TOWN OF BELLINGHAM, MA

FEBRUARY 2025

Stormwater Management Plan

21796

Hartford Ave Water Treatment Plant PFAS Upgrades

WRIGHT-PIERCE
Engineering a Better Environment

Hartford Ave Water Treatment Plant PFAS Upgrades

Town of Bellingham, MA

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Section 1 Introduction

The subject of this analysis is the proposed Hartford Avenue Water Treatment Plant (HAWTP) PFAS Upgrades. HAWTP is located on land owned by the Town about a half mile northwest off Hartford Ave in Bellingham, MA. HAWTP is accessible via an unnamed paved road owned by the Town that begins between 330 and 334 Hartford Ave.

The proposed improvements include the construction of a stand-alone 8,160 square foot PFAS treatment facility and accompanying piping as an addition to the existing water treatment plant on site. The proposed site design for the HAWTP and PFAS treatment facility includes approximately 21,100 square feet of new paved area comprised of driveway, parking area, and walkways. Additionally, there will be two new concrete pads to support a propane tank and generator, which will total approximately 530 square feet of disconnected impervious area. Various stormwater improvements will be completed on site to manage runoff from the existing and new impervious areas. The site grading is designed so stormwater will flow away from the buildings and be captured via swales for conveyance into a sand filter bed for stormwater treatment.

Additionally, approximately 500 feet to the east of the HAWTP there are four existing lagoons utilized for managing residuals waste generated from the water treatment process. Flows containing residuals waste from the water treatment process are piped to the lagoons for settling and treatment. These lagoons will be improved as part of the project and will also be utilized by the new PFAS treatment facility.

1.1 Stormwater Management Plan Approach

This Stormwater Management Plan (SWMP) was prepared in accordance with the Massachusetts Stormwater Management Manual and the Massachusetts Department of Environmental Protection's (DEP) Stormwater Checklist, which has been included in Appendix A. The following sections will address each stormwater standard to document compliance of the proposed project.

1.2 Organization of the SWMP

This SWMP was prepared to comply with the requirements for the ten stormwater Standards as outlined in the Massachusetts Stormwater Handbook. This information is presented herein under the following report format:

Table 1-1 Report Format

MADEP Standard	Report Section	Description
1	2	No New Untreated Discharges
2	3	Peak Rate Attenuation
3	4	Recharge
4	5	Water Quality
5	6	Land Uses with Higher Potential Pollutant Loads
6	7	Critical Areas
7	8	Re-Development and Other Projects
8	9	Pollution Prevention & Erosion/Sedimentation Control Plan
9	10	Operation/Maintenance Plan
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Section 2 No New Untreated Discharges

2.1 Existing Conditions

The existing site is primarily wooded except for the existing HAWTP building, its paved driveway/parking, buried utilities, and surface level utility features. These surface level features include three generators, one of which is not in service, three propane tanks and a transformer sited along the west edge of the facility. The existing buried site utilities include underground electric entering the west side of the facility, various raw and product water pipes, a process backwash waste pipe and a sewer pipe flowing to a tight tank along the northwest corner of the facility. The developed portion of the existing site is surrounded by a chain-link fence. Some of the proposed work will be within the developed portion of the site, but most will be along the rear of the existing site, within the wooded area.

The existing site is primarily sloped from southwest to northeast with a single catch basin, which is currently not in use, and some vegetated swales/ditches. A majority of stormwater flows likely end up in an existing ground depression in the northeast corner of the site. If this depression was to fill and spill-over, stormwater runoff would primarily flow off-site to the northeast and ultimately end up in Stall Brook, which is a tributary to the Charles River. The soils on-site are primarily of the Hydrologic Soil Group (HSG) A and are highly permeable. A small portion of the site soil, approximately 1%, is of the HSG D. As indicated by FEMA Flood Maps, the project site is outside the 100-year floodplain. Therefore, all proposed development will be located outside of the floodplain.

As mentioned above, approximately 500 feet to the east of the HAWTP there are four lagoons utilized in the water treatment process. The lagoons are approximately 9,400 square feet in surface area with 3:1 sloped walls on each side. Lagoon 1A is concrete lined and Lagoons 1B, 2A, and 2B are not. Lagoons 1B, 2A, and 2B bottoms are made up of riprap above crushed stone and sub-grade. In proposed conditions, lagoon 2A will be regraded to design standards and converted to be concrete lined. Lagoons 1B and 2B will also be regraded to the original design standards. In addition to their role in water treatment processes, the lagoons will collect stormwater runoff from the higher ground around it, including some impervious surfaces, and treat the runoff.

2.2 New Stormwater Conveyances

The stormwater management plan has been designed to meet the requirements of the Massachusetts Stormwater Management Policy. As such, there are no untreated stormwater discharges from newly paved areas or existing paved areas being re-paved as part of this project. All stormwater from the new or repaved areas remaining on or leaving the site will receive treatment for TSS by a sand filter bed with adequate pretreatment.

Section 3 Peak Rate Attenuation

Standard 2 of the Massachusetts Stormwater Standards requires new development projects be designed so that post-development peak discharge rates do not exceed pre-development discharge rates. Pre- and post-development hydrologic models have been created to quantify peak flow rates leaving the site. The hydrologic analysis was performed using the SCS TR-20 methodology and HydroCAD version 10 computer modeling software was utilized to perform the computations. The rainfall data used to conduct the analysis was obtained from the Northeast Regional Climate Center (NRCC) and Natural Resources Conservation Service (NRCS) joint website "precip.net," which provides extreme precipitation data for New York and New England. The TR-20 analysis relies heavily on in-situ HSG classification, land cover type and time of concentration calculations.

3.1 Watershed Characteristics

To quantify runoff from the site, an analysis of the site and contributing watershed topography was performed. The site and contributing watershed were measured to be approximately 99,490 square feet total. The existing site is primarily sloped from southwest to northeast with a majority of stormwater flows ending up in an existing ground depression in the northeast corner of the site. If this depression was to fill and spill-over, stormwater runoff would primarily flow off-site to the northeast and ultimately end up in Stall Brook, which is a tributary to the Charles River. In the pre-development analysis, the watershed was considered as a single catchment area. The overall watershed boundary did not change as a result of the proposed work, but the post-development watershed was analyzed with three subcatchments. Two of the three proposed subcatchments flow to proposed sand filter beds with pretreatment, then to the common point of the existing ground depression. The third proposed subcatchment represents stormwater collected from the roof of the new PFAS treatment building which is directed to the proposed sand filter beds via underground piping.

3.2 Soils

Soils data for the proposed project area was obtained through the Natural Resource Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database. Based on the information obtained, the watershed area is comprised primarily of HSG A soils, which have rapid infiltration rates. These HSG A soils are Merrimac Fine Sandy Loam (approximately 74% of the site soils) and Udorthents, Loamy (approximately 25% of the site soils). A small portion of the site soil, approximately 1%, is Freetown Muck of the HSG D.

3.3 Land Cover

Land cover classifications for the project site were selected and quantified based on measurements taken from aerial imagery. Each land cover designation was assigned a runoff curve number (CN), and a weighted curve number was calculated for entry into the HydroCAD model. A summary of the existing and proposed watershed characteristics are included in Tables 3-1 and 3-2.

Table 3-1 Pre-Development Watershed Characteristics

Catchment Area	Total Area (SF)	HSG A – Grass Area (SF)	HSG A – Woods Area (SF)	HSG D – Grass Area (SF)	HSG D– Woods Area (SF)	Impervious Area (SF)	Composite CN	TC (min)
Subcatchment 1 (SP1)	99,490	20,878	66,495	938	59	11,120	42	86.3

Table 3-2 Post-Development Watershed Characteristics

Catchment Area	Total Area (SF)	HSG A – Grass Area (SF)	HSG A – Woods Area (SF)	HSG D – Grass Area (SF)	HSG D– Woods Area (SF)	Impervious Area (SF)	Composite CN	TC (min)
Subcatchment 1 (SP1)	48,034	17,558	9,883	0	0	20,593	66	6
Subcatchment 2 (SP2)	43,301	15,884	14,755	938	59	11,665	56	58.2
Subcatchment 3 (SP3)	8,155	0	0	0	0	8,155	98	6

3.4 Time of Concentration

The time of concentration (Tc) for each watershed area was calculated using the NRCS TR-55 method. This method involves breaking down the longest flow path on site into segments of sheet flow, shallow concentrated flow, and channel flow while considering cover type, soils, and land slope. The travel times for each segment are summed to get the total Tc for the watershed area. For the purposes of the model, a minimum Tc of 6 minutes was used.

3.5 Stormwater Quantity Results

The site has been analyzed for pre- and post-development runoff corresponding to the 2-, 10- and 100-year, 24-hour storms. Peak discharge rates from the edge of the site are summarized in Table 3-3 and the HydroCAD results have been included in Appendix B.

Table 3-3 Pre- and Post-Development Peak Discharge Rates

Storm Event	Rainfall Depth (in)	Peak Discharge Rate (cfs)	
		Pre-Development (SP-1)	Post-Development (SP-1)
2-Year, 24-Hour	3.26	0.00	0.00
10-year, 24-Hour	4.88	0.00	0.00
100-Year, 24-Hour	8.74	0.00	0.00

Based on the results of the TR-20 analysis, there is no increase in the peak discharge rate from pre-development to post-development conditions at Study Point 1 (SP-1) for the 2-, 10-, and 100-year design storm events. This is predominately due to the existing large ground depression in the northeast corner of the project site. In existing conditions, most of the stormwater runoff generated on the site is directed to this depression by natural land slope and constructed drainage swales. In proposed conditions, stormwater runoff will be directed to the existing depression through natural land slope, improved drainage swales, sand filter beds with forebay and underdrain, and piping with riprap outlets. The use of stormwater detention BMP's like sand filter beds with a forebay help reduce peak discharge rates along with providing treatment. The stormwater BMP's and the size of the existing ground depression result in no increase in the peak discharge rate from the site from existing to proposed conditions, therefore this standard is met.

Section 4 Recharge

4.1 Groundwater Recharge

Standard 3 of the Massachusetts Stormwater Standards requires the loss of annual groundwater recharge to be eliminated or minimized using infiltration measures. The proposed development is located within a Zone I wellhead protection area which prohibits infiltration of stormwater. As such, all BMP's have been designed with no opportunity for infiltration.

Section 5 Water Quality

5.1 Water Quality Provisions

To comply with Standard 4, the proposed BMP's have been designed with a storage volume greater than the required Water Quality Volume (WQV). The WQV was calculated based on the total area of proposed impervious surfaces across the site. The WQV was determined based on 1-inch of rainfall over the impervious surfaces.

5.1.1 BMP Selections Considerations

The proposed site has constraints that rule out many BMP's in the Massachusetts Stormwater handbook. For this site, a Sand Filter Bed has been selected as the best BMP for this scenario. This BMP has been modified to include a filter course layer with underdrain on top of an impervious liner at the interface with subgrade to prevent infiltration of stormwater. The filter course layer will provide removal of various pollutants prior to discharge via the underdrain.

5.1.2 Sand Filter Bed Sizing

The required WQV for the site was calculated based on 1-inch of rainfall over the impervious surfaces. The required WQV calculations are listed below:

- Total New Impervious Area = 29,298 ft^2
  - Building: 8,160 ft^2
  - Pavement/Concrete: 21,138 ft^2
- Treatment Depth = 1-inch
- Required WQV = 2,441.5 ft^3

The proposed sand filter beds have been designed to treat runoff from all impervious surfaces. Proposed Sand Filter Bed #1 has a surface area of approximately 905 ft^2, and Proposed Sand Filter Bed #2 has a surface area of approximately 500 ft^2. They both have a storage depth of 18-inches. Calculating the storage volume of the BMP's based on the average surface area of the permanent storage gives a WQV of 3,202.5 ft^3.

- WQV Depth = 18 in
- Average surface area: 2,135 sf
- Proposed Infiltration Basin WQV = Average Surface Area x Depth = 3,202.5 ft^3

Table 5-1 Sand Filter Bed Surface Area Calculation

Sand Filter Bed #1		Sand Filter Bed #2	
Elevation (ft)	Area (SF)	Elevation (ft)	Area (SF)
220	905	220.5	500
221.5	1,845	222	1,020
Average Surface Area (sf):	1,375	Average Surface Area (sf):	760
WQV (cf):	2,062.5	WQV:	1,140

5.2 TSS Removal Best Management Practices

TSS removal will be achieved using sediment forebays and pea gravel diaphragms in conjunction with the sand filter beds. Sediment forebays have been designed to store 0.1-inch of rainfall from tributary impervious surfaces in accordance with the Massachusetts Stormwater Handbook.

The Town of Bellingham requires all drainage systems to meet Massachusetts DEP Stormwater Management Regulations. Massachusetts DEP Stormwater Management Standards require 80% removal of TSS for new development. The 80% TSS removal requirement has been met with the proposed stormwater BMP's. The TSS worksheet, included in Appendix D, shows that 85% TSS removal has been achieved through the use of sediment forebays and sand filter beds.

5.3 Long Term Pollution Prevention Plan

Standard 4 of the Massachusetts Stormwater Standards also requires a Long-Term Pollution Prevention Plan to be submitted. This plan, included in Appendix E, addresses information related to proper procedure for the following items:

- Good housekeeping;
- Storage of materials;
- Vehicle Washing;
- Routine Inspections of Stormwater BMP's;
- Spill prevention and response;
- Landscaping maintenance;
- Storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management;
- Operation and maintenance of waste management systems;
- Proper storage of deicing chemicals and snow;

Section 6 Land Uses with Higher Potential Pollutant Loads

The Massachusetts Department of Environmental Protection has identified certain land uses which generate higher concentrations of pollutants than found in typical runoff. The construction of the HAWTP PFAS upgrades is not a land use which would trigger higher potential pollutant loads.

Section 7 Critical Areas

The proposed project will result in stormwater discharges to an area deemed as critical in the Massachusetts Stormwater Handbook. To comply with Standard 6, stormwater discharges will receive the highest and best practical method of treatment.

Section 8 Re-development and Other Projects

The proposed project does not qualify as re-development.

Section 9 Construction Period Pollution Prevention & Erosion/Sedimentation Control Plan

Per the MassDEP stormwater standards, projects that disturb one acre of land or more are required to obtain coverage under the NPDES Construction General Permit issued by EPA and prepare a Stormwater Pollution Prevention Plan (SWPPP). The following plan is meant to serve as a combined Construction Period Pollution Prevention & Erosion/Sedimentation Control Plan as well as the SWPPP.

The objective of this document is to provide a general outline of the measures required to prevent erosion and pollution associated with the construction of the HAWTP PFAS upgrades located in Bellingham, MA. The selected contractor(s) will be responsible for following and implementing the measures described in this plan. In addition, the contractor will be required to develop and submit a SWPPP prior to the start of construction to document exactly how they intend to address these requirements. Prior to the start of any earthwork on the site, the sedimentation and erosion control barriers will be installed. Section 9.2 provides a listing of controls and a sequence of construction.

