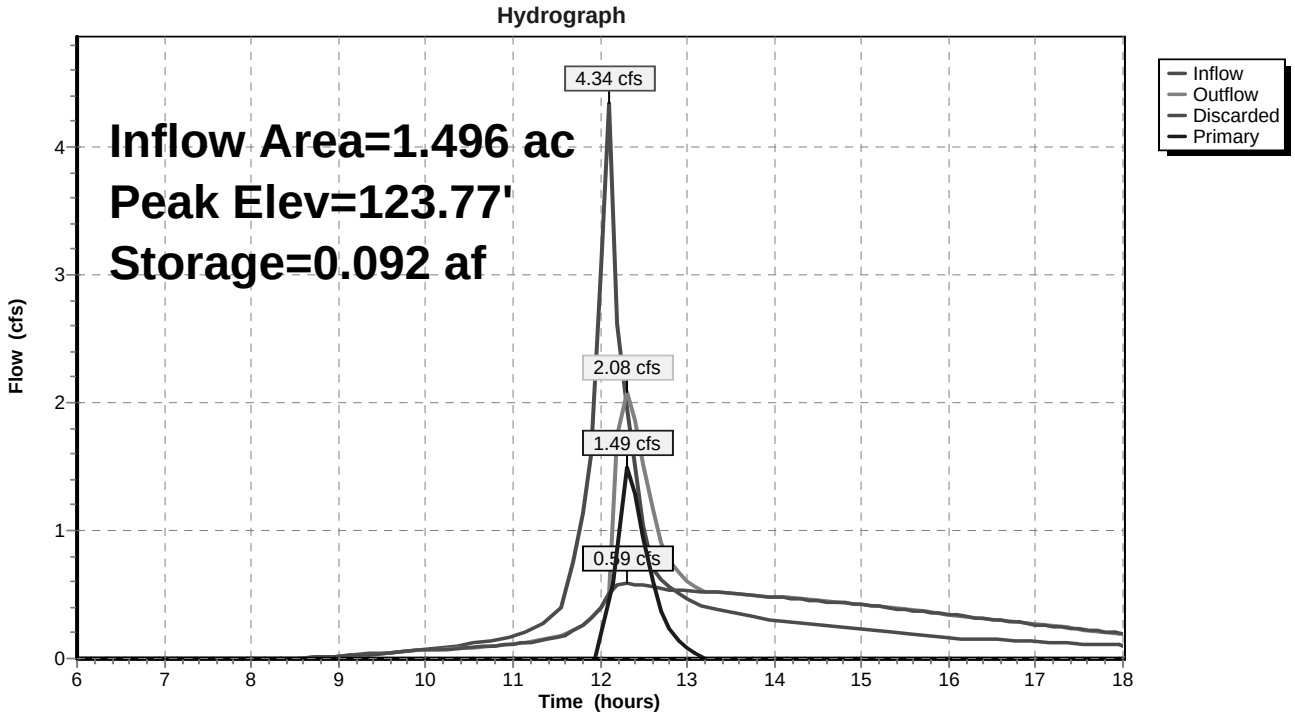
Volume	Invert	Avail.Storage	Storage Description
#1	122.00'	0.115 af	**2.00'W x 240.00'L x 2.00'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	122.00'	**6.000 in/hr Exfiltration over Wetted area**
#2	Primary	123.55'	**5.5' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.59 cfs @ 12.31 hrs HW=123.77' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.59 cfs)

Primary OutFlow Max=1.47 cfs @ 12.31 hrs HW=123.77' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 1.47 cfs @ 1.20 fps)

Pond 6P: Grassed Swale

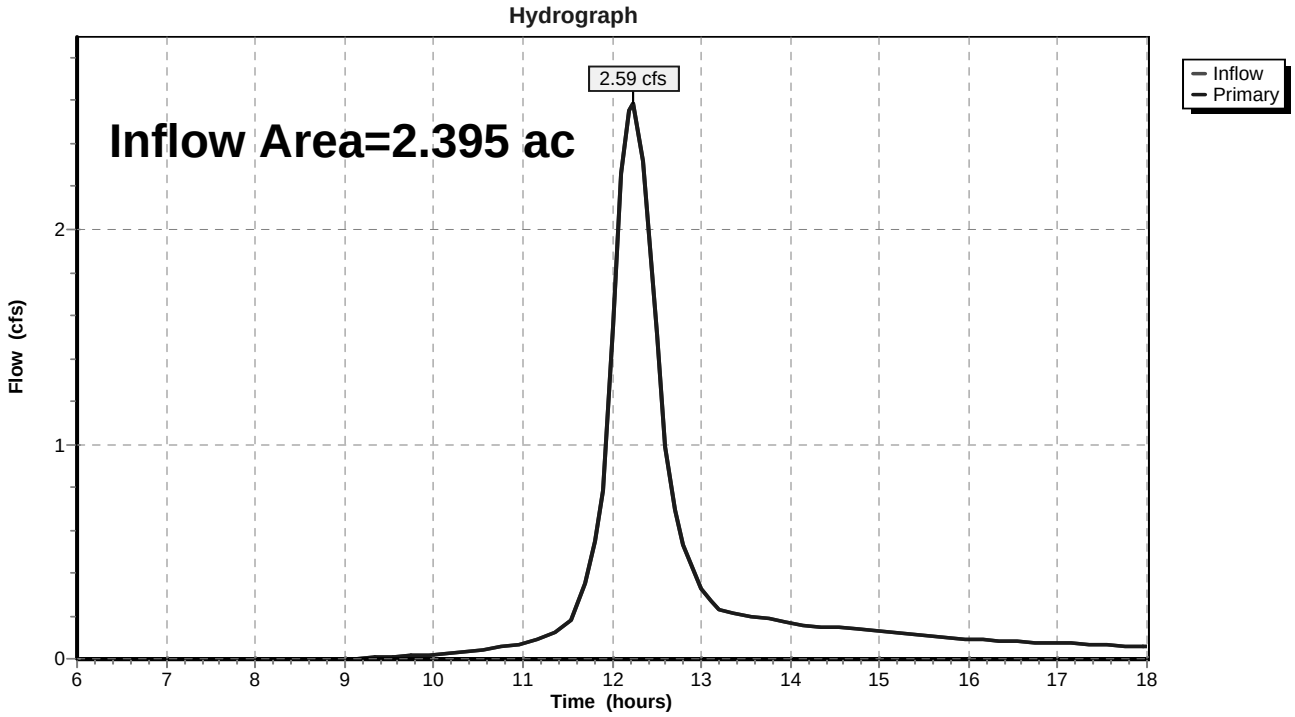


Summary for Pond 7P: Combined Discharge to Wetlands

Inflow Area = 2.395 ac, 19.51% Impervious, Inflow Depth > 1.01" for 10-Year event
Inflow = 2.59 cfs @ 12.24 hrs, Volume= 0.202 af
Primary = 2.59 cfs @ 12.24 hrs, Volume= 0.202 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Combined Discharge to Wetlands



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Wetlands Runoff Area=39,187 sf 9.97% Impervious Runoff Depth>2.96"
Tc=5.0 min CN=73 Runoff=3.32 cfs 0.222 af

Subcatchment 2S: Infield Grassed Area Runoff Area=5,156 sf 12.57% Impervious Runoff Depth>3.05"
Tc=5.0 min CN=74 Runoff=0.45 cfs 0.030 af

Subcatchment 3S: Western Parking Area Runoff Area=16,403 sf 49.51% Impervious Runoff Depth>4.05"
Tc=5.0 min CN=84 Runoff=1.82 cfs 0.127 af

Subcatchment 4S: Infield Runoff to Swale Runoff Area=65,145 sf 25.26% Impervious Runoff Depth>3.34"
Tc=5.0 min CN=77 Runoff=6.17 cfs 0.417 af

Pond 5P: Existing Conveyance System Inflow=2.27 cfs 0.157 af
Primary=2.27 cfs 0.157 af

Pond 6P: Grassed Swale Peak Elev=123.96' Storage=0.110 af Inflow=6.17 cfs 0.417 af
Discarded=0.64 cfs 0.268 af Primary=3.73 cfs 0.130 af Outflow=4.37 cfs 0.399 af

Pond 7P: Combined Discharge to Wetlands Inflow=6.15 cfs 0.352 af
Primary=6.15 cfs 0.352 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.796 af Average Runoff Depth = 3.30"
76.86% Pervious = 2.221 ac 23.14% Impervious = 0.669 ac

Summary for Subcatchment 1S: Runoff to Wetlands

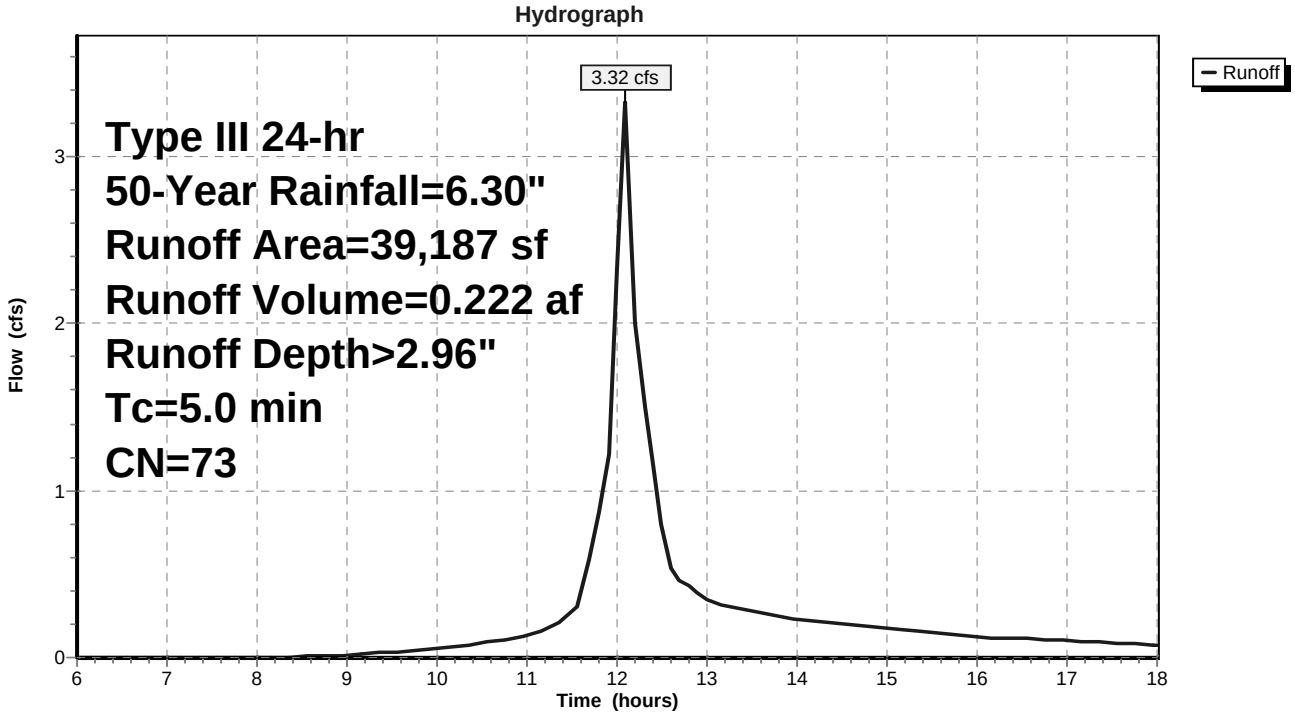
Runoff = 3.32 cfs @ 12.09 hrs, Volume= 0.222 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 50-Year Rainfall=6.30"

	Area (sf)	CN	Description
*	3,906	98	pavement
*	35,281	70	grassed and wooded areas
	39,187	73	Weighted Average
	35,281		90.03% Pervious Area
	3,906		9.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