1. Site Description and Overview:
    a. The proposed improvements include the construction of a stand-alone 8,155 square foot PFAS treatment facility and accompanying piping as an addition to the existing water treatment plant on site. The proposed site design includes approximately 21,100 feet of new paved area comprised of driveway, parking area, and walkways. Additionally, there will be two new concrete pads to support a propane tank and generator, which will total approximately 530 square feet of disconnected impervious area. Various stormwater improvements will be completed on site to manage runoff from the existing and new impervious areas. The site grading is designed so stormwater will flow away from the buildings, then into one of multiple swales along the impervious areas, and eventually into sand filter beds with forebays located on downgradient portions of the site. The existing site is partially developed with the HAWTP, and the remainder is wooded. The site is underlain primarily by type A soils, and a small portion is type D.
2. Location and description of Resource Areas:
    a. Watercourses and Water bodies: The proposed development is near Stall Brook. A small portion of the project is within the 200-foot Riverfront Area of Stall Brook. The project area is located outside the FEMA 100-year flood zone.

    b. Wetlands have been identified immediately adjacent to Stall Brook and near the project site. Some proposed work will take place within the 100-foot wetland buffer. Erosion and sedimentation controls will be implemented pre and post construction to reduce or eliminate impacts.

3. Existing soils and the volume and nature of imported soil materials: In depth discussion of existing soil types and classifications has been included in section 3.2 of this report. The proposed site has been designed to reuse excess material to the extent feasible. The only materials that will be imported to the site would be screened gravel for use as structural fill, roadway base and subbase on an as needed basis when existing material cannot be used.

4. Drainage patterns, watersheds, and sub-watersheds: Detailed discussion of existing drainage patterns, watersheds and stormwater calculations have been included in section 3 of this report. The existing site is

primarily sloped from southwest to northeast with a majority of stormwater flows likely ending up in a large ground depression in the northeast corner of the site. If this depression was to fill and spill-over, stormwater runoff would primarily flow off-site to the northeast and ultimately end up in Stall Brook, which is a tributary to the Charles River. In proposed conditions, all runoff from the development will be directed through the treatment train before discharging to a riprap apron via a 15-inch pipe from the outlet control structure (OCS) of Sand Filter Bed #1. This outlet and riprap apron will be within the existing large ground depression limits in the northeast corner of the site to coincide with existing drainage conditions. The emergency spillway is not anticipated to be active for storms less than or equal to a 100-year, 24-hour storm.

5. A description of construction and waste materials to be stored on-site: All waste generated by construction activities will be stored in dumpsters and disposed of regularly. The contractor will be required to address handling of waste in the SWPPP. The contractor's SWPPP will address practices to minimize exposure of materials to stormwater as well as spill response procedures. The contractor will also provide detailed descriptions of their proposed storage areas and methods of handling construction debris.

6. Location of all erosion and sediment control measures with a narrative of construction sequencing: Discussion of proposed erosion and sediment control measures can be found on the construction plans. Notes and details have been included on the design drawings for convenience to the contractor. The E&SC measures shown on the plan are meant to be the minimum required, however the contractor will be required to implement measures as required to control erosion and sedimentation to the standards discussed in this plan.

7. Construction period stormwater handling: During construction, the contractor will be required to implement erosion and sedimentation control measures prior to the start of work. Temporary erosion and sediment control measures are discussed on plan sheet C-99-503. This sheet details requirements for the maximum amount of disturbed area, temporary stabilization measures and seasonal variances in these requirements.

8. Post-construction stormwater handling: After construction, stormwater will be controlled via drainage swales, pea gravel diaphragms, sediment forebays and sand filter beds. In order for these systems to function properly, they will need to be inspected and maintained regularly in accordance with the maintenance schedule outlined in the Operation and Maintenance Plan.

9.1 Inspection and Maintenance of Stormwater Controls

Stormwater controls must be maintained in good operating condition until all disturbed soils are permanently stabilized. To ensure this, the erosion and sedimentation controls shall be inspected by the Resident Engineer once every two weeks and after every rainfall event of 0.5 inches or greater.

The following standard maintenance practices will apply to the erosion and sedimentation controls for the project:

- All erosion and sediment control measures will be properly maintained. If repairs or other maintenance is necessary, it will be initiated by the Contractor within 24 hours of report;

- Silt fence will be inspected for depth of sediment, tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground;

- Built up sediment will be removed from silt fence when it has reached one-half the height of the fence and at end of the job;
- Dust will be controlled by periodic driveway sweeping during the progress of the work;
- Erosion control measures will be maintained for disturbed areas of the site that have not been stabilized;
- Erosion control measures will be installed and maintained for the construction staging area, fueling area, stockpiles, and material storage areas until those areas have been stabilized after construction; and,
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth.

If the inspections reveal the need for additional control devices to prevent erosion and sedimentation, the Contractor will promptly install additional protection devices as required. Control devices in need of repair will be repaired promptly after identification. A stockpile of 100 linear feet of silt fence will be maintained on the site and under cover for emergency repairs and routine maintenance.

The Owner (or their representative) will be responsible for preparing an inspection and maintenance report (Attached in Appendix F) following each inspection and filing completed reports after maintenance action has taken place by the Contractor. The Contractor's superintendent will be responsible for maintenance and repair activities and completing and signing the maintenance action part of inspection and maintenance reports.

9.2 Stormwater Controls During the Construction Period

The contractor will be required to implement BMPs as necessary to control stormwater and erosion for a 100-year, 24-hour storm. Temporary BMPs include a stabilized construction entrance, silt fence, compost silt socks, temporary sediment basins, stone check dams and erosion control matting. Specific details noting installation requirements are included on plan sheet C-99-503 Erosion Control Notes and Details and in specification section 02270 Temporary Erosion Controls.

PROJECT SCHEDULE: Prior to the start of construction, the selected contractor will be required to submit a construction schedule outlining the sequencing/phasing of the work. The project construction phasing will generally proceed in the following sequence:

1. Field location and flagging of the limits of work and any critical resource areas.
2. Installation of sedimentation/erosion control barriers at the downgradient limit of work. This includes, but is not limited to installation of silt fence, silt sacks, stabilized construction entrances, temporary and/or permanent sediment basins and check dams.
3. Establish storage/stockpiling areas. Clearing and Grubbing.
4. Excavation, site preparation and installation of stormwater BMPs.
5. Installation of site piping, concrete pads and fine grading of the site.

6. Building construction, water main installation, electrical duct bank installation and paving.

7. Loaming, seeding, and mulching of disturbed areas as construction in those areas is completed.

8. Inspection of seeding success and removal of sedimentation/erosion control barriers once permanent stabilization has become established pursuant to the specifications and satisfaction of the Resident Engineer.

EROSION AND SEDIMENT CONTROLS:
Various erosion and sedimentation control measures will be utilized to prevent or minimize soil erosion and sedimentation of on-site stormwater systems near wetlands. Refer to plan sheet C-01-102 for locations and C-99-503 for details of temporary erosion and sedimentation control measures.

Sedimentation controls mainly include silt fence, compost silt socks, and temporary sediment basins as needed. Anti-tracking aprons (stabilized construction entrances) shall also be utilized as shown on the plans. These measures will be installed as detailed on the Erosion and Sediment Control Plan sheet. Land disturbance is required to be kept to a minimum to reduce soil erosion and sedimentation. Whenever possible, work shall be phased to avoid disturbances of more than one acre at a time.

Contractor Staging Area: Contractor staging and/or stockpiles may be placed on-site in locations as approved by the Engineer and Owner. The maximum permissible slope of a stockpile will be 2H:1V. The area selected for stockpiling shall be dry and stable and the location approved by the Engineer and Owner. Stockpiles will be required to be stabilized or covered and stockpiles not used within 30 days shall be seeded or mulched immediately after the formation of the stockpile.

Dust Control: Dust Control Measures will be implemented in accordance with the project specifications if determined to be necessary. Off-site vehicle tracking of sediment and the generation of dust shall be minimized. It is recommended that water be used for dust control due to the proximity to wetlands and drinking water wells. The volume of water sprayed to prevent dust shall be minimized to prevent the runoff of water, and any water running off shall contain no visible oil sheen, floating solids, discoloration, or cause foaming in the receiving water.

Restoration and Stabilization: Disturbed areas will be stabilized with mulch or temporary seeding in accordance with the requirements and timeframes noted on the site plans and in accordance with the specifications. At a minimum, any disturbed area left exposed for a period greater than 14 days will be stabilized. Stabilization should occur within seven days after suspension of work in the disturbed areas. Site restoration will include installation of pavement, aprons, walkways, loam, seed, and other restoration as shown on the site plans and detailed in the project specifications.

Maintenance: During construction, various measures will be used to conserve soil and minimize erosion until disturbed areas are stabilized. The selected contractor will be responsible for inspecting, maintaining, and periodically cleaning all E&SC measures in accordance with the site plans and specifications. Some of the maintenance tasks are listed below:

- Remove sediment when deposits reach one half the height of a silt fence. Replace silt sacks or temporary sediment traps in accordance with manufacturer's recommendations.

- Construction Entrances: Maintain in a condition to prevent tracking of debris onto paved surfaces. This may include the need for periodic top dressing with additional stone as conditions warrant.
- Concrete washout areas: Remove hardened concrete when materials have accumulated to half the height of the container or washout area.
- Sediment/Dewatering Basins: Accumulated sediment shall be removed from systems periodically to promote proper function and shall be inspected frequently.
- All erosion and sedimentation controls shall be inspected every 7 days and immediately following any significant rain event.

Temporary stabilization measures shall be instituted to minimize effects of sedimentation and erosion during construction. Temporary Erosion Controls will be established at the site in accordance with specification section 02270 included in Appendix G.

Permanent stabilization measures shall be employed to minimize effects of sedimentation and erosion after the completion of construction. Detailed information is included in Specification Section 02485 – Loaming and Seeding attached in Appendix G.

Housekeeping: The contractor will be required to follow good housekeeping practices, material management and spill prevention practices that will minimize the risk of spills or accidental exposure of materials to stormwater runoff or wetland areas. These minimum practices are outlined below:

- Contractor shall make an effort to store only enough products on-site required to do the job.
- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof, plastic, or other waterproof enclosure.
- Products will be kept in their original containers with the original manufacturer's label intact.
- Original labels and material safety data sheets will be retained.
- Substances will not be mixed unless in accordance with the manufacturer's recommendations.
- Whenever possible, all of a product will be used up before properly disposing of the container.
- Contractor shall take measures to ensure that no litter, debris, building materials or similar materials are discharged to the waters of the State.
- The contractor will inspect periodically to ensure proper use and disposal of materials.
- Care will be taken in the selection of the location and method of storage of any petroleum products, hazardous material, or similar, to minimize the potential for accidental spillage, leakage, or release to the environment.
- All onsite vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage.

Spill Prevention and Response Practices: In addition to good housekeeping and material management practices discussed above, the following general practices will be followed for spill prevention, response, and cleanup:

- Materials and equipment required for spill response will be maintained onsite. Equipment and materials may include, but are not limited to gloves, safety glasses, speedi-dri, spill "pigs", sorbent materials, poly sheeting, and miscellaneous containers.
- Adequate personnel will be trained in spill response procedures.
- The contractor shall designate a specific person to be responsible for spill prevention and response.
- All spills will be properly reported and cleaned up immediately after discovery.

Section 10 Operation/Maintenance Plan

10.1 Responsible Party

The BMP's are not part of the public stormwater system and will, therefore be maintained by the water treatment plant operator. Contact info for the responsible party is listed below:

Jesse Riedle
Director of Department of Public Works
Town of Bellingham
(508) 966-5816

10.2 Description of Stormwater BMP's

Three types of BMP's are proposed to achieve the required level of stormwater treatment and detention. Pea gravel diaphragms and sediment forebays are proposed for pretreatment prior to discharge into the sand filter beds.

10.2.1 Pea Gravel Diaphragm

A pea gravel diaphragm is a type of pretreatment level spreader for sheet flows. The pea gravel diaphragms are 1-foot wide, and 2-feet deep trench backfilled with clean washed pea gravel and lined with filter fabric. The diaphragm serves two purposes. First, it acts as a pretreatment device, settling out sediment particles before they reach the sand filter beds. Second, it acts as a level spreader, maintaining sheet flow as runoff flows out of the diaphragm toward the detention basin.

10.2.2 Sediment Forebay

A sediment forebay is a post-construction measure consisting of an excavated pit, bermed area and a stone weir designed to slow incoming stormwater runoff and facilitate gravity separation of suspended solids. A majority of flow entering the sand filter beds will first be pretreated through a sediment forebay, with the remainder being pretreated through a pea gravel diaphragm.

10.2.3 Sand Filter Beds

Sand filter beds are designed to improve water quality by straining pollutants through a filtering media and by settling pollutants on top of the sand bed. The sand filter beds are also designed with storage above the filter media to hold stormwater to allow solids to settle before flows move through the filter media. The sand filter beds will reduce local and downstream flooding while providing stormwater treatment. The sand filter beds have an impermeable liner which allows for temporary runoff storage. The impermeable liner is necessary to meet Zone I wellhead protection area infiltration restrictions. On top of the impermeable liner is a 6" underdrain with a flow regulating orifice embedded in 18-inches of a sand filter layer. On top of the sand filter layer is 6-inches of loamy sand. The storage above these layers contains the capacity to hold flows from up to the 100-year design storm event for its contributing impervious area without overflowing.

10.3 Maintenance Requirements

Maintenance requirements specific to the proposed BMP's have been established in accordance with the Massachusetts Stormwater Handbook. Table 10-1 details the long-term maintenance requirements for each BMP.

Table 10-1 Long Term Maintenance Schedule

BMP	Activity	Frequency
Swale	Remove sediment and debris.	Annually.
	Mow.	As needed.
	Repair areas of erosion and revegetate.	As needed, but no less than once per year.
	Re-seed.	As necessary.
Pea Gravel Diaphragm	Inspect and remove debris.	Twice per year and after every major storm.
Sediment Forebay	Inspect sediment forebays for accumulated sediment and debris,	Monthly;
	Remove Sediment and Debris.	Two to four times per year.
Sand Filter Bed	Examine outlet structure for evidence of clogging.	Twice per year.
	Mow embankments and emergency spillway of basin.	Twice per year.
	Remove trash and debris from the basin.	Twice per year.
	Remove sediment from the basin.	Once every five years.
	Inspect sand filter and remove sediment, trash, and debris. Replace parts of sand filter that have been penetrated by finer sediments as needed.	Twice per year.
Riprap	Clean out vegetation and organic matter	As needed.