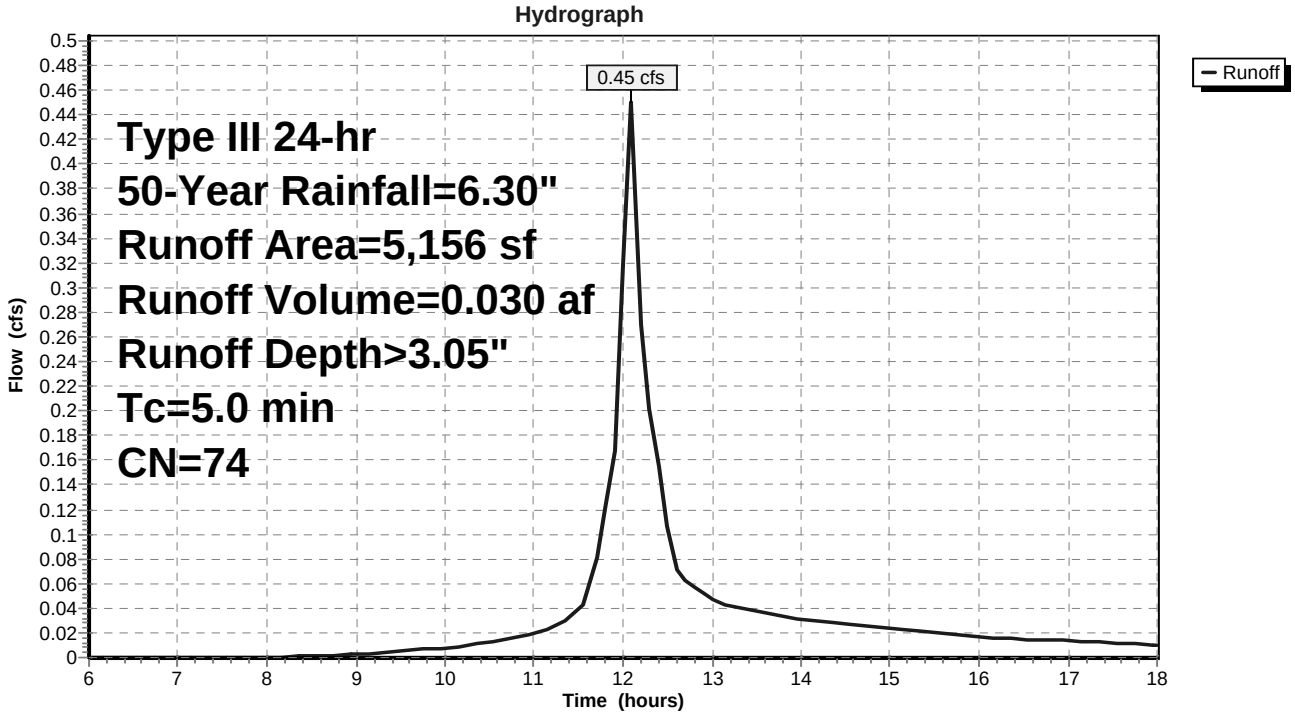
Runoff = 0.45 cfs @ 12.09 hrs, Volume= 0.030 af, Depth> 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 50-Year Rainfall=6.30"

	Area (sf)	CN	Description
*	648	98	paved areas
*	4,508	70	grassed areas
	5,156	74	Weighted Average
	4,508		87.43% Pervious Area
	648		12.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

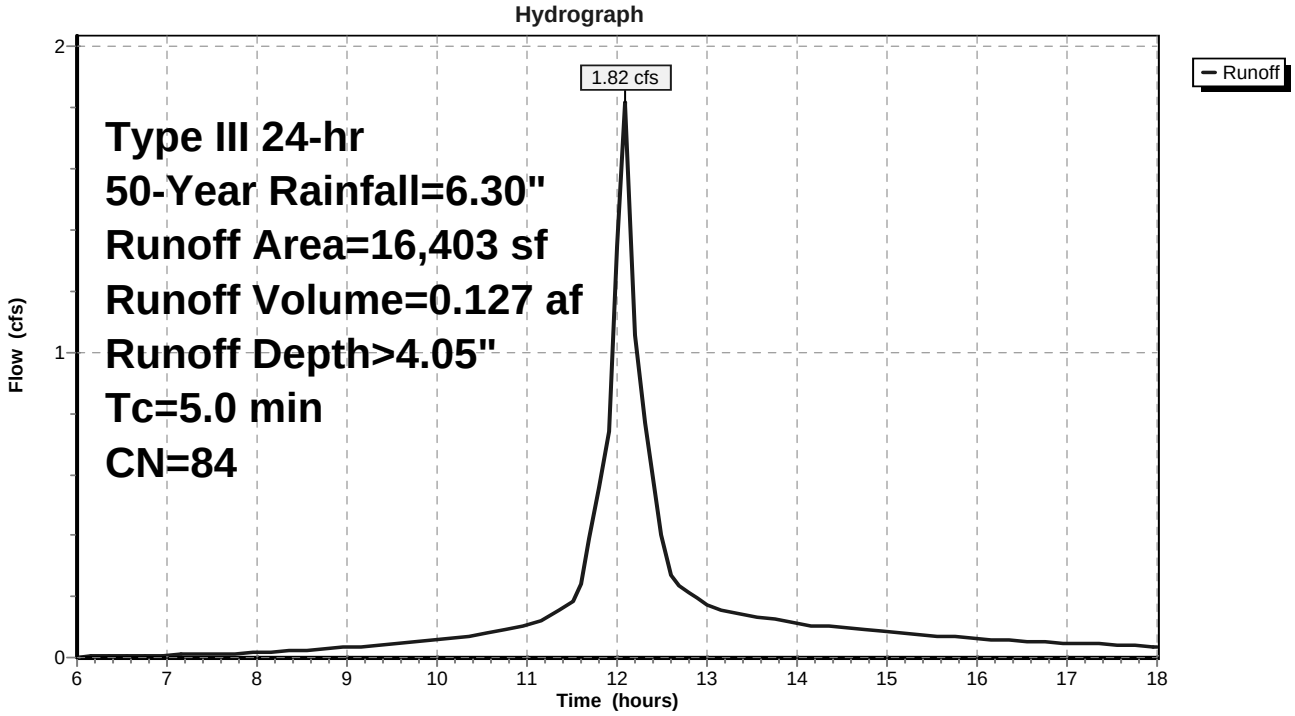
Runoff = 1.82 cfs @ 12.09 hrs, Volume= 0.127 af, Depth> 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 50-Year Rainfall=6.30"

	Area (sf)	CN	Description
*	8,121	98	paved area
*	8,282	70	grassed area
	16,403	84	Weighted Average
	8,282		50.49% Pervious Area
	8,121		49.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area



Summary for Subcatchment 4S: Infield Runoff to Swale

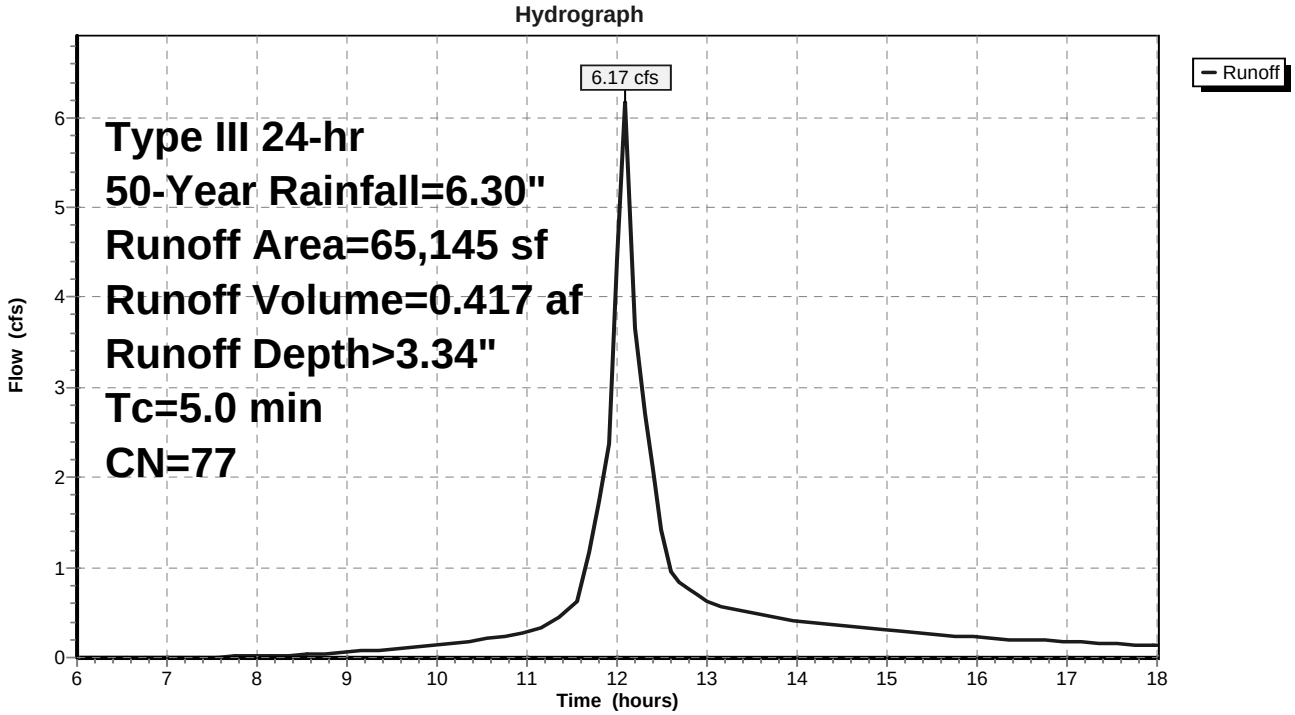
Runoff = 6.17 cfs @ 12.09 hrs, Volume= 0.417 af, Depth> 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 50-Year Rainfall=6.30"

	Area (sf)	CN	Description
*	16,453	98	paved areas, buildings
*	48,692	70	grassed aea
	65,145	77	Weighted Average
	48,692		74.74% Pervious Area
	16,453		25.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Infield Runoff to Swale

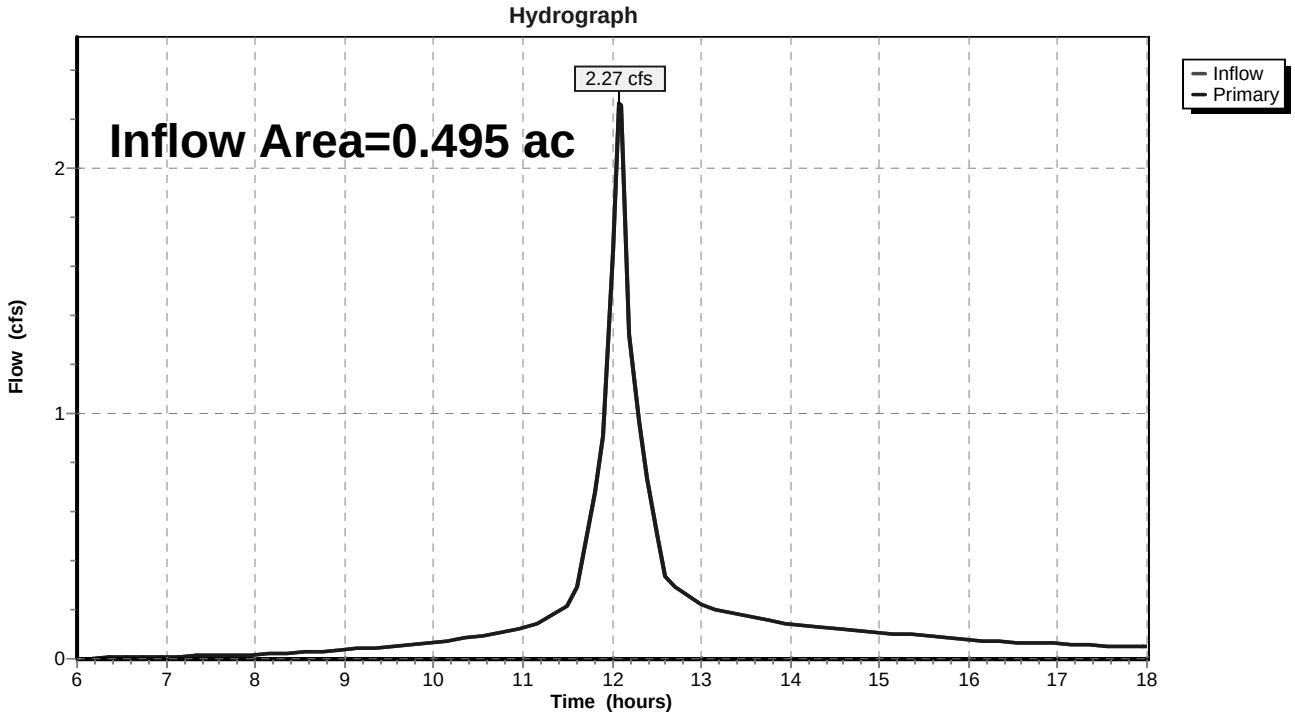


Summary for Pond 5P: Existing Conveyance System

Inflow Area = 0.495 ac, 40.67% Impervious, Inflow Depth > 3.81" for 50-Year event
Inflow = 2.27 cfs @ 12.09 hrs, Volume= 0.157 af
Primary = 2.27 cfs @ 12.09 hrs, Volume= 0.157 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 5P: Existing Conveyance System