Additional information related to the extent of each maintenance activity can be found in the Massachusetts Stormwater Handbook. All maintenance activities shall be documented by filling out the Inspection Maintenance Checklist and tracked on the Stormwater Maintenance Log which can be found in Appendix F.

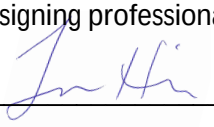
10.3.1 Snow Storage

In accordance with the Bellingham bylaws and the Massachusetts stormwater standards, snow shall not be stored in stormwater BMPs. Snow storage shall only be permitted in areas identified on the plans. These areas have been strategically located to allow for snow melt/runoff to be subject to the complete stormwater treatment train to ensure pollutants are removed in accordance with Town and State requirements.

Section 11 Prohibition of Illicit Discharges

Standard 10 of the Massachusetts Stormwater Standards prohibits all illicit discharges to the stormwater management system. In order to comply with this standard, appropriate disposal methods have been designed for all sanitary and process related waste. The proposed design does not contain any cross connections between sanitary and storm water conveyances or any opportunity for illicit discharges to enter the stormwater system. In addition, spill containment has been designed to capture any spills from chemical deliveries. The project site will be monitored during and after construction to verify that there is no opportunity for illicit discharges. The HAWTP will specifically prohibit the discharge of any illicit substance to the stormwater management system. Measures to prevent any possible future illicit discharges have been implemented as part of the Operation and Maintenance Plan.

Stamp of signing professional Engineer



2/10/25

Registered Professional Engineer | Date

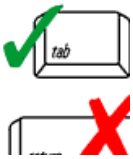
Appendix A – Stormwater Checklist

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

2/10/25

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

☒ No disturbance to any Wetland Resource Areas

☒ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☒ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☒ Grass Channel

☐ Green Roof

☒ Other (describe): Sand Filter Bed

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☒ is within the Zone II or Interim Wellhead Protection Area
- ☒ is near or to other critical areas
- ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☒ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

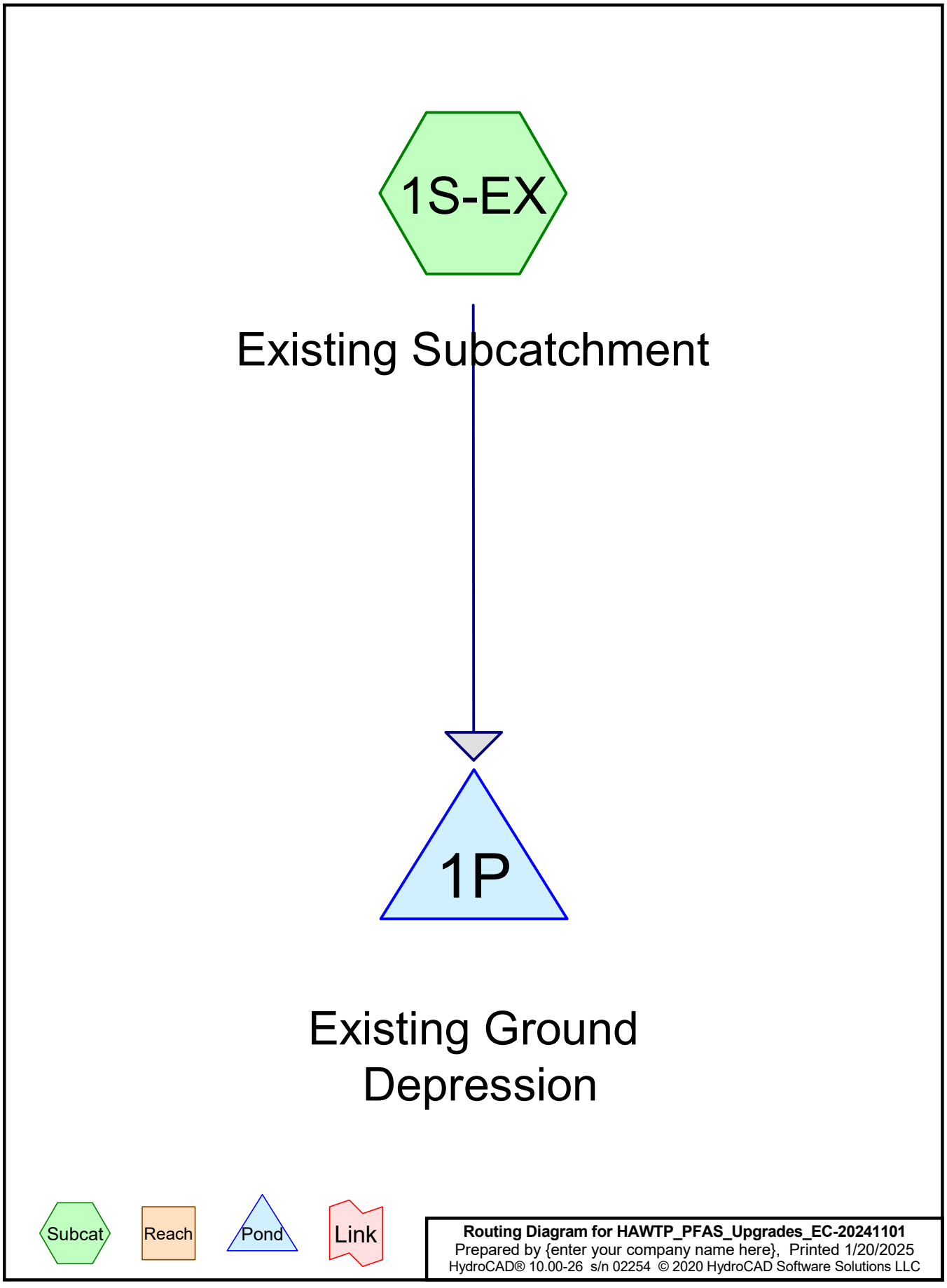
Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Appendix B – HydroCAD Model Results



Routing Diagram for HAWTP_PFAS_Upgrades_EC-20241101
Prepared by {enter your company name here}, Printed 1/20/2025

Project Notes

Defined 7 rainfall events from Bellingham-rain IDF
Copied 7 events from Bellingham-rain 24-hr S1 storm

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
20,865	39	>75% Grass cover, Good, HSG A (1S-EX)
958	80	>75% Grass cover, Good, HSG D (1S-EX)
5,924	98	Paved parking, HSG A (1S-EX)
348	83	Paved roads w/open ditches, 50% imp, HSG A (1S-EX)
4,835	98	Unconnected roofs, HSG A (1S-EX)
66,516	30	Woods, Good, HSG A (1S-EX)
44	77	Woods, Good, HSG D (1S-EX)
99,490	**40**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
98,488	HSG A	1S-EX
0	HSG B	
0	HSG C	
1,002	HSG D	1S-EX
0	Other	
99,490		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
20,865	0	0	958	0	21,823	>75% Grass cover, Good
5,924	0	0	0	0	5,924	Paved parking
348	0	0	0	0	348	Paved roads w/open ditches, 50% imp
4,835	0	0	0	0	4,835	Unconnected roofs
66,516	0	0	44	0	66,560	Woods, Good
98,488	**0**	**0**	**1,002**	**0**	**99,490**	**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S-EX: Existing Runoff Area=99,490 sf 10.99% Impervious Runoff Depth=0.00"
Flow Length=537' Tc=86.3 min UI Adjusted CN=38 Runoff=0.00 cfs 0 cf

Pond 1P: Existing Ground Depression Peak Elev=212.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Total Runoff Area = 99,490 sf Runoff Volume = 0 cf Average Runoff Depth = 0.00"
89.01% Pervious = 88,557 sf 10.99% Impervious = 10,933 sf

Summary for Subcatchment 1S-EX: Existing Subcatchment

[45] Hint: Runoff=Zero

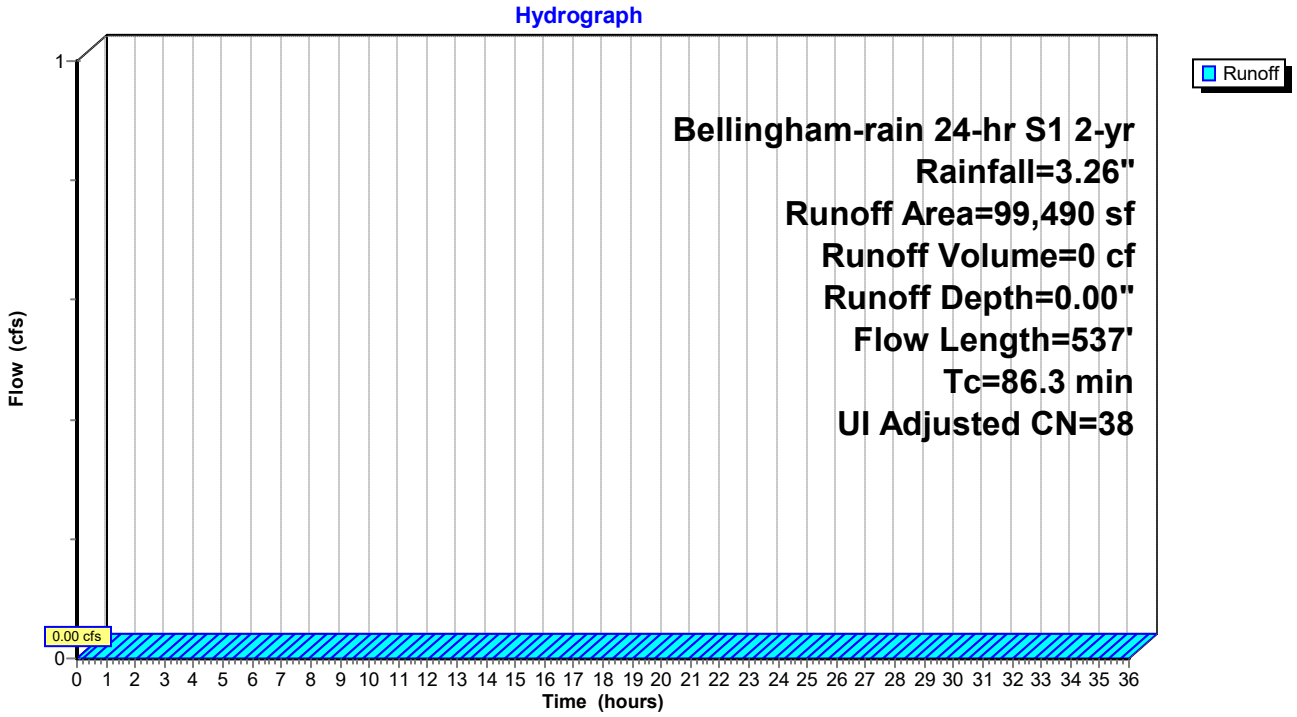
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 2-yr Rainfall=3.26"

Area (sf)	CN	Adj	Description
4,835	98		Unconnected roofs, HSG A
5,924	98		Paved parking, HSG A
348	83		Paved roads w/open ditches, 50% imp, HSG A
20,865	39		>75% Grass cover, Good, HSG A
958	80		>75% Grass cover, Good, HSG D
66,516	30		Woods, Good, HSG A
44	77		Woods, Good, HSG D
99,490	40	38	Weighted Average, UI Adjusted
88,557			89.01% Pervious Area
10,933			10.99% Impervious Area
4,835			44.22% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
46.1	100	0.0170	0.04		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 2.40"
26.2	304	0.0060	0.19		**Shallow Concentrated Flow, SCF 1** Forest w/Heavy Litter Kv= 2.5 fps
14.0	133	0.0040	0.16		**Shallow Concentrated Flow, SCF 2** Forest w/Heavy Litter Kv= 2.5 fps
86.3	537	Total			

Subcatchment 1S-EX: Existing Subcatchment



Summary for Pond 1P: Existing Ground Depression

Inflow Area = 99,490 sf, 10.99% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 212.00' @ 0.00 hrs Surf.Area= 483 sf Storage= 0 cf
Flood Elev= 221.50' Surf.Area= 8,809 sf Storage= 39,065 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

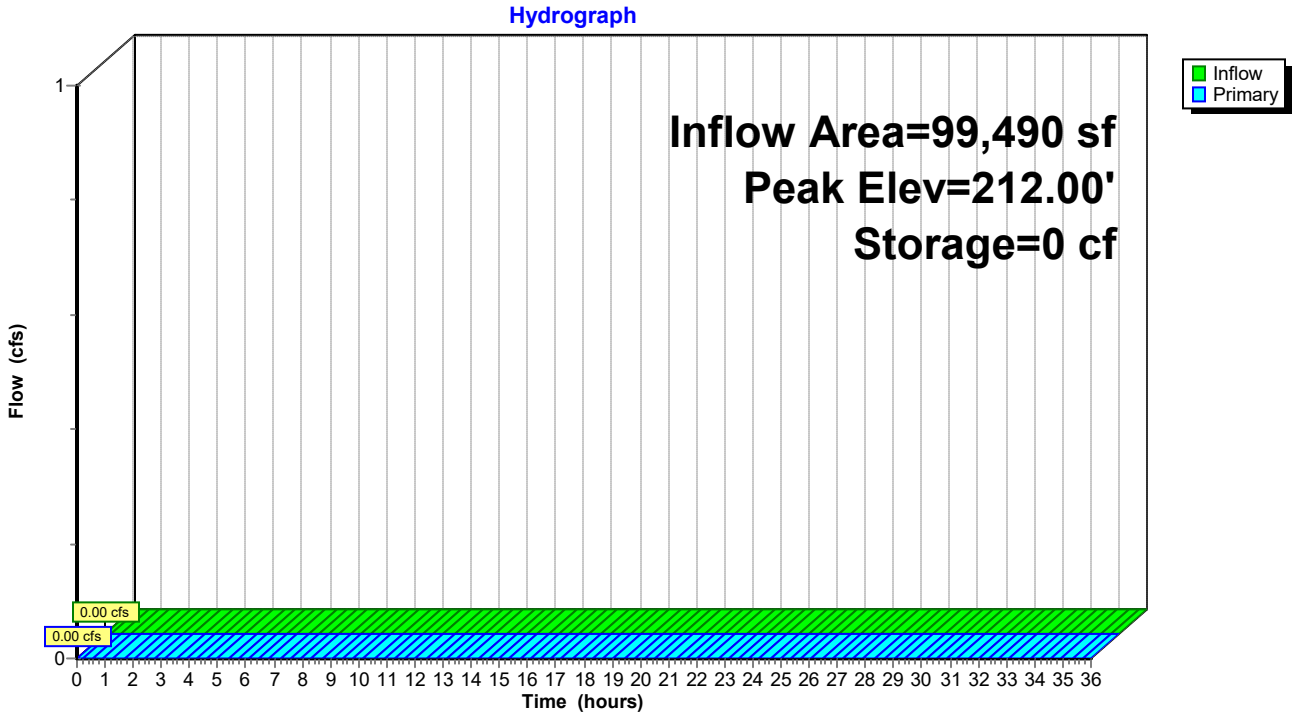
Volume	Invert	Avail.Storage	Storage Description
#1	212.00'	52,364 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
212.00	483	0	0	483
214.00	1,883	2,213	2,213	1,902
216.00	3,315	5,131	7,344	3,378
218.00	4,962	8,222	15,566	5,086
220.00	6,864	11,775	27,341	7,065
221.50	8,809	11,724	39,065	9,066
222.00	50,000	13,299	52,364	50,257