Summary for Pond 6P: Grassed Swale

Inflow Area =	1.496 ac, 25.26% Impervious, Inflow Depth > 3.34" for 50-Year event				
Inflow =	6.17 cfs @	12.09 hrs,	Volume=	0.417 af	
Outflow =	4.37 cfs @	12.21 hrs,	Volume=	0.399 af,	Atten= 29%, Lag= 7.2 min
Discarded =	0.64 cfs @	12.21 hrs,	Volume=	0.268 af	
Primary =	3.73 cfs @	12.21 hrs,	Volume=	0.130 af	

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 123.96' @ 12.21 hrs Surf.Area= 0.104 ac Storage= 0.110 af

Plug-Flow detention time= 54.0 min calculated for 0.399 af (96% of inflow)
Center-of-Mass det. time= 41.8 min (809.3 - 767.5)

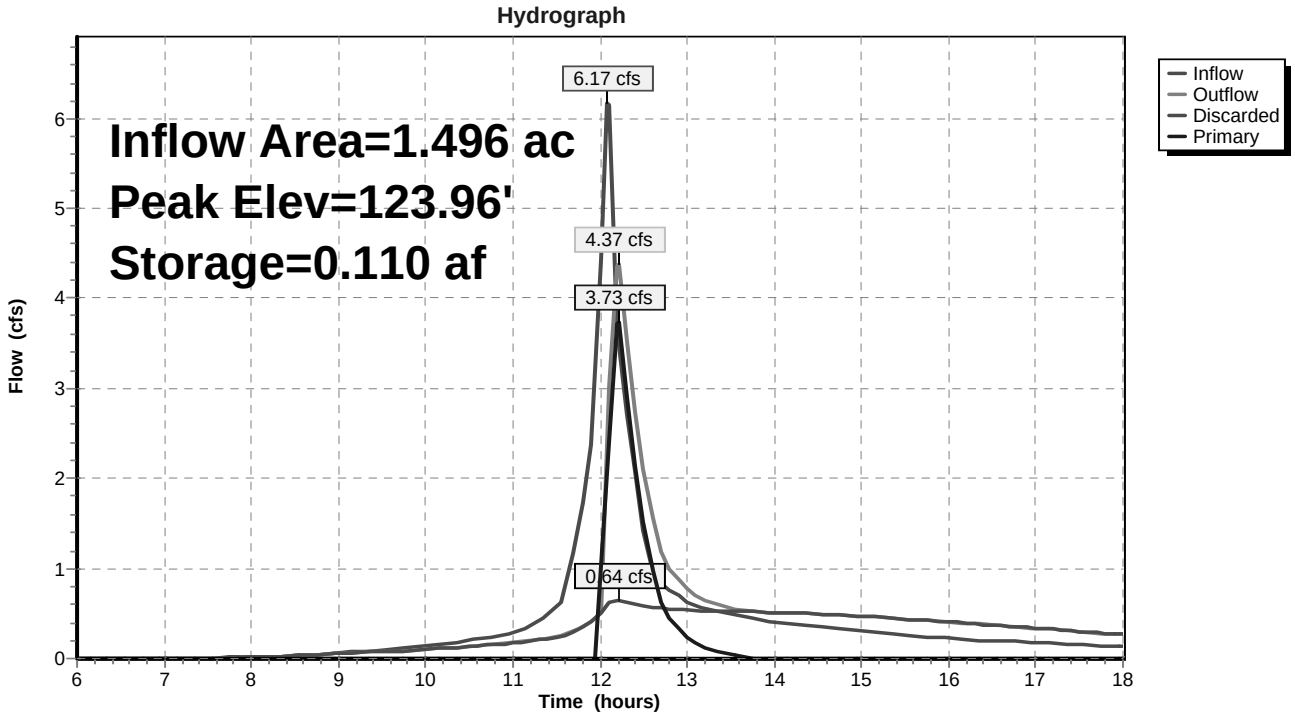
Volume	Invert	Avail.Storage	Storage Description
#1	122.00'	0.115 af	**2.00'W x 240.00'L x 2.00'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	122.00'	**6.000 in/hr Exfiltration over Wetted area**
#2	Primary	123.55'	**5.5' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.64 cfs @ 12.21 hrs HW=123.95' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.64 cfs)

Primary OutFlow Max=3.62 cfs @ 12.21 hrs HW=123.95' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 3.62 cfs @ 1.65 fps)

Pond 6P: Grassed Swale

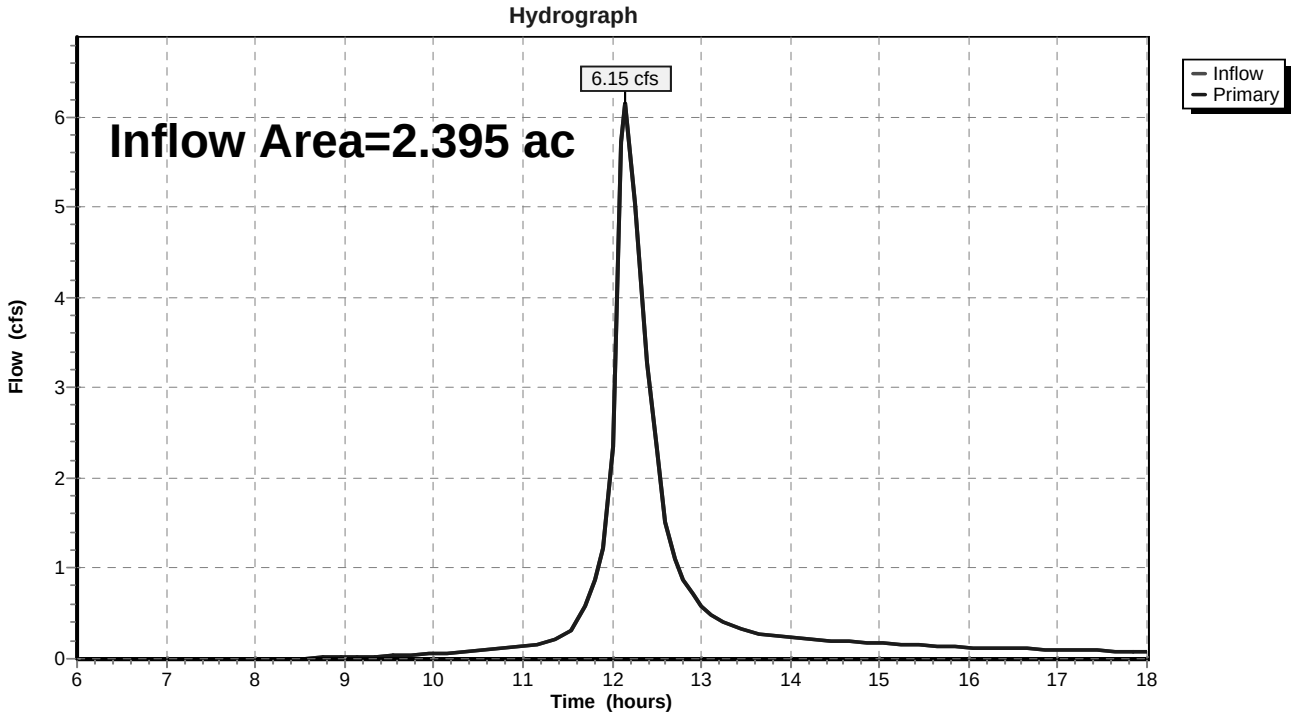


Summary for Pond 7P: Combined Discharge to Wetlands

Inflow Area = 2.395 ac, 19.51% Impervious, Inflow Depth > 1.76" for 50-Year event
Inflow = 6.15 cfs @ 12.15 hrs, Volume= 0.352 af
Primary = 6.15 cfs @ 12.15 hrs, Volume= 0.352 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Combined Discharge to Wetlands



Time span=6.00-18.00 hrs, dt=0.10 hrs, 121 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 1S: Runoff to Wetlands Runoff Area=39,187 sf 9.97% Impervious Runoff Depth>3.58"
Tc=5.0 min CN=73 Runoff=4.00 cfs 0.268 af

Subcatchment 2S: Infield Grassed Area Runoff Area=5,156 sf 12.57% Impervious Runoff Depth>3.68"
Tc=5.0 min CN=74 Runoff=0.54 cfs 0.036 af

Subcatchment 3S: Western Parking Area Runoff Area=16,403 sf 49.51% Impervious Runoff Depth>4.74"
Tc=5.0 min CN=84 Runoff=2.11 cfs 0.149 af

Subcatchment 4S: Infield Runoff to Swale Runoff Area=65,145 sf 25.26% Impervious Runoff Depth>4.00"
Tc=5.0 min CN=77 Runoff=7.31 cfs 0.498 af

Pond 5P: Existing Conveyance System Inflow=2.65 cfs 0.185 af
Primary=2.65 cfs 0.185 af

Pond 6P: Grassed Swale Peak Elev=124.10' Storage=0.115 af Inflow=7.31 cfs 0.498 af
Discarded=0.66 cfs 0.290 af Primary=5.78 cfs 0.184 af Outflow=6.44 cfs 0.474 af

Pond 7P: Combined Discharge to Wetlands Inflow=8.54 cfs 0.453 af
Primary=8.54 cfs 0.453 af

Total Runoff Area = 2.890 ac Runoff Volume = 0.951 af Average Runoff Depth = 3.95"
76.86% Pervious = 2.221 ac 23.14% Impervious = 0.669 ac

Summary for Subcatchment 1S: Runoff to Wetlands

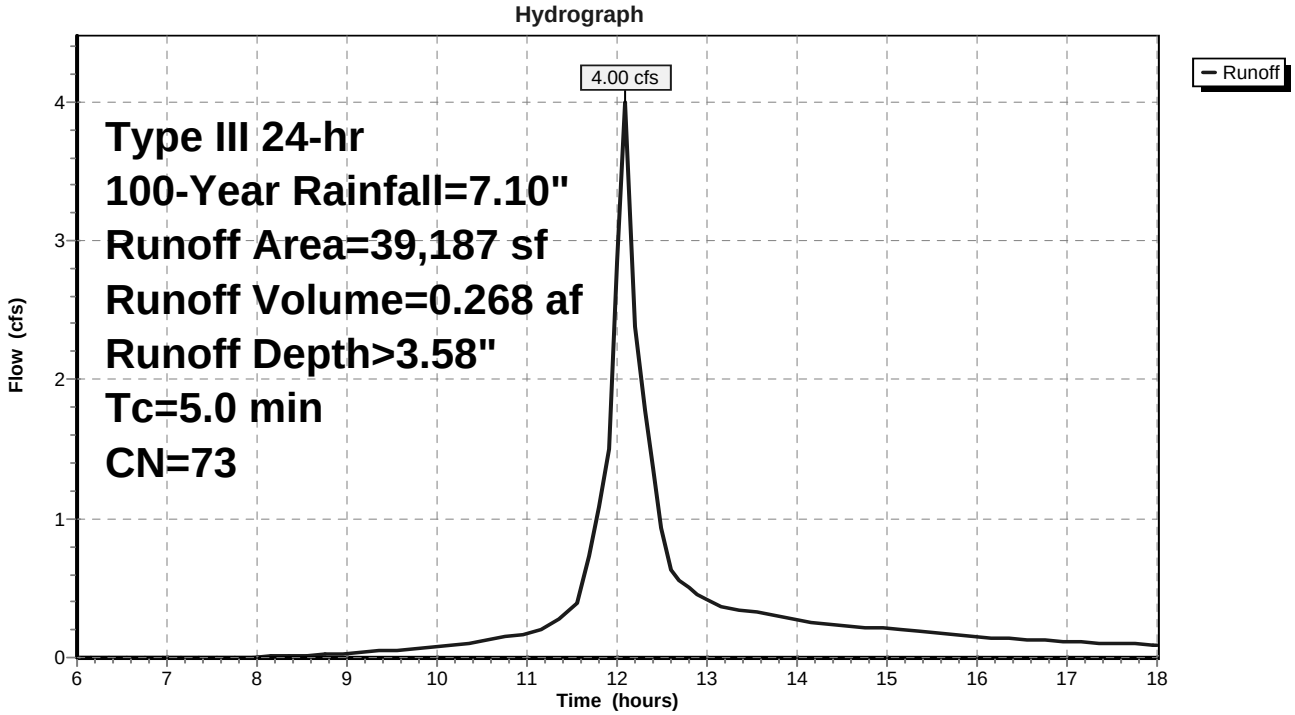
Runoff = 4.00 cfs @ 12.09 hrs, Volume= 0.268 af, Depth> 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	3,906	98	pavement
*	35,281	70	grassed and wooded areas
	39,187	73	Weighted Average
	35,281		90.03% Pervious Area
	3,906		9.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Runoff to Wetlands



Summary for Subcatchment 2S: Infield Grassed Area

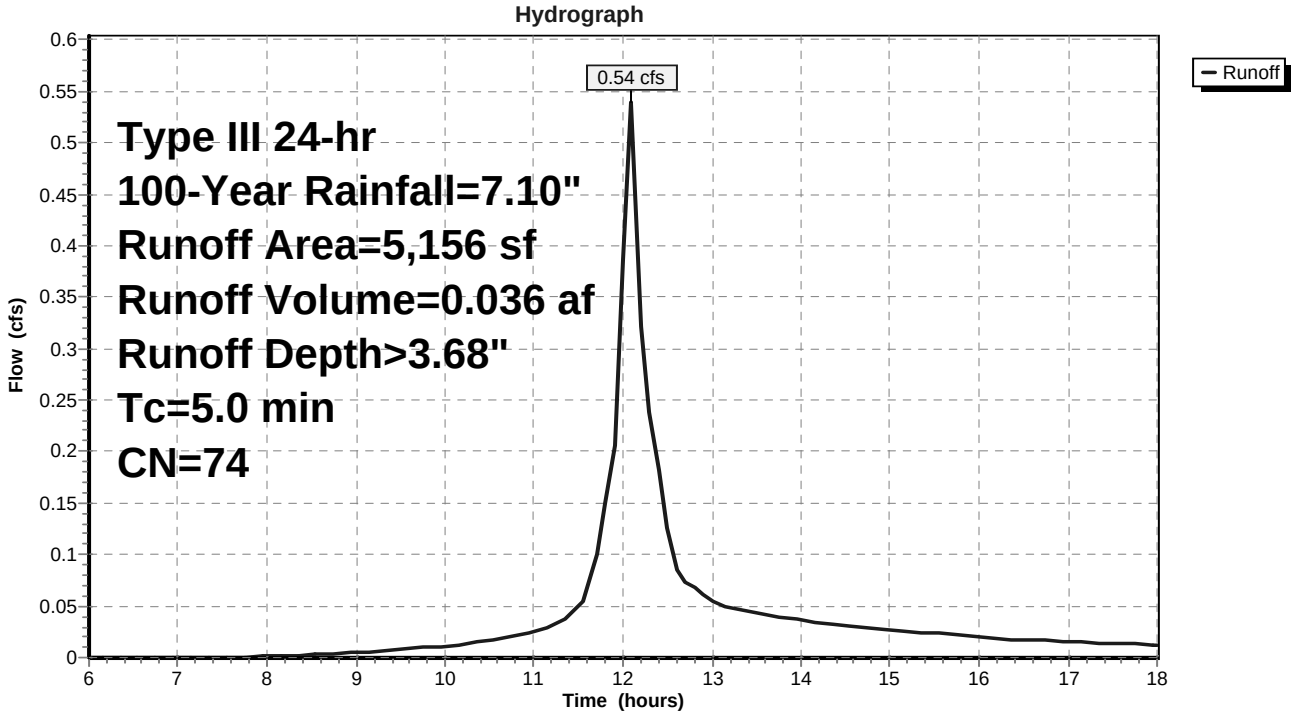
Runoff = 0.54 cfs @ 12.09 hrs, Volume= 0.036 af, Depth> 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	648	98	paved areas
*	4,508	70	grassed areas
	5,156	74	Weighted Average
	4,508		87.43% Pervious Area
	648		12.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Infield Grassed Area



Summary for Subcatchment 3S: Western Parking Area

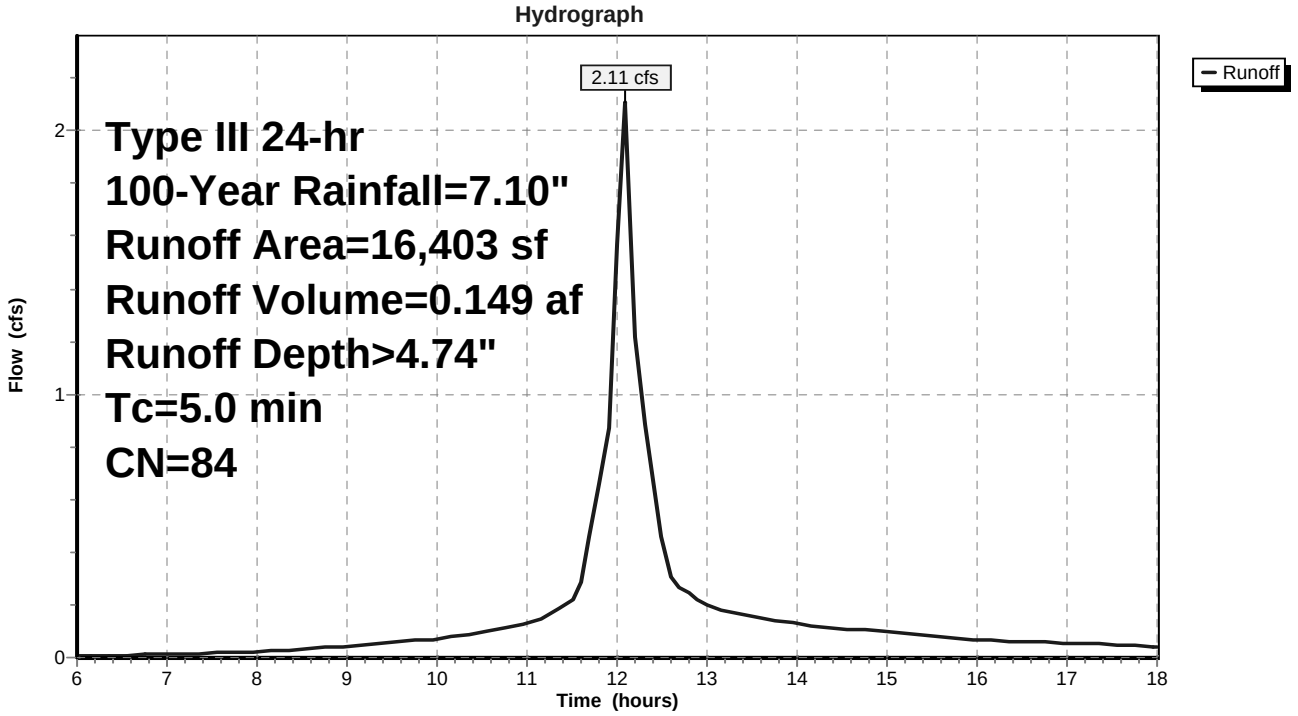
Runoff = 2.11 cfs @ 12.09 hrs, Volume= 0.149 af, Depth> 4.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	8,121	98	paved area
*	8,282	70	grassed area
	16,403	84	Weighted Average
	8,282		50.49% Pervious Area
	8,121		49.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Western Parking Area



Summary for Subcatchment 4S: Infield Runoff to Swale

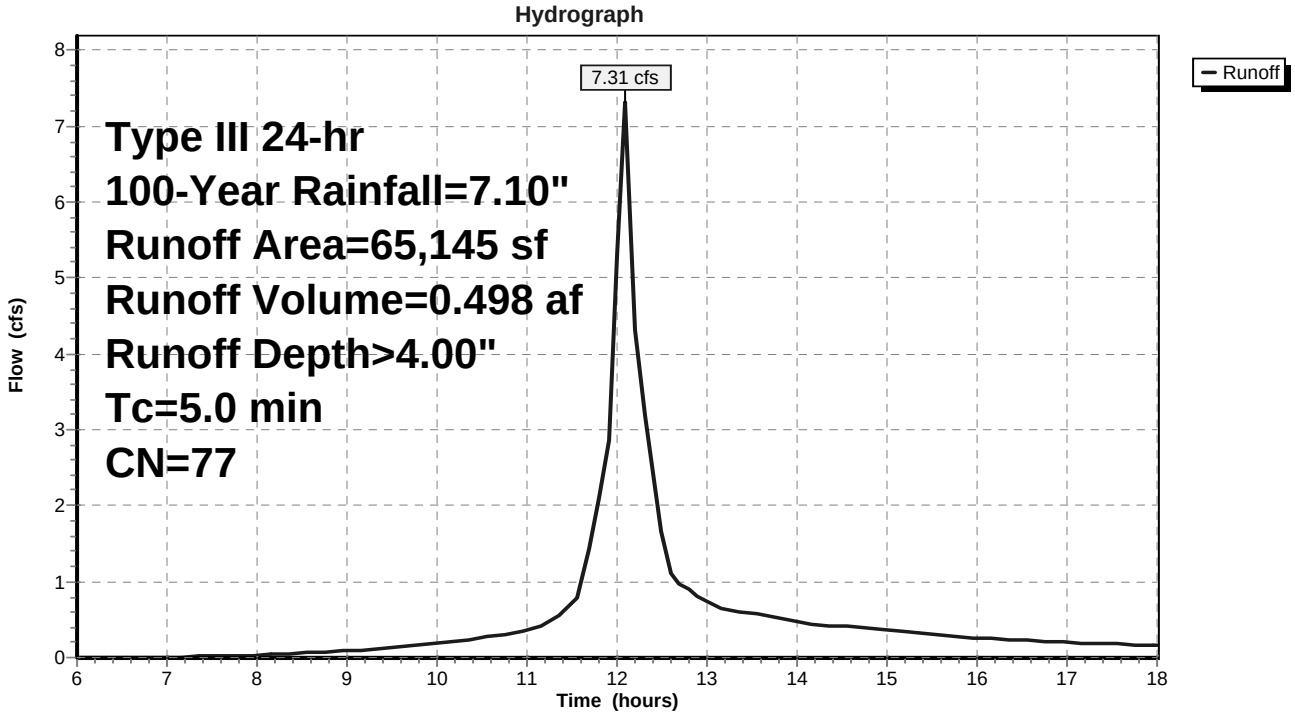
Runoff = 7.31 cfs @ 12.09 hrs, Volume= 0.498 af, Depth> 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	16,453	98	paved areas, buildings
*	48,692	70	grassed aea
	65,145	77	Weighted Average
	48,692		74.74% Pervious Area
	16,453		25.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Infield Runoff to Swale