Device	Routing	Invert	Outlet Devices
#1	Primary	221.50'	**24.2' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Existing Ground Depression



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S-EX: Existing Runoff Area=99,490 sf 10.99% Impervious Runoff Depth=0.15"
Flow Length=537' Tc=86.3 min UI Adjusted CN=38 Runoff=0.03 cfs 1,209 cf

Pond 1P: Existing Ground Depression Peak Elev=213.38' Storage=1,209 cf Inflow=0.03 cfs 1,209 cf
Outflow=0.00 cfs 0 cf

Total Runoff Area = 99,490 sf Runoff Volume = 1,209 cf Average Runoff Depth = 0.15"
89.01% Pervious = 88,557 sf 10.99% Impervious = 10,933 sf

Summary for Subcatchment 1S-EX: Existing Subcatchment

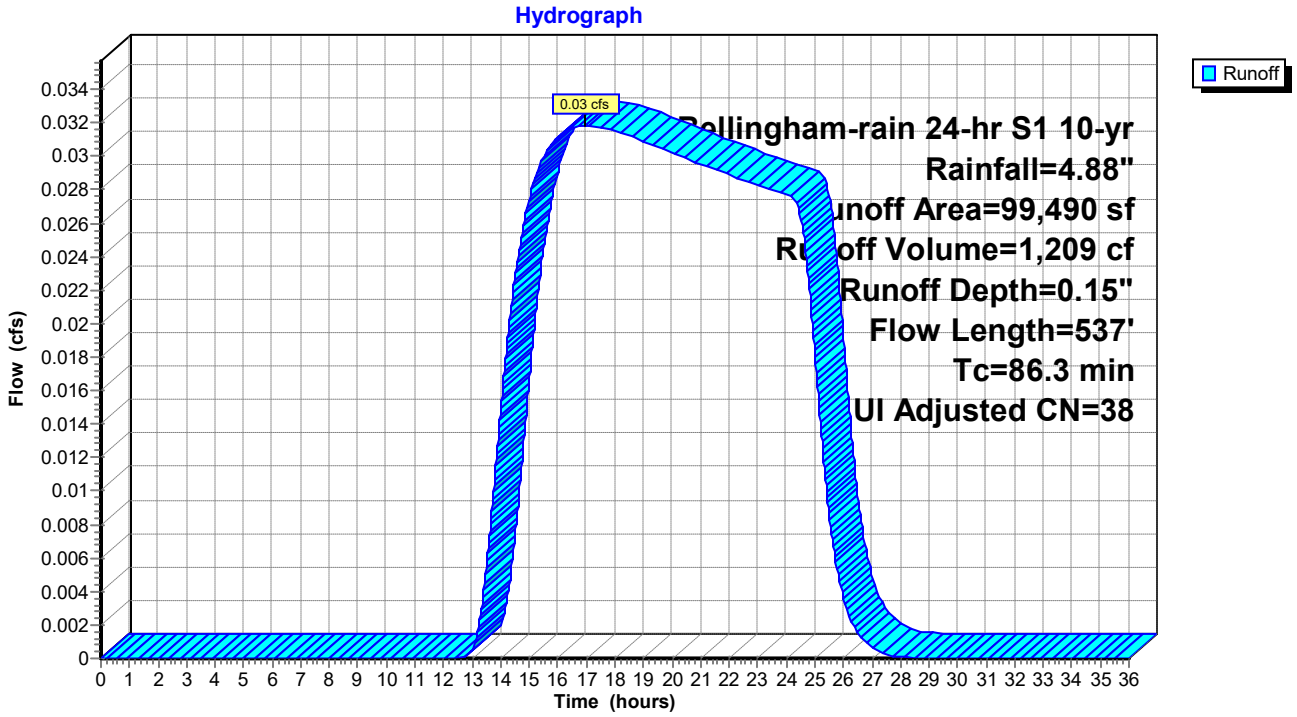
Runoff = 0.03 cfs @ 16.97 hrs, Volume= 1,209 cf, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 10-yr Rainfall=4.88"

Area (sf)	CN	Adj	Description
4,835	98		Unconnected roofs, HSG A
5,924	98		Paved parking, HSG A
348	83		Paved roads w/open ditches, 50% imp, HSG A
20,865	39		>75% Grass cover, Good, HSG A
958	80		>75% Grass cover, Good, HSG D
66,516	30		Woods, Good, HSG A
44	77		Woods, Good, HSG D
99,490	40	38	Weighted Average, UI Adjusted
88,557			89.01% Pervious Area
10,933			10.99% Impervious Area
4,835			44.22% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
46.1	100	0.0170	0.04		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 2.40"
26.2	304	0.0060	0.19		**Shallow Concentrated Flow, SCF 1** Forest w/Heavy Litter Kv= 2.5 fps
14.0	133	0.0040	0.16		**Shallow Concentrated Flow, SCF 2** Forest w/Heavy Litter Kv= 2.5 fps
86.3	537	Total			

Subcatchment 1S-EX: Existing Subcatchment



Summary for Pond 1P: Existing Ground Depression

Inflow Area = 99,490 sf, 10.99% Impervious, Inflow Depth = 0.15" for 10-yr event
Inflow = 0.03 cfs @ 16.97 hrs, Volume= 1,209 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 213.38' @ 28.97 hrs Surf.Area= 1,347 sf Storage= 1,209 cf
Flood Elev= 221.50' Surf.Area= 8,809 sf Storage= 39,065 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

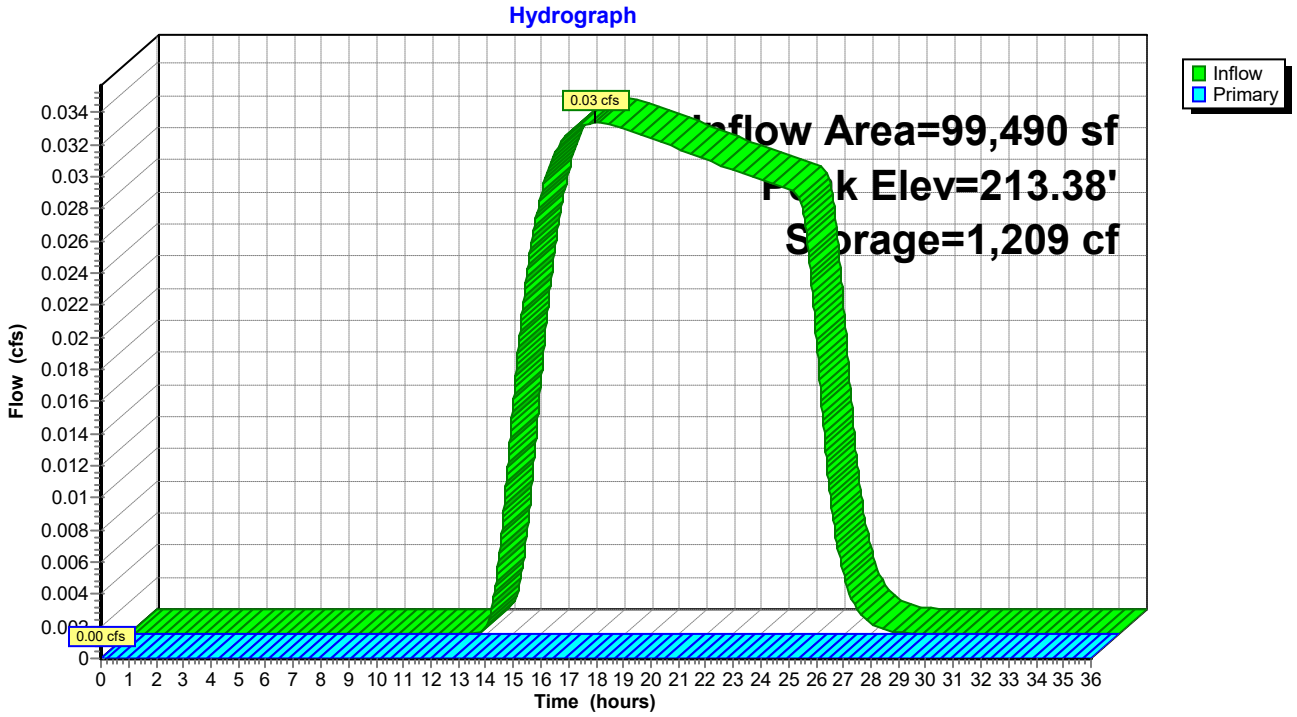
Volume	Invert	Avail.Storage	Storage Description
#1	212.00'	52,364 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
212.00	483	0	0	483
214.00	1,883	2,213	2,213	1,902
216.00	3,315	5,131	7,344	3,378
218.00	4,962	8,222	15,566	5,086
220.00	6,864	11,775	27,341	7,065
221.50	8,809	11,724	39,065	9,066
222.00	50,000	13,299	52,364	50,257

Device	Routing	Invert	Outlet Devices
#1	Primary	221.50'	**24.2' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Existing Ground Depression



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S-EX: Existing Runoff Area=99,490 sf 10.99% Impervious Runoff Depth=1.38"
Flow Length=537' Tc=86.3 min UI Adjusted CN=38 Runoff=0.70 cfs 11,412 cf

Pond 1P: Existing Ground Depression Peak Elev=217.09' Storage=11,412 cf Inflow=0.70 cfs 11,412 cf
Outflow=0.00 cfs 0 cf

Total Runoff Area = 99,490 sf Runoff Volume = 11,412 cf Average Runoff Depth = 1.38"
89.01% Pervious = 88,557 sf 10.99% Impervious = 10,933 sf

Summary for Subcatchment 1S-EX: Existing Subcatchment

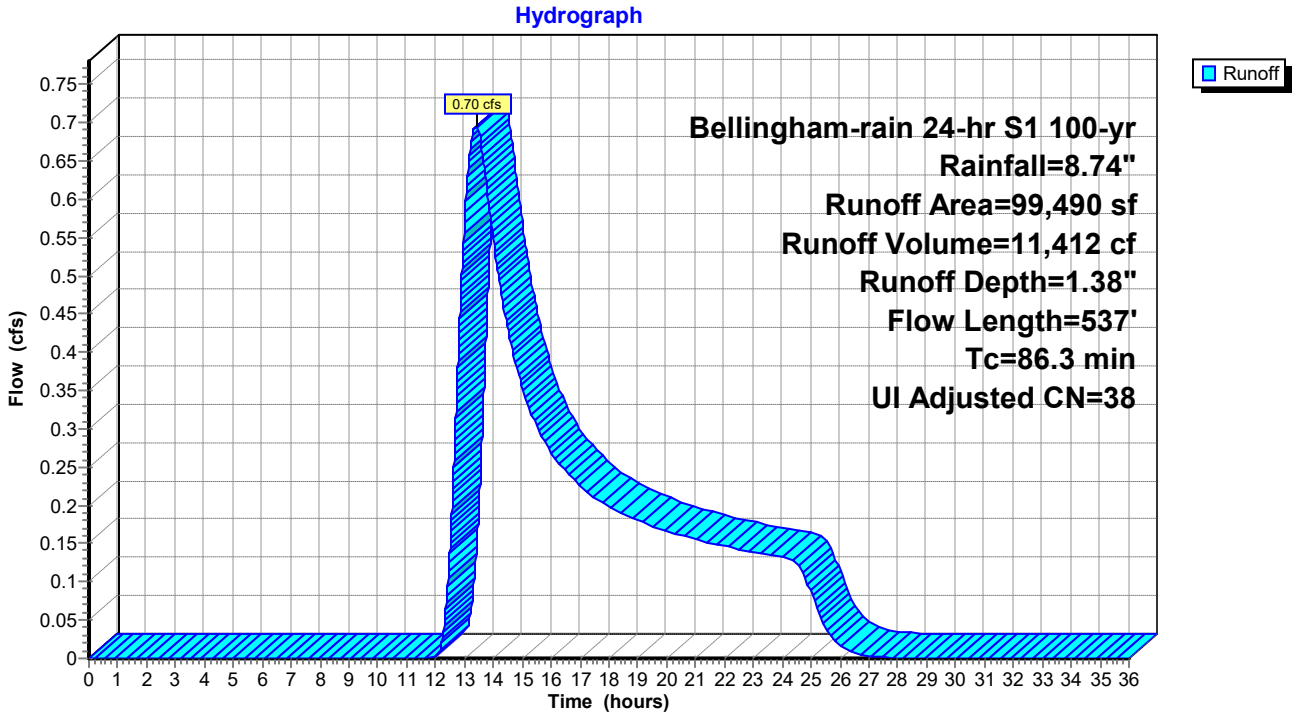
Runoff = 0.70 cfs @ 13.42 hrs, Volume= 11,412 cf, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 100-yr Rainfall=8.74"

Area (sf)	CN	Adj	Description
4,835	98		Unconnected roofs, HSG A
5,924	98		Paved parking, HSG A
348	83		Paved roads w/open ditches, 50% imp, HSG A
20,865	39		>75% Grass cover, Good, HSG A
958	80		>75% Grass cover, Good, HSG D
66,516	30		Woods, Good, HSG A
44	77		Woods, Good, HSG D
99,490	40	38	Weighted Average, UI Adjusted
88,557			89.01% Pervious Area
10,933			10.99% Impervious Area
4,835			44.22% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
46.1	100	0.0170	0.04		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 2.40"
26.2	304	0.0060	0.19		**Shallow Concentrated Flow, SCF 1** Forest w/Heavy Litter Kv= 2.5 fps
14.0	133	0.0040	0.16		**Shallow Concentrated Flow, SCF 2** Forest w/Heavy Litter Kv= 2.5 fps
86.3	537	Total			

Subcatchment 1S-EX: Existing Subcatchment



Summary for Pond 1P: Existing Ground Depression

Inflow Area = 99,490 sf, 10.99% Impervious, Inflow Depth = 1.38" for 100-yr event
Inflow = 0.70 cfs @ 13.42 hrs, Volume= 11,412 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 217.09' @ 28.97 hrs Surf.Area= 4,171 sf Storage= 11,412 cf
Flood Elev= 221.50' Surf.Area= 8,809 sf Storage= 39,065 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