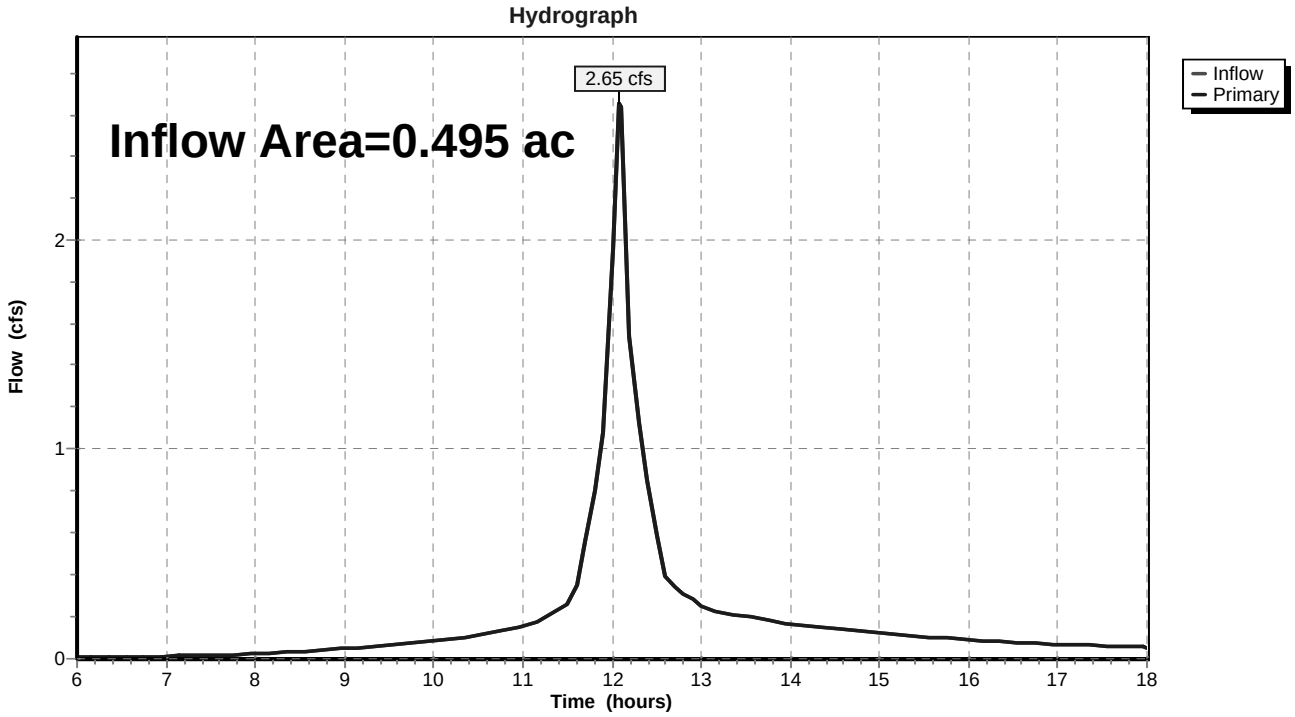


Summary for Pond 5P: Existing Conveyance System

Inflow Area = 0.495 ac, 40.67% Impervious, Inflow Depth > 4.49" for 100-Year event
Inflow = 2.65 cfs @ 12.09 hrs, Volume= 0.185 af
Primary = 2.65 cfs @ 12.09 hrs, Volume= 0.185 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 5P: Existing Conveyance System



Summary for Pond 6P: Grassed Swale

Inflow Area =	1.496 ac, 25.26% Impervious, Inflow Depth > 4.00" for 100-Year event				
Inflow =	7.31 cfs @	12.09 hrs,	Volume=	0.498 af	
Outflow =	6.44 cfs @	12.19 hrs,	Volume=	0.474 af,	Atten= 12%, Lag= 5.8 min
Discarded =	0.66 cfs @	12.17 hrs,	Volume=	0.290 af	
Primary =	5.78 cfs @	12.19 hrs,	Volume=	0.184 af	

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs
Peak Elev= 124.10' @ 12.19 hrs Surf.Area= 0.106 ac Storage= 0.115 af

Plug-Flow detention time= 49.9 min calculated for 0.474 af (95% of inflow)
Center-of-Mass det. time= 36.4 min (800.2 - 763.8)

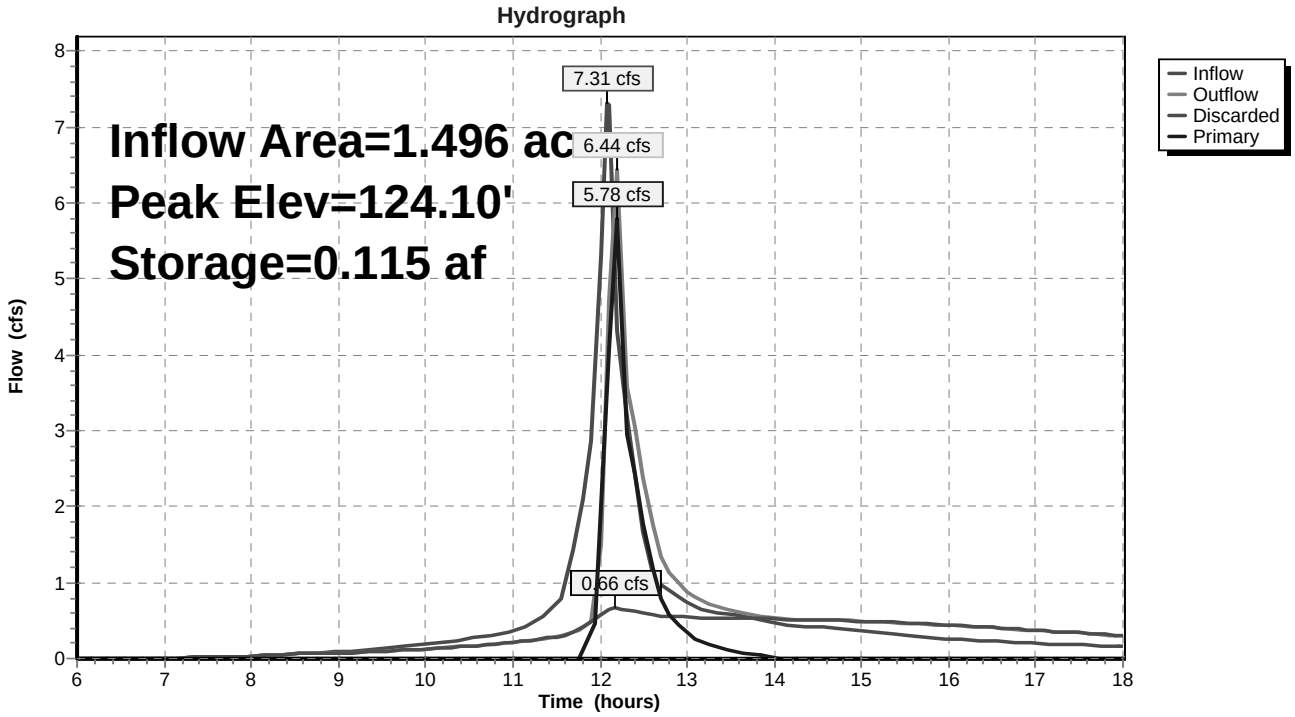
Volume	Invert	Avail.Storage	Storage Description
#1	122.00'	0.115 af	**2.00'W x 240.00'L x 2.00'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	122.00'	**6.000 in/hr Exfiltration over Wetted area**
#2	Primary	123.55'	**5.5' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.66 cfs @ 12.17 hrs HW=124.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.66 cfs)

Primary OutFlow Max=5.53 cfs @ 12.19 hrs HW=124.08' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 5.53 cfs @ 1.90 fps)

Pond 6P: Grassed Swale

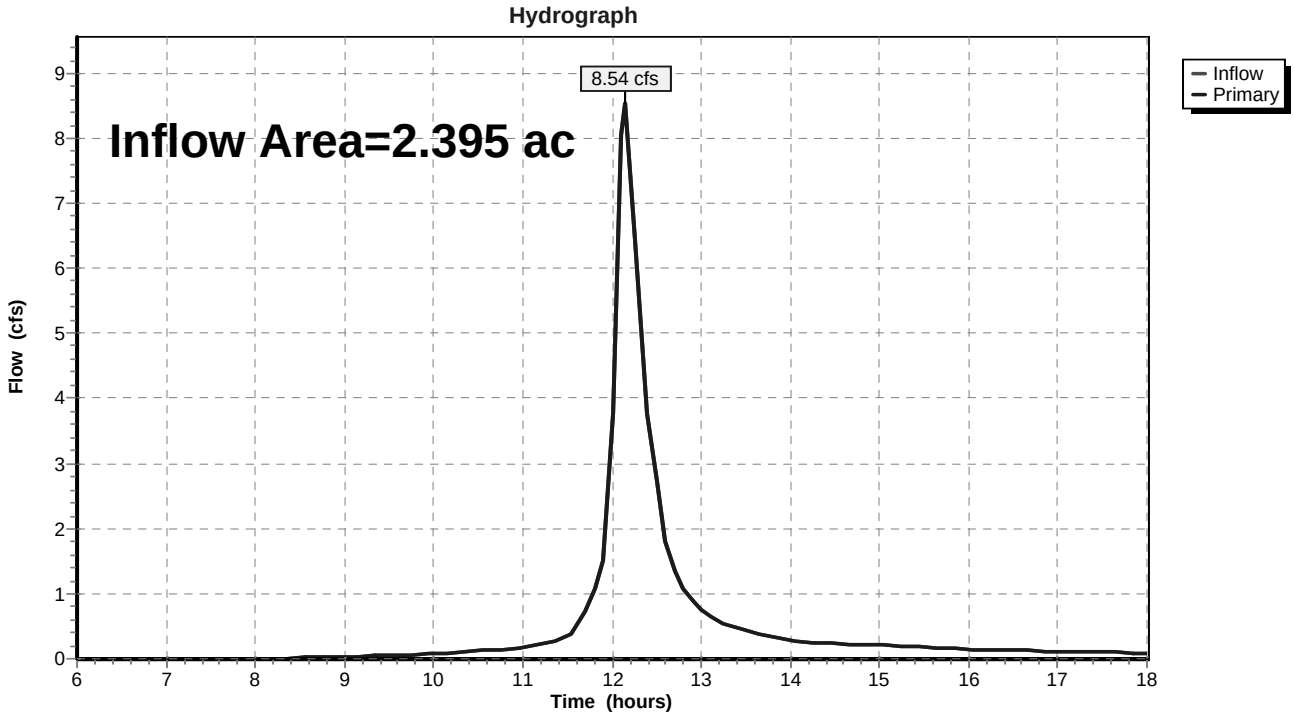


Summary for Pond 7P: Combined Discharge to Wetlands

Inflow Area = 2.395 ac, 19.51% Impervious, Inflow Depth > 2.27" for 100-Year event
Inflow = 8.54 cfs @ 12.15 hrs, Volume= 0.453 af
Primary = 8.54 cfs @ 12.15 hrs, Volume= 0.453 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 6.00-18.00 hrs, dt= 0.10 hrs

Pond 7P: Combined Discharge to Wetlands



Attachment E

Permanent BMP Calculations

S.O. No.

Subject: SPECTRA AIM PROJECT
CROMWELL, CT
WQV calcs

Sheet No. of

Drawing No.

Computed by PMB Checked By Date 8/15/14

Baker

WATER QUALITY CALCS

$$WQV = \frac{P \times R_v \times A}{12}$$

$P = 1.0''$

$R_v = 0.05 + 0.009I$

$I = \%\ \text{impervious} = \frac{16453}{61171} = 0.27 = 27\%$

$R_v = 0.05 + (0.009 \times 27)$

$= 0.293$

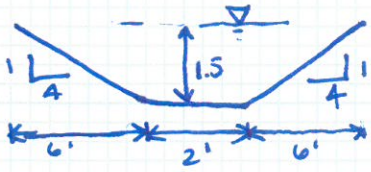
$A = 1.40$ Acres

$$WQV = \frac{1.0\text{ in} \times 0.293 \times 1.40\text{ acres}}{12\text{ in/ft}}$$

$= 0.0342$ acre · ft

$= 1489\ ft^3$

Grassed Swale Dimensions = 240' long x 2' bottom x 1.5' storage



X sect Area = $\frac{1.5' \times 6'}{2} + \frac{1.5' \times 6'}{2} + 1.5' \times 2' = 12\ ft^2$

Storage Volume below Outlet = $12\ ft^2 \times 240\ ft$

$\boxed{= 2880\ ft^3 > 1489\ ft^3}$

Attachment F

Custom Soil Resource Report

Hydrologic Soil Group—State of Connecticut
(Basic Systems_Cromwell, CT)

Map Scale: 1:2,540 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: State of Connecticut
Survey Area Data: Version 11, Nov 19, 2013

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

Date(s) aerial images were photographed: Mar 28, 2011—May 12, 2011

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — State of Connecticut (CT600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
13	Walpole sandy loam	D	0.2	1.0%
15	Scarboro muck	D	0.4	2.6%
23A	Sudbury sandy loam, 0 to 5 percent slopes	B	1.6	9.9%
33A	Hartford sandy loam, 0 to 3 percent slopes	B	0.9	5.9%
33B	Hartford sandy loam, 3 to 8 percent slopes	B	2.3	14.1%
306	Udorthents-Urban land complex	B	10.6	66.4%
Totals for Area of Interest			**16.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Attachment G

Erosion and Sediment Control Plan

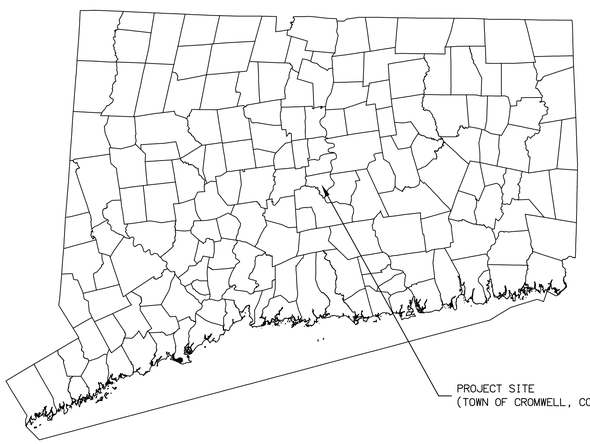
SPECTRA ENERGY COMPRESSOR STATION
EROSION AND SEDIMENT CONTROL PLAN

TOWN OF CROMWELL, MIDDLESEX COUNTY
CONNECTICUT
FOR

BASIC SYSTEMS, INC.