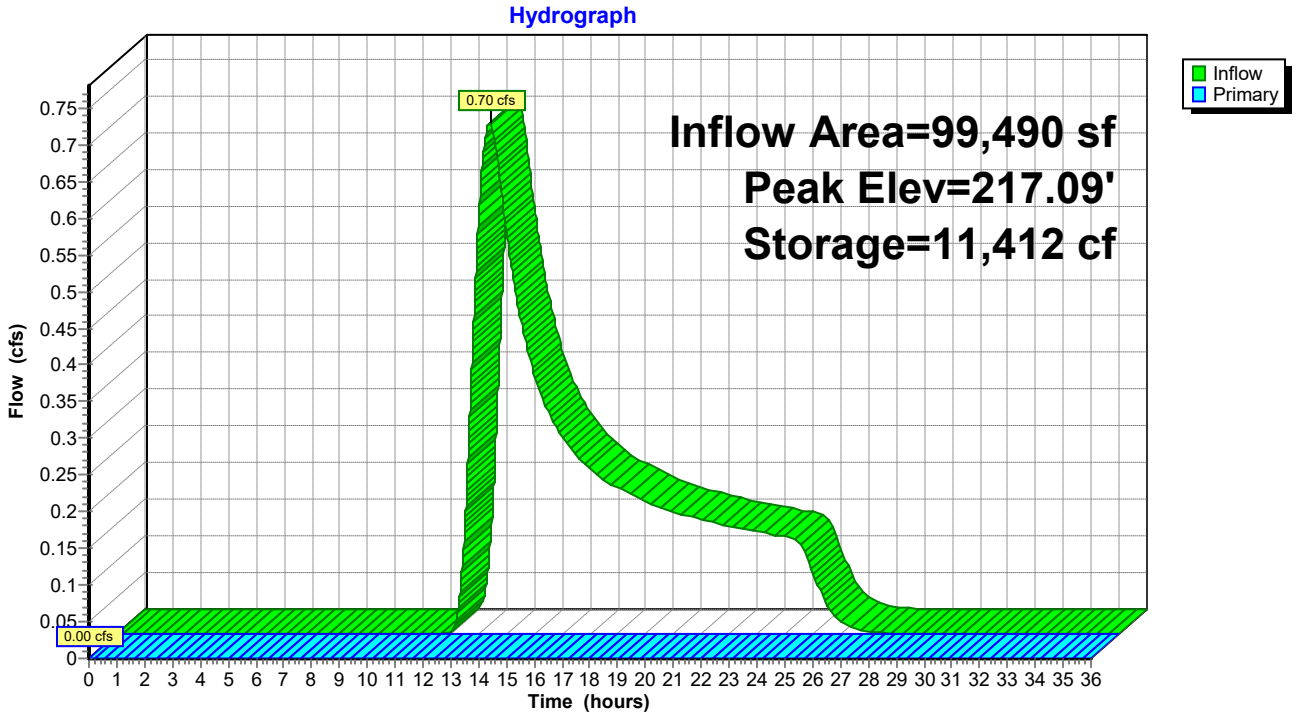
Volume	Invert	Avail.Storage	Storage Description
#1	212.00'	52,364 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

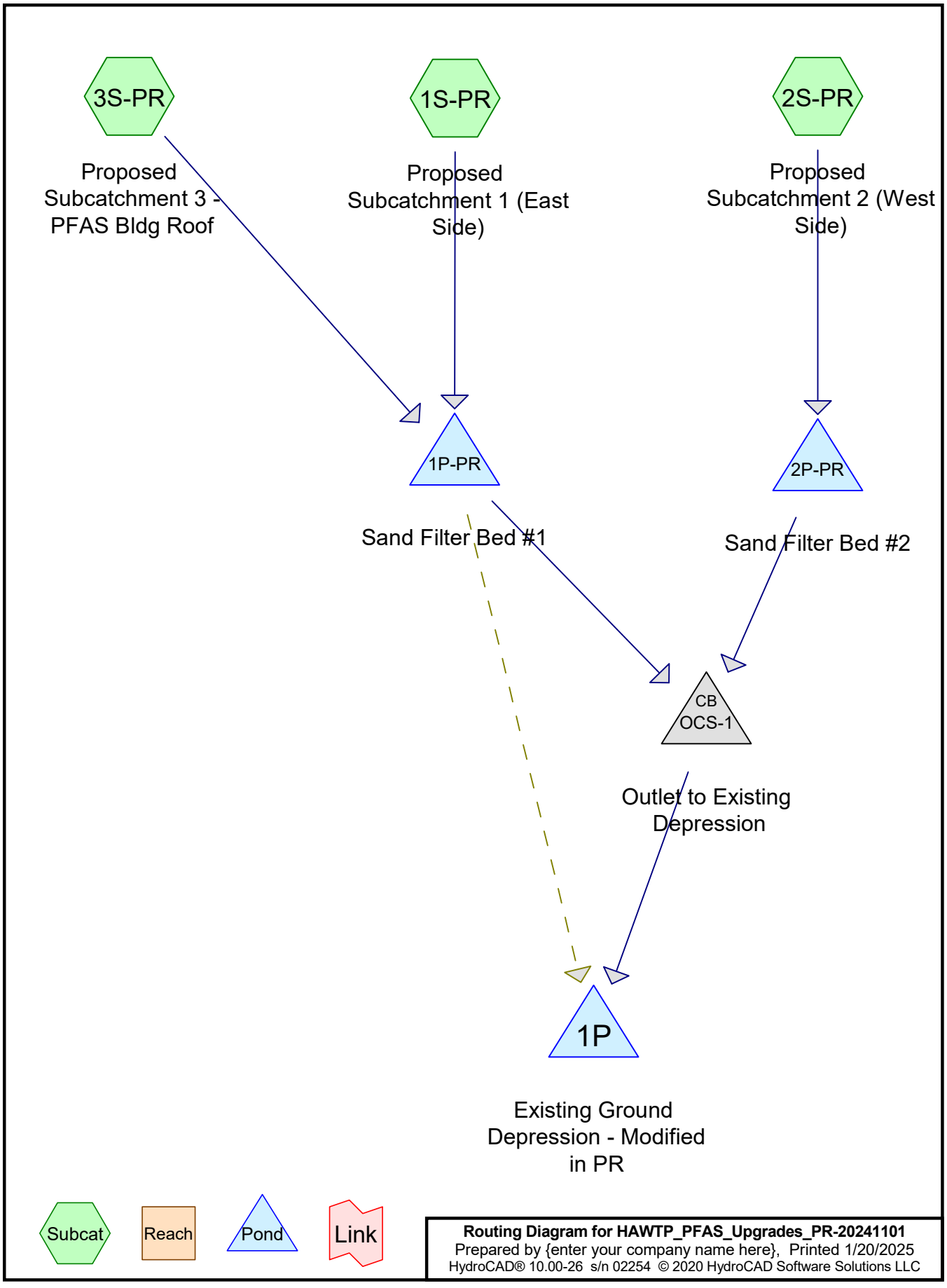
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
212.00	483	0	0	483
214.00	1,883	2,213	2,213	1,902
216.00	3,315	5,131	7,344	3,378
218.00	4,962	8,222	15,566	5,086
220.00	6,864	11,775	27,341	7,065
221.50	8,809	11,724	39,065	9,066
222.00	50,000	13,299	52,364	50,257

Device	Routing	Invert	Outlet Devices
#1	Primary	221.50'	**24.2' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Existing Ground Depression




3S-PR
1S-PR
2S-PR
Proposed Subcatchment 3 - PFAS Bldg Roof
Proposed Subcatchment 1 (East Side)
Proposed Subcatchment 2 (West Side)
1P-PR
2P-PR
Sand Filter Bed #1
Sand Filter Bed #2
CB OCS-1
Outlet to Existing Depression
1P
Existing Ground Depression - Modified in PR
Subcat
Reach
Pond
Link
Routing Diagram for HAWTP_PFAS_Upgrades_PR-20241101
Prepared by {enter your company name here}, Printed 1/20/2025
HydroCAD® 10.00-26 s/n 02254 © 2020 HydroCAD Software Solutions LLC

Project Notes

Defined 7 rainfall events from Bellingham-rain IDF
Copied 7 events from Bellingham-rain 24-hr S1 storm

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
33,439	39	>75% Grass cover, Good, HSG A (1S-PR, 2S-PR)
958	80	>75% Grass cover, Good, HSG D (2S-PR)
27,051	98	Paved parking, HSG A (1S-PR, 2S-PR)
348	83	Paved roads w/open ditches, 50% imp, HSG A (1S-PR, 2S-PR)
12,995	98	Unconnected roofs, HSG A (1S-PR, 3S-PR)
24,655	30	Woods, Good, HSG A (1S-PR, 2S-PR)
44	77	Woods, Good, HSG D (2S-PR)
99,490	**61**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
98,488	HSG A	1S-PR, 2S-PR, 3S-PR
0	HSG B	
0	HSG C	
1,002	HSG D	2S-PR
0	Other	
99,490		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
33,439	0	0	958	0	34,397	>75% Grass cover, Good
27,051	0	0	0	0	27,051	Paved parking
348	0	0	0	0	348	Paved roads w/open ditches, 50% imp
12,995	0	0	0	0	12,995	Unconnected roofs
24,655	0	0	44	0	24,699	Woods, Good
98,488	**0**	**0**	**1,002**	**0**	**99,490**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P-PR	215.50	215.25	1.0	0.2500	0.013	15.0	0.0	0.0
2	1P-PR	215.50	215.25	66.0	0.0038	0.013	4.0	0.0	0.0
3	2P-PR	217.00	215.50	192.0	0.0078	0.013	15.0	0.0	0.0
4	2P-PR	217.00	215.50	197.0	0.0076	0.013	4.0	0.0	0.0
5	OCS-1	215.25	215.00	72.0	0.0035	0.013	15.0	0.0	0.0

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S-PR: Proposed Runoff Area=48,047 sf 42.79% Impervious Runoff Depth=0.51"
Flow Length=210' Tc=6.0 min CN=62 Runoff=0.43 cfs 2,030 cf

Subcatchment 2S-PR: Proposed Runoff Area=43,283 sf 26.57% Impervious Runoff Depth=0.21"
Flow Length=207' Tc=58.2 min CN=53 Runoff=0.03 cfs 770 cf

Subcatchment 3S-PR: Proposed Runoff Area=8,160 sf 100.00% Impervious Runoff Depth=3.03"
Tc=6.0 min CN=98 Runoff=0.63 cfs 2,059 cf

Pond 1P: Existing Ground Depression - Peak Elev=213.25' Storage=1,015 cf Inflow=0.10 cfs 4,858 cf
Discarded=0.07 cfs 4,524 cf Primary=0.00 cfs 0 cf Outflow=0.07 cfs 4,524 cf

Pond 1P-PR: Sand Filter Bed #1 Peak Elev=220.68' Storage=1,326 cf Inflow=1.05 cfs 4,088 cf
Primary=0.08 cfs 4,089 cf Tertiary=0.00 cfs 0 cf Outflow=0.08 cfs 4,089 cf

Pond 2P-PR: Sand Filter Bed #2 Peak Elev=218.51' Storage=4 cf Inflow=0.03 cfs 770 cf
Outflow=0.03 cfs 770 cf

Pond OCS-1: Outlet to Existing Depression Peak Elev=215.44' Inflow=0.10 cfs 4,858 cf
15.0" Round Culvert n=0.013 L=72.0' S=0.0035 '/' Outflow=0.10 cfs 4,858 cf

Total Runoff Area = 99,490 sf Runoff Volume = 4,858 cf Average Runoff Depth = 0.59"
59.57% Pervious = 59,270 sf 40.43% Impervious = 40,220 sf

Summary for Subcatchment 1S-PR: Proposed Subcatchment 1 (East Side)

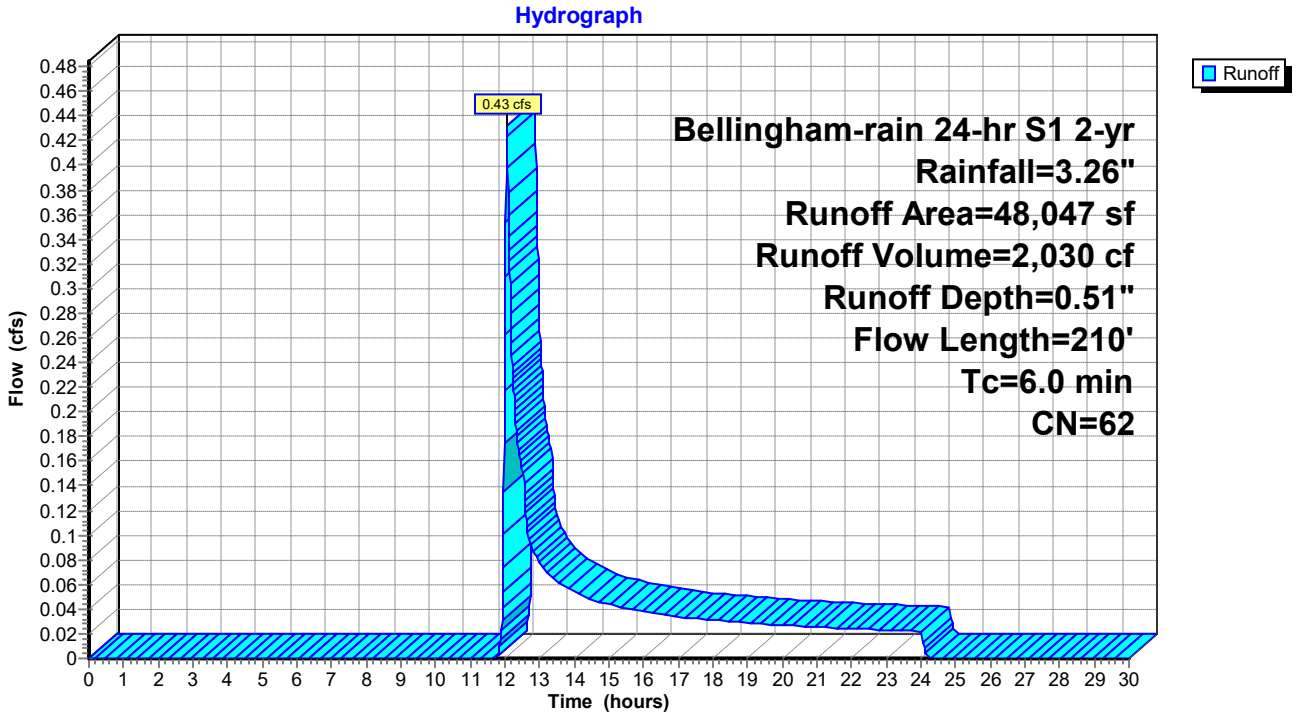
Runoff = 0.43 cfs @ 12.05 hrs, Volume= 2,030 cf, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 2-yr Rainfall=3.26"