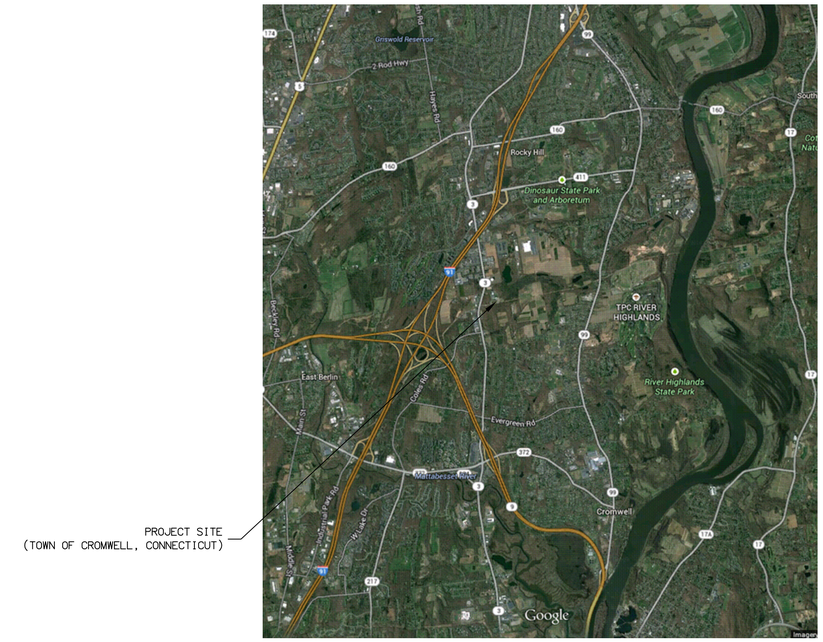
SHEET	REVISION	DATE	TITLE
1	--	JANUARY 2015	TITLE SHEET
2	--	JANUARY 2015	PROJECT OVERVIEW
3	--	JANUARY 2015	COMPRESSOR STATION
4	--	JANUARY 2015	PROJECT DETAILS
5	--	JANUARY 2015	PROJECT DETAILS

OWNER/OPERATOR: ALGONQUIN GAS TRANSMISSION, LLC



VICINITY MAP

NOT TO SCALE



LOCATION MAP

NOT TO SCALE

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500 ENTERPRISE DRIVE, SUITE 2B
ROCKY HILL, CT 06067

Michael Baker INTERNATIONAL

SPECTRA ENERGY COMPRESSOR STATION
CROMWELL, CONNECTICUT

TITLE SHEET
TOWN OF CROMWELL
MIDDLESEX COUNTY, CONNECTICUT

SCALE:
DATE: JANUARY 2015

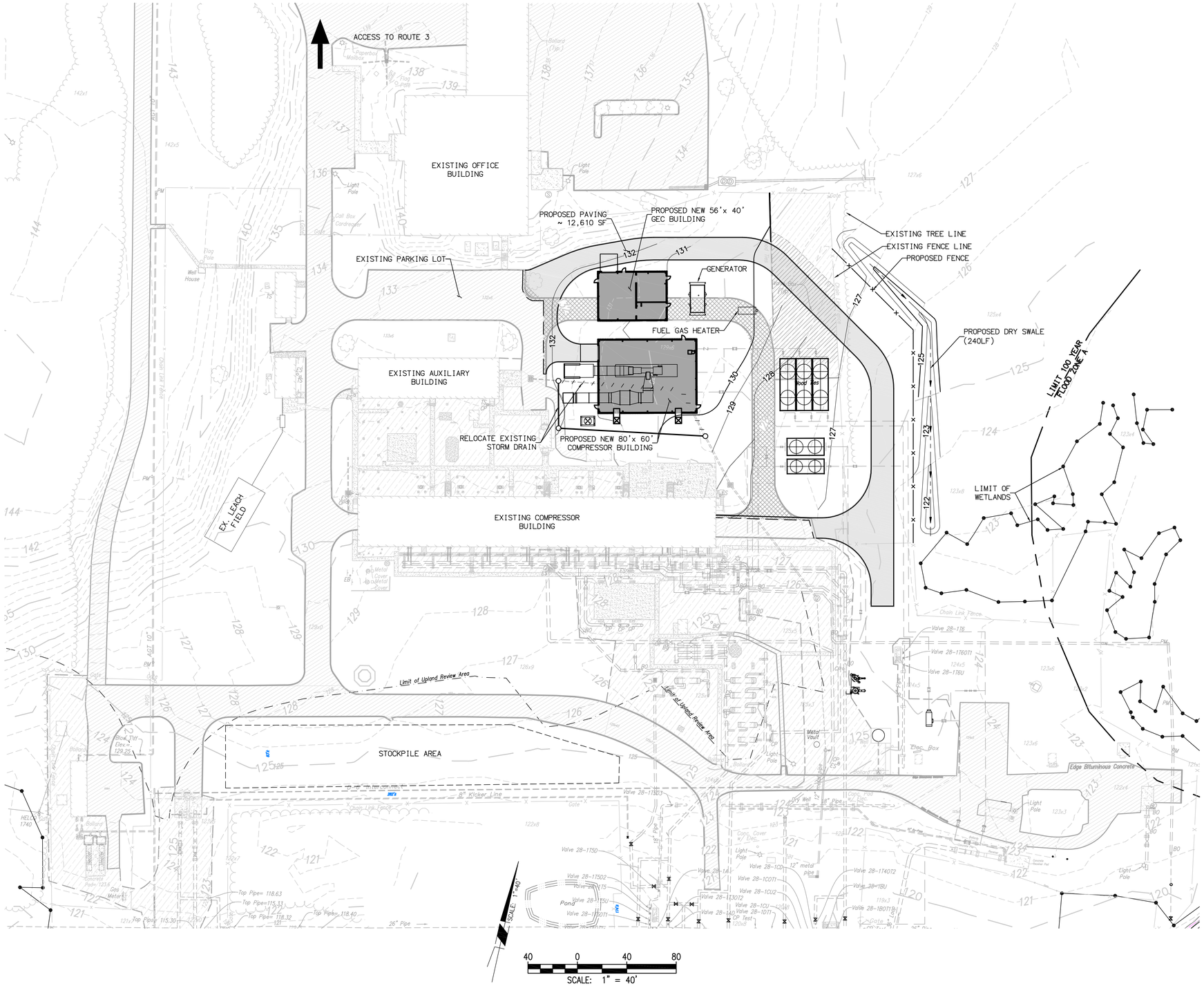
SHEET NO.
C-1
Sheet 1 of 5

NOTES:

1. SITE SPECIFIC SURVEY PERFORMED BY LRC AND PROVIDED BY BASIC SYSTEMS. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE ACCURACY.
2. DISCREPANCIES FOUND IN THE PROJECT MAPPING MUST BE REPORTED TO THE PROJECT ENGINEER/OWNER.
3. THIS DRAWING REPRESENTS THE RECOMMENDED EROSION AND SEDIMENTATION CONTROL BMPs BASED ON THE PROJECT MAPPING. THE TYPE AND LOCATION OF THESE BMPs SHOULD BE REVISED BASED ON ACTUAL FIELD CONDITIONS AND PERFORMANCE IN ACCORDANCE WITH THE DETAILS PRESENTED HEREIN AND LOCAL, STATE AND FEDERAL REQUIREMENTS INCLUDING THE CTDEEP EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.
4. LOCATIONS OF EXISTING UTILITIES ARE BASED ON THE BEST AVAILABLE INFORMATION. NO GUARANTEE OR ASSURANCE IS GIVEN BY THE OWNER OR ENGINEER AS TO THEIR ACCURACY, COMPLETENESS OR VALIDITY. CONTRACT TO PERFORM 'DIG', COORDINATE WITH UTILITY COMPANIES AND LOCATED AND IDENTIFY ALL UTILITIES PRIOR TO CONSTRUCTION.
5. ALL ROADWAY, SHOULDER, DRIVEWAY AND FENCE DISTURBANCE SHALL BE REMEDIED AND REPLACED IN KIND.
6. CONTRACTOR IS RESPONSIBLE FOR ADHERING TO ALL OSHA SAFETY REGULATIONS DURING CONSTRUCTION.
7. ACCESS TO THE CONSTRUCTION SITE SHALL BE FROM THE ROCK CONSTRUCTION ENTRANCES INDICATED.

LEGEND

- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING FENCE
- WETLANDS
- EXISTING BUILDING
- EXISTING IMPERVIOUS (PAVED) SURFACE
- EXISTING GRAVEL SURFACE
- EXISTING CONCRETE SURFACE
- PROPOSED IMPERVIOUS SURFACE
- REMOVE EXISTING PAVEMENT
- REMOVE EXISTING GRAVEL
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR



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Michael Baker INTERNATIONAL

SPECTRA ENERGY COMPRESSOR STATION
CROMWELL, CONNECTICUT

PROJECT OVERVIEW
TOWN OF CROMWELL
MIDDLESEX COUNTY, CONNECTICUT

SCALE:
DATE: JANUARY 2015

SHEET NO.
C-2
Sheet 2 of 5

NOTES:

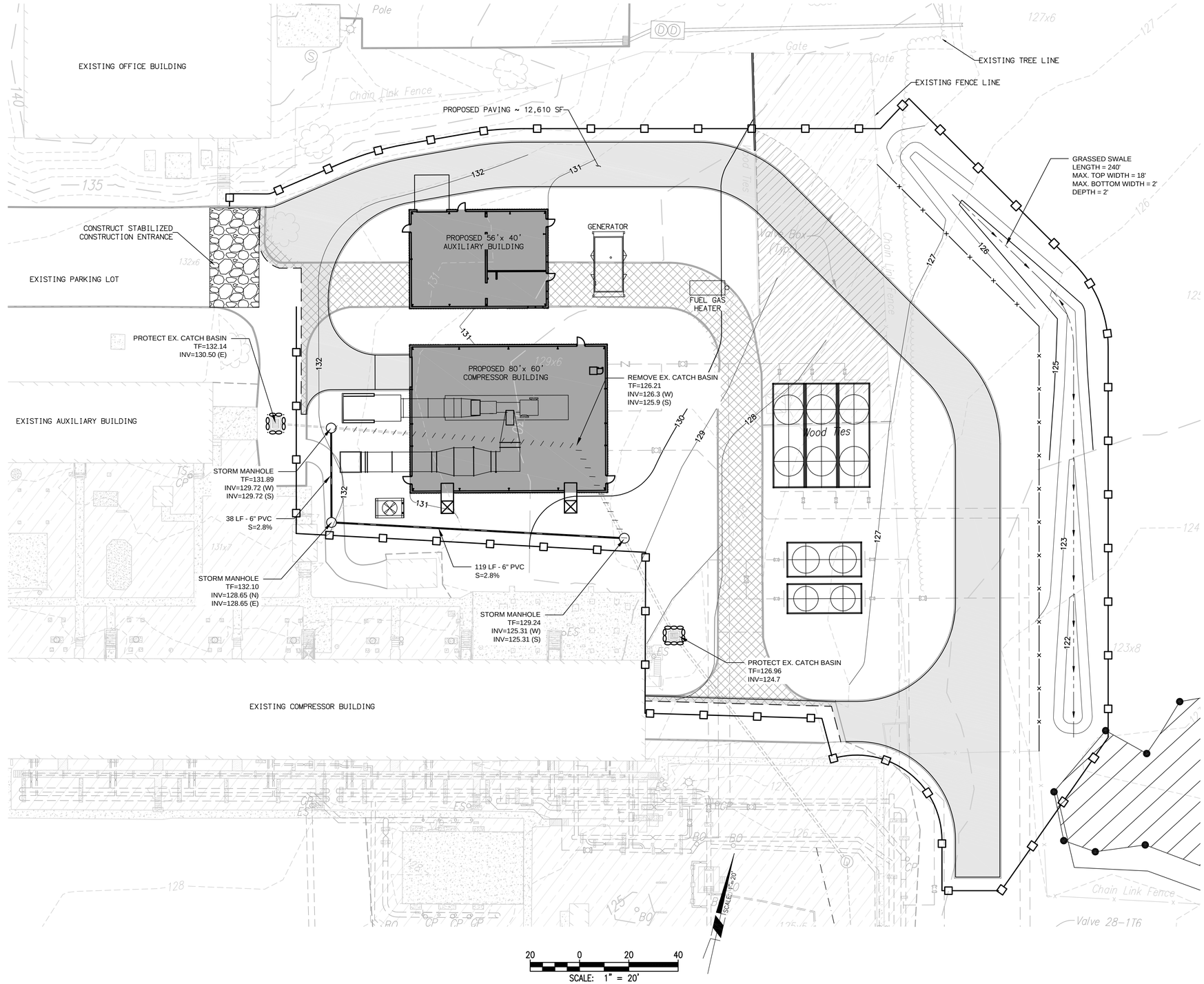
1. SITE SPECIFIC SURVEY PERFORMED BY LRC AND PROVIDED BY BASIC SYSTEMS. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE ACCURACY.
2. DISCREPANCIES FOUND IN THE PROJECT MAPPING MUST BE REPORTED TO THE PROJECT ENGINEER/OWNER.
3. THIS DRAWING REPRESENTS THE RECOMMENDED EROSION AND SEDIMENTATION CONTROL BMPs BASED ON THE PROJECT MAPPING. THE TYPE AND LOCATION OF THESE BMPs SHOULD BE REVISED BASED ON ACTUAL FIELD CONDITIONS AND PERFORMANCE IN ACCORDANCE WITH THE DETAILS PRESENTED HEREIN AND LOCAL, STATE AND FEDERAL REQUIREMENTS INCLUDING THE CTDEEP EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.
4. LOCATIONS OF EXISTING UTILITIES ARE BASED ON THE BEST AVAILABLE INFORMATION. NO GUARANTEE OR ASSURANCE IS GIVEN BY THE OWNER OR ENGINEER AS TO THEIR ACCURACY, COMPLETENESS OR VALIDITY. CONTRACT TO PERFORM 'DIG', COORDINATE WITH UTILITY COMPANIES AND LOCATED AND IDENTIFY ALL UTILITIES PRIOR TO CONSTRUCTION.
5. ALL ROADWAY, SHOULDER, DRIVEWAY AND FENCE DISTURBANCE SHALL BE REMEDIED AND REPLACED IN KIND.
6. CONTRACTOR IS RESPONSIBLE FOR ADHERING TO ALL OSHA SAFETY REGULATIONS DURING CONSTRUCTION.
7. ACCESS TO THE CONSTRUCTION SITE SHALL BE FROM THE ROCK CONSTRUCTION ENTRANCES INDICATED.

LEGEND

- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING FENCE
- WETLANDS
- REMOVE EXISTING PAVEMENT
- REMOVE EXISTING GRAVEL
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- INLET PROTECTION
- STABILIZED CONSTRUCTION ENTRANCE
- SILT FENCE (PERIMETER CONTROL)

CONSTRUCTION SEQUENCE:

1. INSTALL PERIMETER EROSION AND SEDIMENT CONTROLS FOR COMPRESSOR STATION.
2. INSTALL ROCK CONSTRUCTION ENTRANCE WITH WASHOUT RACK AND FILTER SOCK RING.
3. CONSTRUCT COMPRESSOR STATION AND AUXILIARY BUILDING.
4. INSTALL PAVED PARKING AREA AND ACCESS ROAD.
5. UNDER GUIDANCE OF LICENSED PROFESSIONAL OR DESIGNEE, INSTALL VEGETATED SWALE.
6. SCARIFY, SEED, MULCH AND FERTILIZE DISTURBED AREAS.
7. REMOVE EROSION AND SEDIMENT CONTROLS ONCE SITE HAS STABILIZED (70% GROWTH) AND HAS BEEN INSPECTED BY THE CONSERVATION DISTRICT AND THE INFILTRATION BASIN/VEGETATED SWALES HAVE BEEN INSPECTED BY A LICENSED PROFESSIONAL OR DESIGNEE IN ACCORDANCE WITH THE MAINTENANCE SCHEDULE DESCRIBED IN THE POST CONSTRUCTION STORMWATER MANAGEMENT PLAN.



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CROMWELL, CONNECTICUT

COMPRESSOR STATION
TOWN OF CROMWELL
MIDDLESEX COUNTY, CONNECTICUT

SCALE:

DATE: JANUARY 2015

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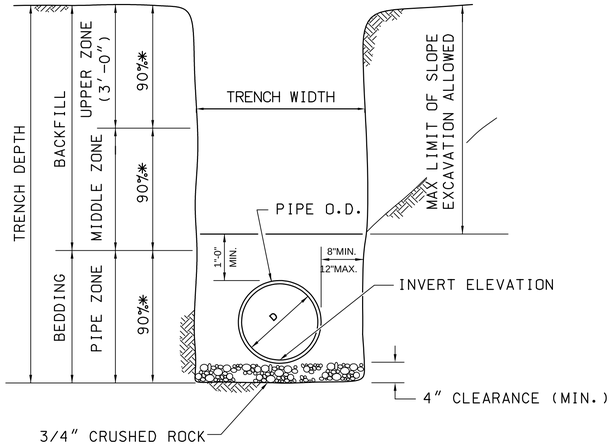
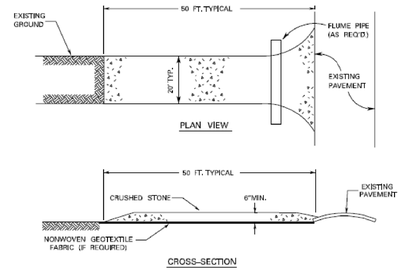


SECTION

NOTE:
1. (*) INDICATES MINIMUM RELATIVE COMPACTION.

PIPE BEDDING AND TRENCH BACKFILL FOR STORM DRAINS

NOT TO SCALE

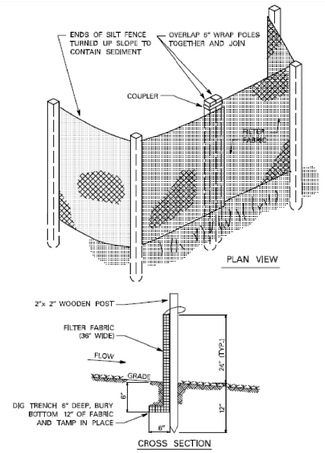


CONSTRUCTION SPECIFICATIONS:

1. STONE SIZE = 4" – 8" (AVG.) CRUSHED STONE
2. ALL STONE MUST BE PLACED ON NON-WOVEN GEOTEXILE FABRIC IF USED IN RESIDENTIAL OR ACTIVE AGRICULTURAL AREAS.
3. LENGTH = FIFTY (50) FOOT TYPICAL (IF SITE CONDITIONS ALLOW)
4. WIDTH = TWENTY (20) FOOT TYPICAL.
5. THICKNESS = SIX (6) INCHES MINIMUM.
6. ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A DRIVEABLE BERM OR OTHER TEMPORARY EROSION CONTROL DEVICE CAN BE USED.
7. THE ENTRANCE SHALL BE PERIODICALLY INSPECTED AND MAINTAINED IN A CONDITION THAT MINIMIZES TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. MAINTENANCE MAY INCLUDE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR THE REPAIR / CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ANY SEDIMENT THAT IS SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED AS SOON AS PRACTICAL.

ROCK ACCESS PAD INSTALLATION AND MAINTENANCE

FIGURE #5 — DWG. ES-0005 — REV.



INSTALLATION REQUIREMENTS:

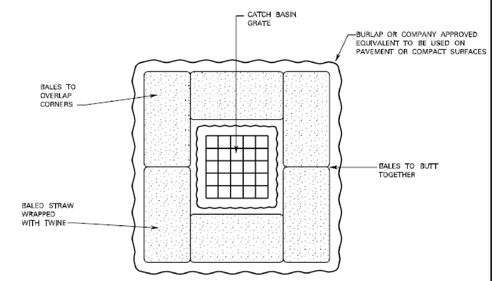
- WHEN USING SILT FENCE, PLACE IT:
  - BETWEEN DISTURBED AREAS AND DOWN-SLOPE ENVIRONMENTAL RESOURCE AREAS
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES
  - APPROXIMATELY 6 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT
- USE SANDBAGS OR BACKFILLING TO KEY IN THE BOTTOM OF THE FABRIC WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE ROOTS, ETC.)

MAINTENANCE REQUIREMENTS:

- INSPECT SILT FENCE:
  - DAILY IN AREAS OF ACTIVE CONSTRUCTION
  - WEEKLY IN AREAS WITH NO CONSTRUCTION
  - WITHIN 24 HOURS FOLLOWING EACH MAJOR STORM EVENT
- REPAIR OR REPLACE SILT FENCE AS NEEDED
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA AS NEEDED

SILT FENCE INSTALLATION AND MAINTENANCE

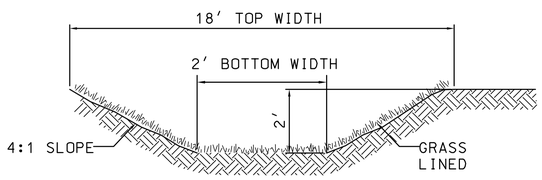
FIGURE #7 — DWG. ES-0007 — REV.



1. SURROUND STREET DRAINAGE STRUCTURE INLET WITH BALES PRIOR TO CONSTRUCTION AND MAINTAIN UNTIL CONSTRUCTION IS COMPLETED.
2. FOR BALES PLACED ON PAVEMENT (OR COMPACT SURFACES), PLACE BURLAP OR COMPANY APPROVED EQUIVALENT BETWEEN PAVEMENT AND BALE.
3. REMOVE ACCUMULATED SEDIMENT.

STORM DRAIN INLET PROTECTION

FIGURE #10 — DWG. ES-0010 — REV.



GRASSED SWALE

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SPECTRA ENERGY COMPRESSOR STATION
CROMWELL, CONNECTICUT

PROJECT DETAILS
TOWN OF CROMWELL
MIDDLESEX COUNTY, CONNECTICUT

SCALE:
DATE: JANUARY 2015

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C-4
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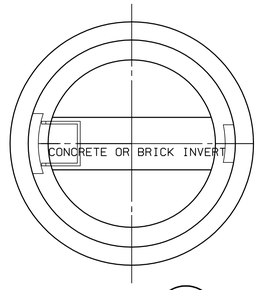
GENERAL NOTES:

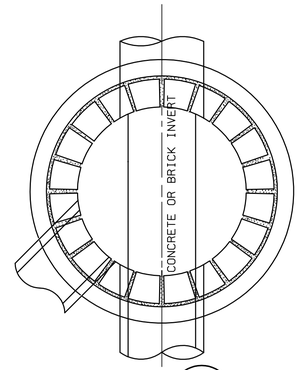
1. CHANNELS MAY BE SHAPED IN CONCRETE BASE OF MANHOLE OR FORMED USING BRICK OR MASONRY.
2. A FRAME DIAMETER OF 3'-3" (991) WITH 4" (102) FLANGE MUST BE USED WHEN THE TOP DIAMETER OF THE PRECAST CONE IS LESS THAN 3'-6" (1067). ALL OTHER FRAME DIMENSIONS SHALL REMAIN THE SAME.
3. COVER:

	CAST IRON	STEEL
MIN. COVER WEIGHT	134LB.(61KG)	134LB.(61KG)

4. ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES.