Area (sf)	CN	Description
4,835	98	Unconnected roofs, HSG A
15,682	98	Paved parking, HSG A
87	83	Paved roads w/open ditches, 50% imp, HSG A
17,555	39	>75% Grass cover, Good, HSG A
9,888	30	Woods, Good, HSG A
48,047	62	Weighted Average
27,487		57.21% Pervious Area
20,561		42.79% Impervious Area
4,835		23.52% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	35	0.0200	0.97		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 2.40"
0.9	95	0.0150	1.84		**Shallow Concentrated Flow, SCF 1** Grassed Waterway Kv= 15.0 fps
1.7	80	0.0027	0.78		**Shallow Concentrated Flow, SCF 2** Grassed Waterway Kv= 15.0 fps
3.2	210	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S-PR: Proposed Subcatchment 1 (East Side)



Summary for Subcatchment 2S-PR: Proposed Subcatchment 2 (West Side)

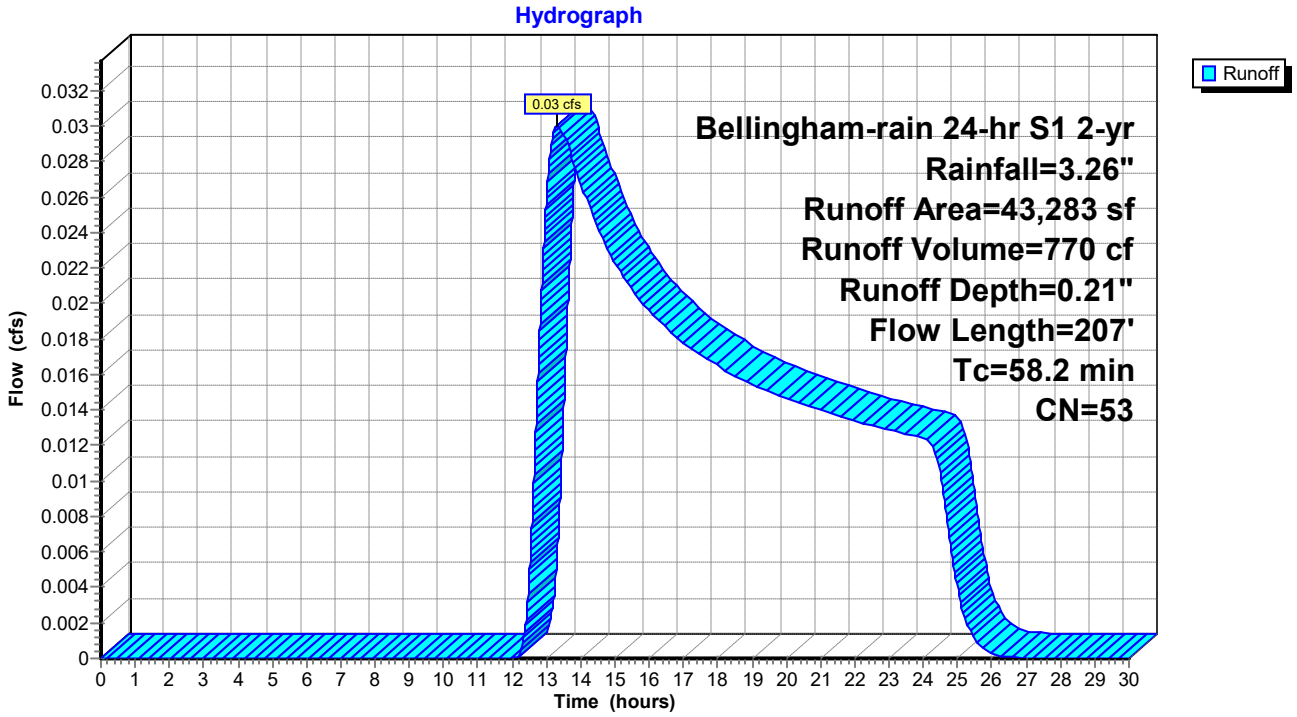
Runoff = 0.03 cfs @ 13.32 hrs, Volume= 770 cf, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 2-yr Rainfall=3.26"

Area (sf)	CN	Description
11,369	98	Paved parking, HSG A
261	83	Paved roads w/open ditches, 50% imp, HSG A
15,884	39	>75% Grass cover, Good, HSG A
958	80	>75% Grass cover, Good, HSG D
14,767	30	Woods, Good, HSG A
44	77	Woods, Good, HSG D
43,283	53	Weighted Average
31,784		73.43% Pervious Area
11,500		26.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
57.0	100	0.0100	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 2.40"
0.1	19	0.1580	5.96		**Shallow Concentrated Flow, SCF 1** Grassed Waterway Kv= 15.0 fps
1.1	88	0.0080	1.34		**Shallow Concentrated Flow, SCF 2** Grassed Waterway Kv= 15.0 fps
58.2	207	Total			

Subcatchment 2S-PR: Proposed Subcatchment 2 (West Side)



Summary for Subcatchment 3S-PR: Proposed Subcatchment 3 - PFAS Bldg Roof

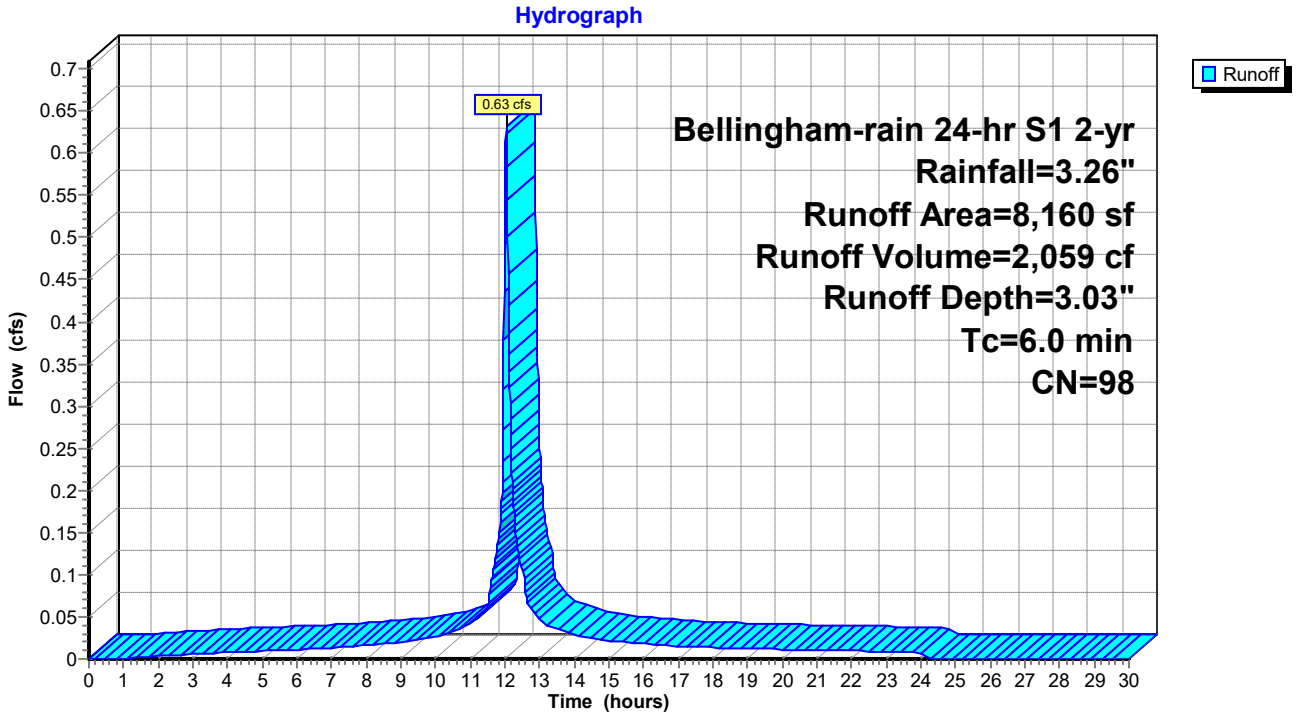
Runoff = 0.63 cfs @ 12.04 hrs, Volume= 2,059 cf, Depth= 3.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 2-yr Rainfall=3.26"

Area (sf)	CN	Description
8,160	98	Unconnected roofs, HSG A
8,160		100.00% Impervious Area
8,160		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 3S-PR: Proposed Subcatchment 3 - PFAS Bldg Roof



Summary for Pond 1P: Existing Ground Depression - Modified in PR

Inflow Area = 99,490 sf, 40.43% Impervious, Inflow Depth = 0.59" for 2-yr event
Inflow = 0.10 cfs @ 14.20 hrs, Volume= 4,858 cf
Outflow = 0.07 cfs @ 21.25 hrs, Volume= 4,524 cf, Atten= 32%, Lag= 422.7 min
Discarded = 0.07 cfs @ 21.25 hrs, Volume= 4,524 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 213.25' @ 21.25 hrs Surf.Area= 1,198 sf Storage= 1,015 cf
Flood Elev= 221.50' Surf.Area= 8,367 sf Storage= 37,062 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 128.6 min (1,183.4 - 1,054.8)

Volume	Invert	Avail.Storage	Storage Description
#1	212.00'	50,199 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

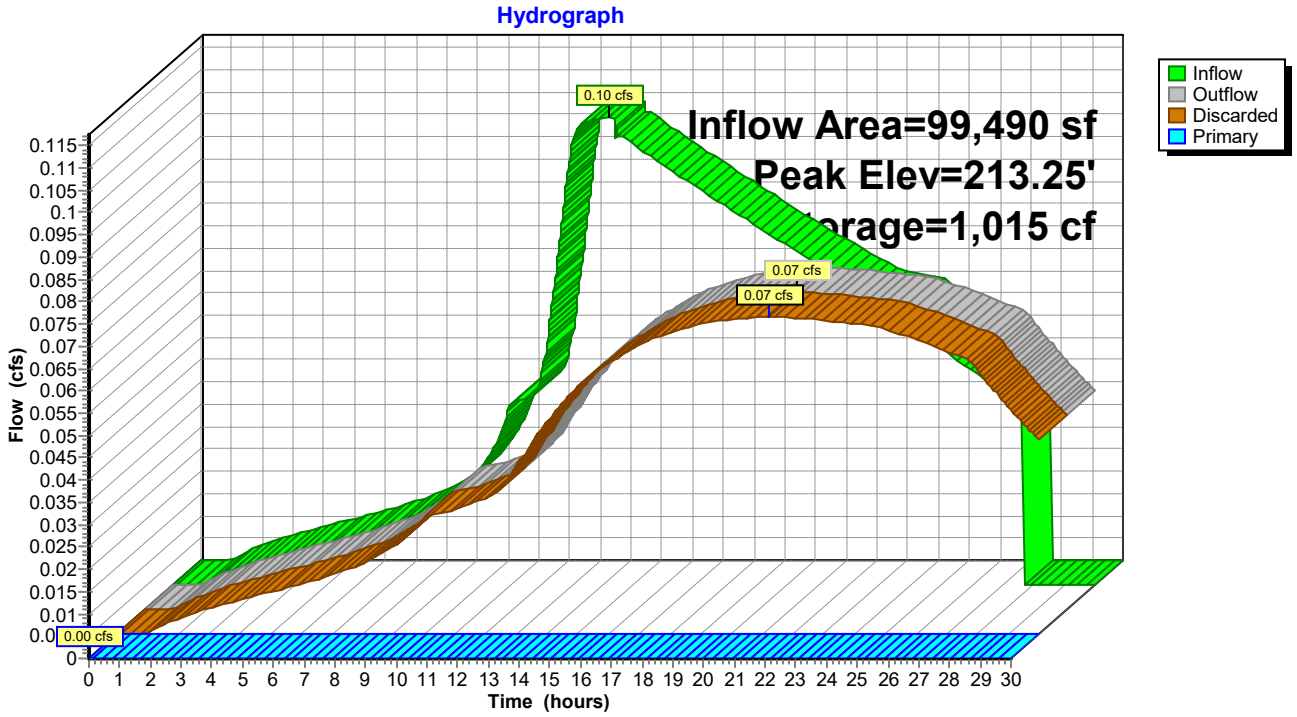
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
212.00	483	0	0	483
214.00	1,785	2,131	2,131	1,805
216.00	3,112	4,836	6,967	3,177
218.00	4,692	7,750	14,717	4,817
220.00	6,547	11,188	25,905	6,746
221.50	8,367	11,158	37,062	8,623
222.00	50,000	13,137	50,199	50,257

Device	Routing	Invert	Outlet Devices
#1	Primary	221.50'	**24.2' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	212.00'	**2.400 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 200.00'

Discarded OutFlow Max=0.07 cfs @ 21.25 hrs HW=213.25' (Free Discharge)
↑└**2=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.00' (Free Discharge)
↑└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Existing Ground Depression - Modified in PR



Summary for Pond 1P-PR: Sand Filter Bed #1

Inflow Area = 56,207 sf, 51.10% Impervious, Inflow Depth = 0.87" for 2-yr event
Inflow = 1.05 cfs @ 12.04 hrs, Volume= 4,088 cf
Outflow = 0.08 cfs @ 14.27 hrs, Volume= 4,089 cf, Atten= 93%, Lag= 133.7 min
Primary = 0.08 cfs @ 14.27 hrs, Volume= 4,089 cf
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 220.68' @ 14.27 hrs Surf.Area= 1,119 sf Storage= 1,326 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 198.7 min (1,051.7 - 852.9)

Volume	Invert	Avail.Storage	Storage Description
#1	217.99'	7,511 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

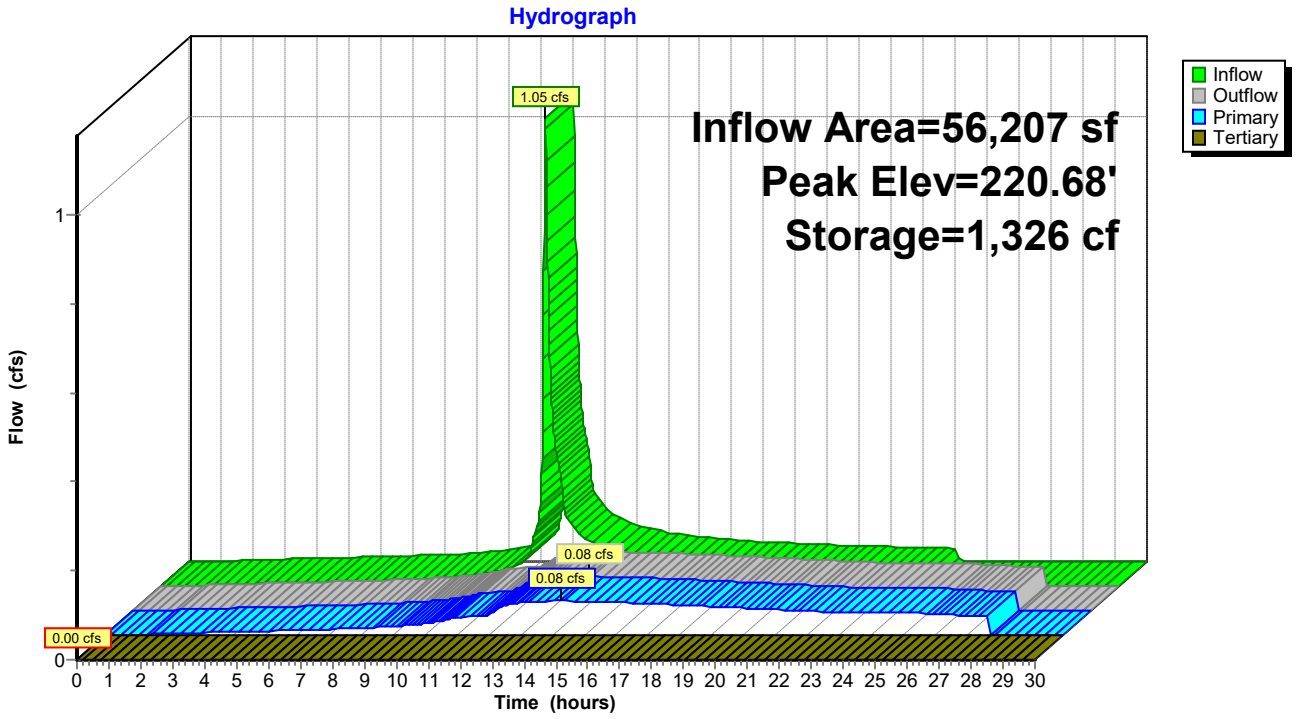
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
217.99	740	0.0	0	0	740
218.00	740	30.0	2	2	741
219.50	740	30.0	333	335	886
219.51	740	20.0	1	337	887
220.00	740	100.0	363	699	934
221.00	1,326	100.0	1,019	1,718	1,531
222.00	2,795	100.0	2,015	3,734	3,008
223.00	4,855	100.0	3,778	7,511	5,079

Device	Routing	Invert	Outlet Devices
#1	Primary	215.50'	**15.0" Round Culvert** L= 1.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 215.50' / 215.25' S= 0.2500 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	215.50'	**4.0" Round Culvert** L= 66.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 215.50' / 215.25' S= 0.0038 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#3	Device 2	217.99'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 210.00'
#4	Tertiary	222.00'	**11.0' long x 6.0' 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) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#5	Primary	221.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.08 cfs @ 14.27 hrs HW=220.68' TW=215.44' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.08 cfs of 9.95 cfs potential flow)
  - **2=Culvert** (Passes 0.08 cfs of 0.49 cfs potential flow)
    - **3=Exfiltration** (Controls 0.08 cfs)
- **5=Orifice/Grate** (Controls 0.00 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=217.99' TW=212.00' (Dynamic Tailwater)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P-PR: Sand Filter Bed #1



Summary for Pond 2P-PR: Sand Filter Bed #2

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=11)

Inflow Area = 43,283 sf, 26.57% Impervious, Inflow Depth = 0.21" for 2-yr event
Inflow = 0.03 cfs @ 13.32 hrs, Volume= 770 cf
Outflow = 0.03 cfs @ 13.80 hrs, Volume= 770 cf, Atten= 7%, Lag= 28.5 min
Primary = 0.03 cfs @ 13.80 hrs, Volume= 770 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 218.51' @ 13.80 hrs Surf.Area= 500 sf Storage= 4 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.2 min (1,071.2 - 1,071.0)

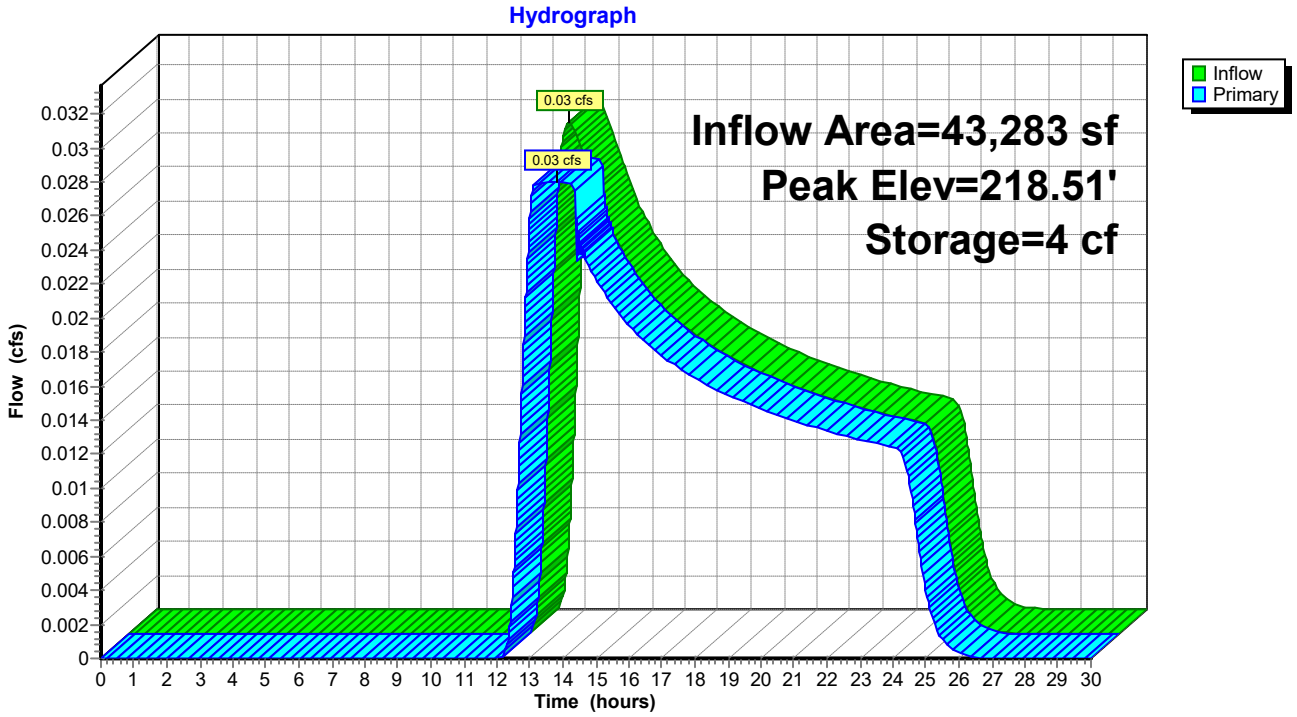
Volume	Invert	Avail.Storage	Storage Description
#1	218.49'	3,460 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.49	500	0.0	0	0	500
218.50	500	30.0	1	1	501
220.49	500	30.0	299	300	659
220.50	500	100.0	5	305	659
221.00	657	100.0	288	593	822
222.00	1,026	100.0	835	1,428	1,205
223.00	3,245	100.0	2,032	3,460	3,429

Device	Routing	Invert	Outlet Devices
#1	Primary	217.00'	**15.0" Round Culvert** L= 192.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.00' / 215.50' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	217.00'	**4.0" Round Culvert** L= 197.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 217.00' / 215.50' S= 0.0076 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#3	Device 2	218.49'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 210.00'
#4	Device 1	222.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.03 cfs @ 13.80 hrs HW=218.51' TW=215.44' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.03 cfs of 4.40 cfs potential flow)
  - **2=Culvert** (Passes 0.03 cfs of 0.16 cfs potential flow)
    - **3=Exfiltration** (Controls 0.03 cfs)
  - **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P-PR: Sand Filter Bed #2



Summary for Pond OCS-1: Outlet to Existing Depression

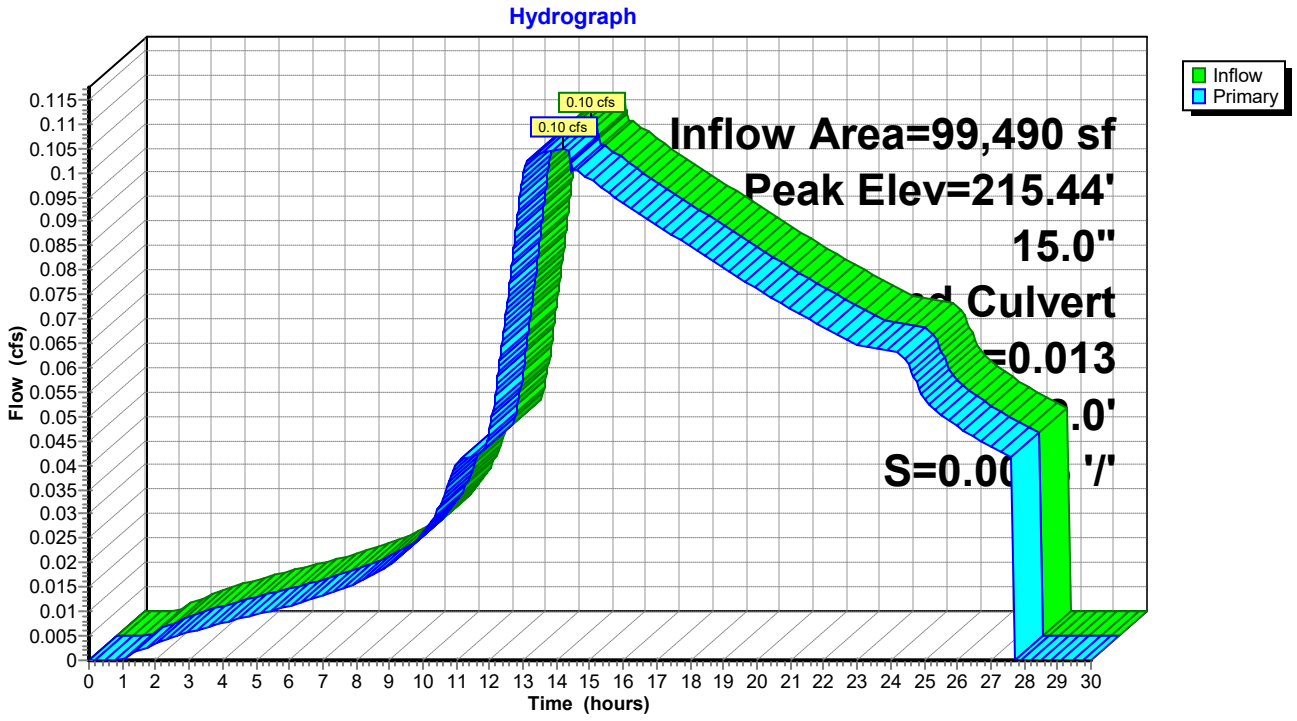
Inflow Area = 99,490 sf, 40.43% Impervious, Inflow Depth = 0.59" for 2-yr event
Inflow = 0.10 cfs @ 14.20 hrs, Volume= 4,858 cf
Outflow = 0.10 cfs @ 14.20 hrs, Volume= 4,858 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 14.20 hrs, Volume= 4,858 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 215.44' @ 14.20 hrs
Flood Elev= 222.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	215.25'	**15.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 215.25' / 215.00' S= 0.0035 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.10 cfs @ 14.20 hrs HW=215.44' TW=212.71' (Dynamic Tailwater)
1=Culvert (Barrel Controls 0.10 cfs @ 1.34 fps)

Pond OCS-1: Outlet to Existing Depression



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S-PR: Proposed Runoff Area=48,047 sf 42.79% Impervious Runoff Depth=1.36"
Flow Length=210' Tc=6.0 min CN=62 Runoff=1.53 cfs 5,465 cf

Subcatchment 2S-PR: Proposed Runoff Area=43,283 sf 26.57% Impervious Runoff Depth=0.81"
Flow Length=207' Tc=58.2 min CN=53 Runoff=0.23 cfs 2,907 cf

Subcatchment 3S-PR: Proposed Runoff Area=8,160 sf 100.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=98 Runoff=0.88 cfs 3,157 cf

Pond 1P: Existing Ground Depression - Peak Elev=214.64' Storage=3,390 cf Inflow=0.54 cfs 11,234 cf
Discarded=0.14 cfs 8,570 cf Primary=0.00 cfs 0 cf Outflow=0.14 cfs 8,570 cf

Pond 1P-PR: Sand Filter Bed #1 Peak Elev=221.61' Storage=2,767 cf Inflow=2.40 cfs 8,622 cf
Primary=0.51 cfs 8,327 cf Tertiary=0.00 cfs 0 cf Outflow=0.51 cfs 8,327 cf

Pond 2P-PR: Sand Filter Bed #2 Peak Elev=221.48' Storage=950 cf Inflow=0.23 cfs 2,907 cf
Outflow=0.06 cfs 2,907 cf

Pond OCS-1: Outlet to Existing Depression Peak Elev=215.68' Inflow=0.54 cfs 11,234 cf
15.0" Round Culvert n=0.013 L=72.0' S=0.0035 '/' Outflow=0.54 cfs 11,234 cf

Total Runoff Area = 99,490 sf Runoff Volume = 11,529 cf Average Runoff Depth = 1.39"
59.57% Pervious = 59,270 sf 40.43% Impervious = 40,220 sf

Summary for Subcatchment 1S-PR: Proposed Subcatchment 1 (East Side)

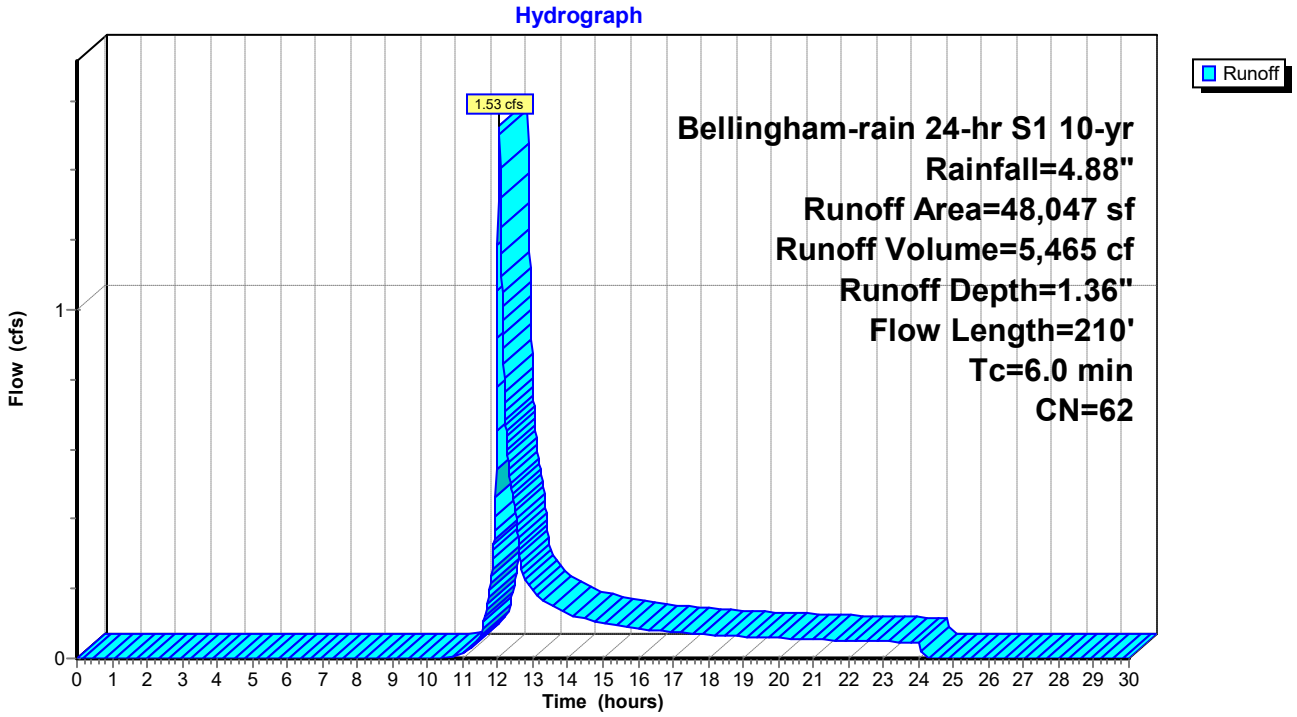
Runoff = 1.53 cfs @ 12.04 hrs, Volume= 5,465 cf, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 10-yr Rainfall=4.88"