SECTION A



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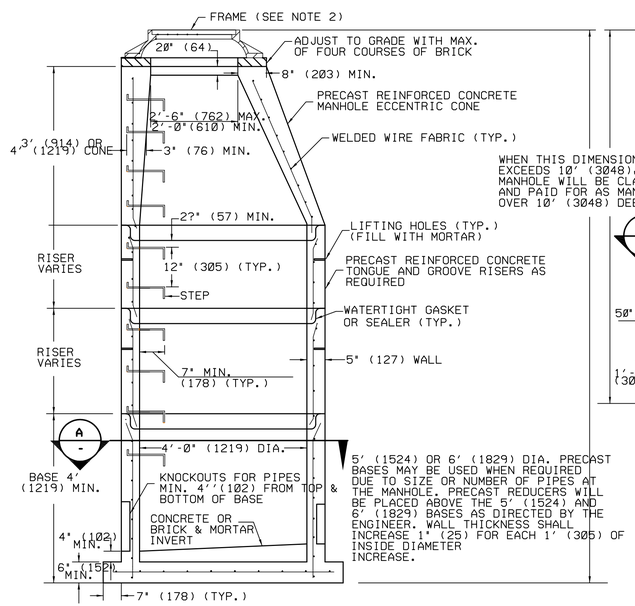
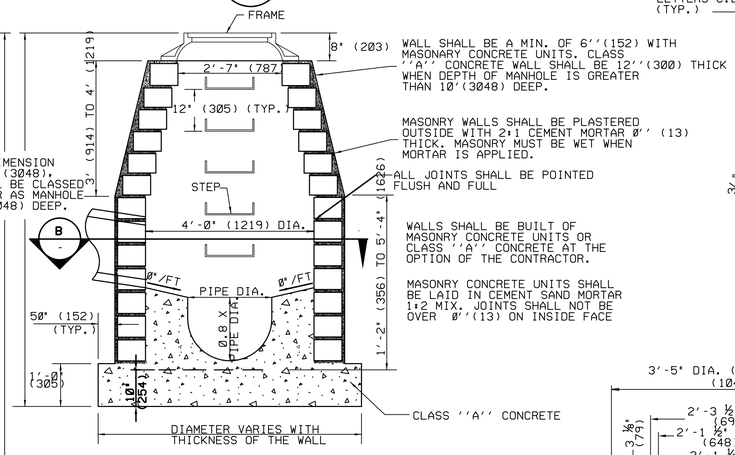


ELEVATION

MANHOLE

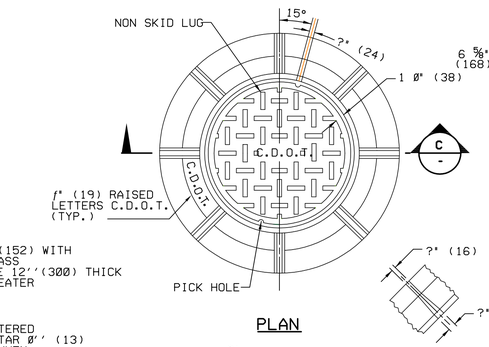
REINFORCED PRECAST CONCRETE UNIT



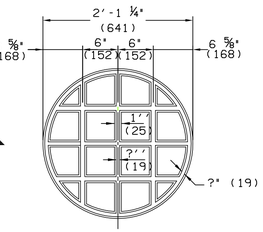
ELEVATION

MANHOLE

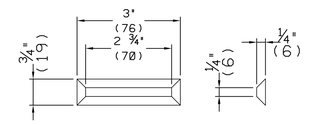
MASONARY CONCRETE UNIT OR CLASS "A" CONCRETE



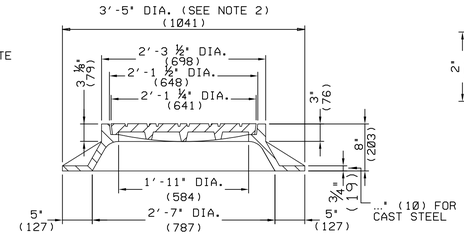
PLAN



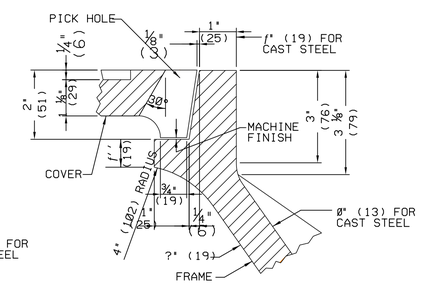
UNDERSIDE OF COVER DETAIL



NON SKID LUG DETAIL



SECTION C



DETAIL OF SEAT

FRAME AND COVER DETAILS

STORM MANHOLE

NOT TO SCALE

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CROMWELL, CONNECTICUT

PROJECT DETAILS
TOWN OF CROMWELL
MIDDLESEX COUNTY, CONNECTICUT

SCALE:

DATE: JANUARY 2015

SHEET NO.

C-5

Sheet 5 of 5

APPENDIX H

DUST CONTROL PLAN

Algonquin Gas Transmission, LLC

ALGONQUIN INCREMENTAL MARKET PROJECT

Dust Control Plan

September 2014

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 RESPONSIBILITY 1

3.0 DUST EMISSIONS AND CONTROL MEASURES 1

3.1 Control Measures 2

4.0 DUST CONTROL INSPECTION AND COMPLIANCE 2

5.0 RECORDKEEPING AND MONITORING 2

1.0 INTRODUCTION

Algonquin Gas Transmission, LLC ("Algonquin") has developed this Dust Control Plan for the Algonquin Incremental Market Project ("AIM Project" or "Project"). The purpose of the Dust Control Plan is to identify potential sources of fugitive dust emissions that may occur during construction of the AIM Project and describe dust abatement measures to be implemented by Algonquin and its contractor(s) to control and suppress dust. Measures identified in this Dust Control Plan apply to work within the Project area defined as the construction right-of-way ("ROW"), access roads, additional temporary workspace ("ATWS"), and other areas used during construction of the AIM Project.

Algonquin's inspection personnel and its contractor(s) will be thoroughly familiar with this Dust Control Plan and its contents prior to initiating construction on the AIM Project.

2.0 RESPONSIBILITY

The contractor(s) will furnish, operate and maintain equipment, and employ methods to prevent migration of dust beyond the boundaries of the work site. The contractor(s) will provide a copy of the Dust Control Plan to all applicable site subcontractors. The contractor's construction manager will be responsible for implementing the Dust Control Plan, and maintaining the daily log of implemented control measures.

3.0 DUST EMISSIONS AND CONTROL MEASURES

Construction activities coupled with certain weather conditions can create conditions that promote the production and dispersal of fugitive dust from a construction area. The amount of dust generated is a function of construction activities, soil type, moisture content, wind speed, frequency of precipitation, vehicle traffic, vehicle types, and roadway characteristics. During certain weather conditions, several construction activities could generate dust.

The contractor will implement measures to reduce dust generation and employ practices to prevent excessive fugitive dust emissions (e.g., visible dust clouds). No dust control measures are generally required during precipitation events. Dust control measures are required especially during warm dry weather and those days with strong winds. A source of clean, potable water must be made available to wet down exposed soil surfaces. Dust control measures include but are not limited to:

<u>Unpaved areas and access roads</u>

- Apply water when needed;
- Control track-out;
- Maintain appropriate low vehicle speeds (5 miles per hour) in unpaved areas;
- Route vehicles and equipment to covered surfaces (e.g., paved or graveled) when possible;
- Prevent motor vehicle use when unnecessary in unpaved areas; and
- Remove soil from the exteriors of vehicles and construction equipment prior to moving off of the right-of-way and other work sites.

<u>Soil excavation and handling</u>

- Load haul trucks such that the load is below the freeboard;
- Cover loads as necessary;
- Prevent spillage;
- Apply water when needed prior to disturbance and during disturbance to prevent dust generation;

- Maintain existing ground coverings (e.g., existing pavement) until disturbance is required for construction and stabilize exposed soil with gravel or other stabilizing material, if dust generation is observed that cannot be controlled with water; and
- Discontinue construction activities if generation of dust is observed until dust control is applied.

3.1 Control Measures

Dust control will be implemented by Algonquin and its contractor(s) in areas of active construction. The primary means of dust control for the AIM Project will be vehicle and equipment speed control and the use of graveled construction entrances (rock access pads). If these measures do not effectively mitigate excessive dust migration, wet suppression through the application of water using water trucks will be employed. No surface water sources are proposed to be used as a water source. Water will be obtained from municipal sources (hydrant) from locations to be determined along the Project. The application and quantity of water to be used for dust suppression will be commensurate with field conditions during construction. Any required state and local approvals will be acquired as needed to withdraw water from municipal sources. Water spray will be regulated to avoid water pooling and the generation of mud that could be tracked onto paved roadways.

Vehicular speed will be reduced for all vehicles and equipment travelling along the construction ROW. The vehicular speed limit for the AIM Project construction area will be five miles per hour. In addition, construction gravel pad entrances will be installed at the interfaces of the ROW and each paved road intersection which will reduce the tracking of mud and soil onto the paved roadway. Excessive mud and soil tracked onto the roadway will be cleaned up by the Contractor. All cargo areas of open bodied haul trucks will be securely covered during material transport on public roadways.

In the event that fugitive dust is generated from spoil piles, wet suppression will be implemented. In addition, topsoil piles may be temporarily mulched and/or temporarily seeded in accordance with Algonquin's Erosion & Sediment Control Plan ("E&SCP"). Additionally, spoil piles may be temporarily mulched and/or temporarily seeded to prevent excessive dust migration. Once construction is completed, all areas of disturbance will be restored to preconstruction condition and permanently seeded and mulched in accordance with Algonquin's E&SCP to revegetate and stabilize the ROW.

4.0 DUST CONTROL INSPECTION AND COMPLIANCE

Field inspection and the need to implement dust control measures for the construction area will be assessed daily by the contractor(s) and all inspection staff members working in that construction area. The dust control assessment will be based on several criteria including 1) the present and forecasted weather conditions, 2) the condition of previous problem areas, and 3) an assessment of existing soil conditions along the construction ROW. The contractor(s) will be responsible for implementing the appropriate measure(s). Algonquin's Environmental Inspector will have the authority to determine if/when water or a palliative needs to be used for dust control if the contractor is not meeting the intent of this Plan. If the contractor(s) does not comply with the recommended dust control measures, any one of Algonquin's inspection staff is authorized to stop work until the contractor implements proper dust control measures.

5.0 RECORDKEEPING AND MONITORING

For the entire construction area on the West Roxbury Lateral and also along the AIM Project construction area located within 200 feet of a receptor such as a residence, school, church, or business, Algonquin will utilize dedicated inspectors to monitor dust levels. These inspectors will keep a daily written log

recording the actual application or implementation of the control measures delineated in this Dust Control Plan.

Dust monitoring will be performed using real-time monitoring equipment. The particulate monitoring equipment will be capable of measuring dust particulates that have an aerodynamic diameter less than or equal to 10 microns in size or respirable dust. The monitoring equipment will be equipped with an audible alarm to indicate exceedance of the action level. The air monitoring equipment will be inspected at least once every 30 minutes and measurements will be recorded manually in a project log book by the Inspector. At the end of each work day, the Inspector will download the particulate data and review and compare the data to action levels to verify proper controls were in place throughout the work day. Each calibration event, any equipment malfunctions, unusual conditions, air monitoring station locations, and any exceedances of action levels and countermeasures implemented will be recorded in the log book. The Inspector will maintain at the site at all times one (1) spare particulate meter in fully operational condition, available for immediate service.