Area (sf)	CN	Description
4,835	98	Unconnected roofs, HSG A
15,682	98	Paved parking, HSG A
87	83	Paved roads w/open ditches, 50% imp, HSG A
17,555	39	>75% Grass cover, Good, HSG A
9,888	30	Woods, Good, HSG A
48,047	62	Weighted Average
27,487		57.21% Pervious Area
20,561		42.79% Impervious Area
4,835		23.52% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	35	0.0200	0.97		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 2.40"
0.9	95	0.0150	1.84		**Shallow Concentrated Flow, SCF 1** Grassed Waterway Kv= 15.0 fps
1.7	80	0.0027	0.78		**Shallow Concentrated Flow, SCF 2** Grassed Waterway Kv= 15.0 fps
3.2	210	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S-PR: Proposed Subcatchment 1 (East Side)



Summary for Subcatchment 2S-PR: Proposed Subcatchment 2 (West Side)

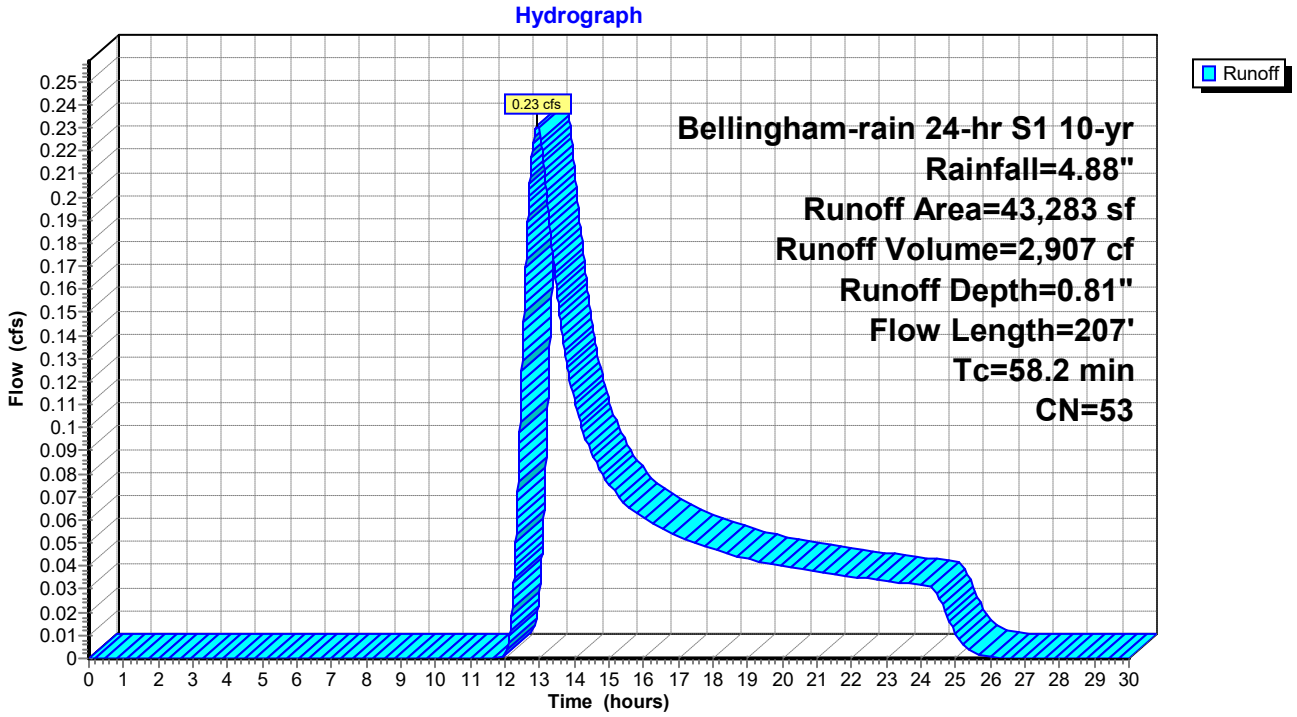
Runoff = 0.23 cfs @ 12.93 hrs, Volume= 2,907 cf, Depth= 0.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 10-yr Rainfall=4.88"

Area (sf)	CN	Description
11,369	98	Paved parking, HSG A
261	83	Paved roads w/open ditches, 50% imp, HSG A
15,884	39	>75% Grass cover, Good, HSG A
958	80	>75% Grass cover, Good, HSG D
14,767	30	Woods, Good, HSG A
44	77	Woods, Good, HSG D
43,283	53	Weighted Average
31,784		73.43% Pervious Area
11,500		26.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
57.0	100	0.0100	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 2.40"
0.1	19	0.1580	5.96		**Shallow Concentrated Flow, SCF 1** Grassed Waterway Kv= 15.0 fps
1.1	88	0.0080	1.34		**Shallow Concentrated Flow, SCF 2** Grassed Waterway Kv= 15.0 fps
58.2	207	Total			

Subcatchment 2S-PR: Proposed Subcatchment 2 (West Side)



Summary for Subcatchment 3S-PR: Proposed Subcatchment 3 - PFAS Bldg Roof

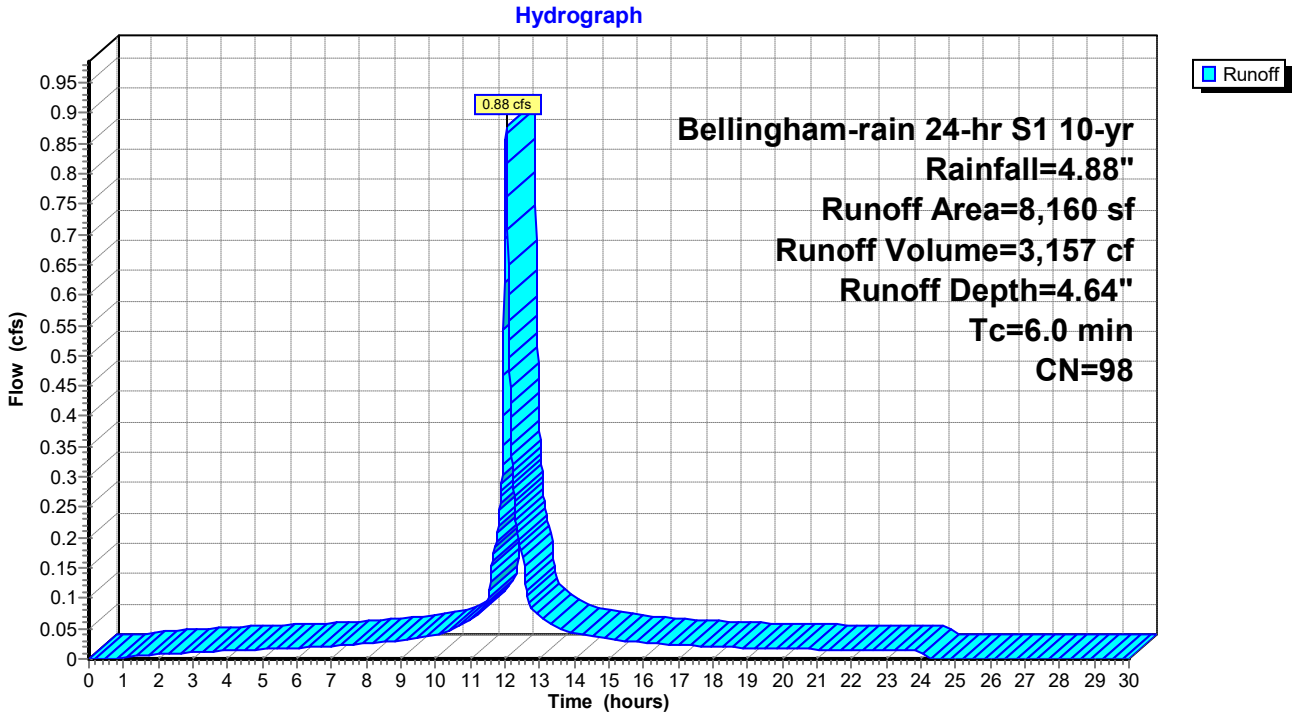
Runoff = 0.88 cfs @ 12.04 hrs, Volume= 3,157 cf, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 10-yr Rainfall=4.88"

Area (sf)	CN	Description
8,160	98	Unconnected roofs, HSG A
8,160		100.00% Impervious Area
8,160		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 3S-PR: Proposed Subcatchment 3 - PFAS Bldg Roof



Summary for Pond 1P: Existing Ground Depression - Modified in PR

Inflow Area = 99,490 sf, 40.43% Impervious, Inflow Depth > 1.36" for 10-yr event
Inflow = 0.54 cfs @ 12.57 hrs, Volume= 11,234 cf
Outflow = 0.14 cfs @ 23.78 hrs, Volume= 8,570 cf, Atten= 75%, Lag= 672.8 min
Discarded = 0.14 cfs @ 23.78 hrs, Volume= 8,570 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 214.64' @ 23.78 hrs Surf.Area= 2,168 sf Storage= 3,390 cf
Flood Elev= 221.50' Surf.Area= 8,367 sf Storage= 37,062 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 129.5 min (1,221.5 - 1,092.1)

Volume	Invert	Avail.Storage	Storage Description
#1	212.00'	50,199 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

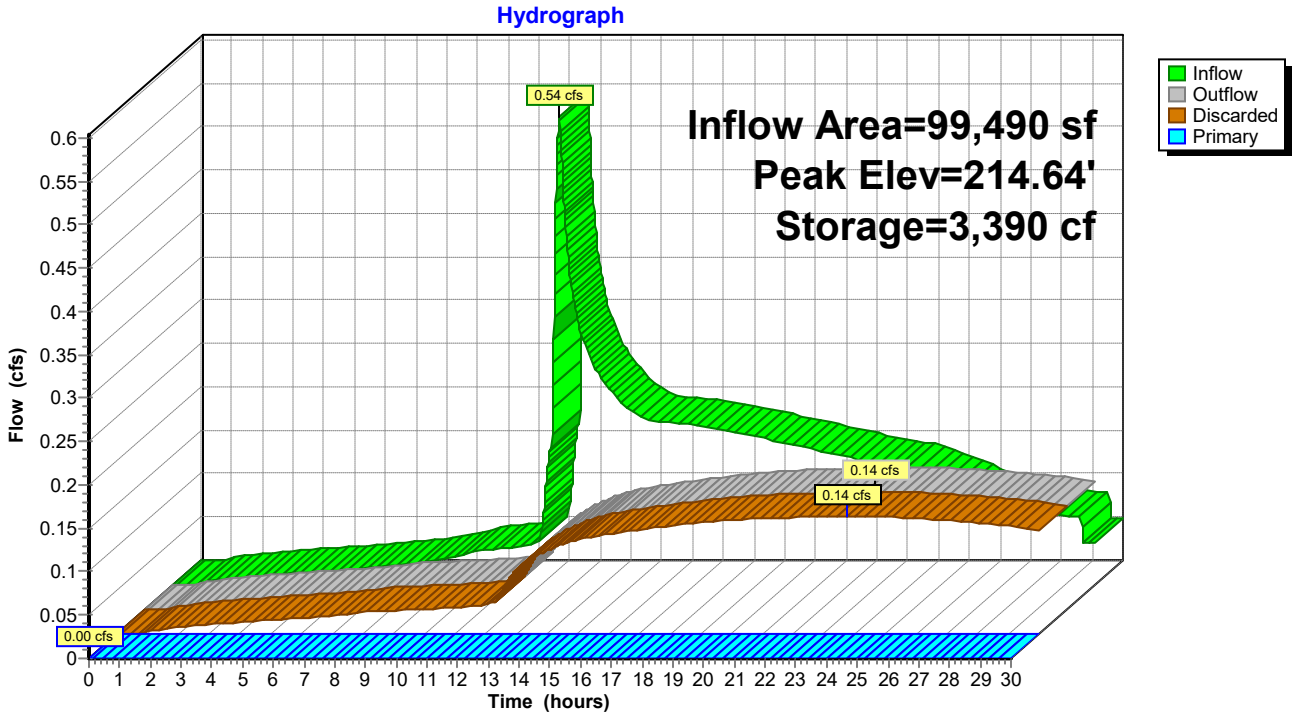
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
212.00	483	0	0	483
214.00	1,785	2,131	2,131	1,805
216.00	3,112	4,836	6,967	3,177
218.00	4,692	7,750	14,717	4,817
220.00	6,547	11,188	25,905	6,746
221.50	8,367	11,158	37,062	8,623
222.00	50,000	13,137	50,199	50,257

Device	Routing	Invert	Outlet Devices
#1	Primary	221.50'	**24.2' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	212.00'	**2.400 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 200.00'

Discarded OutFlow Max=0.14 cfs @ 23.78 hrs HW=214.64' (Free Discharge)
2=Exfiltration (Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Existing Ground Depression - Modified in PR



Summary for Pond 1P-PR: Sand Filter Bed #1

Inflow Area = 56,207 sf, 51.10% Impervious, Inflow Depth = 1.84" for 10-yr event
Inflow = 2.40 cfs @ 12.04 hrs, Volume= 8,622 cf
Outflow = 0.51 cfs @ 12.57 hrs, Volume= 8,327 cf, Atten= 79%, Lag= 31.6 min
Primary = 0.51 cfs @ 12.57 hrs, Volume= 8,327 cf
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 221.61' @ 12.57 hrs Surf.Area= 2,155 sf Storage= 2,767 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 199.4 min (1,047.8 - 848.4)

Volume	Invert	Avail.Storage	Storage Description
#1	217.99'	7,511 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

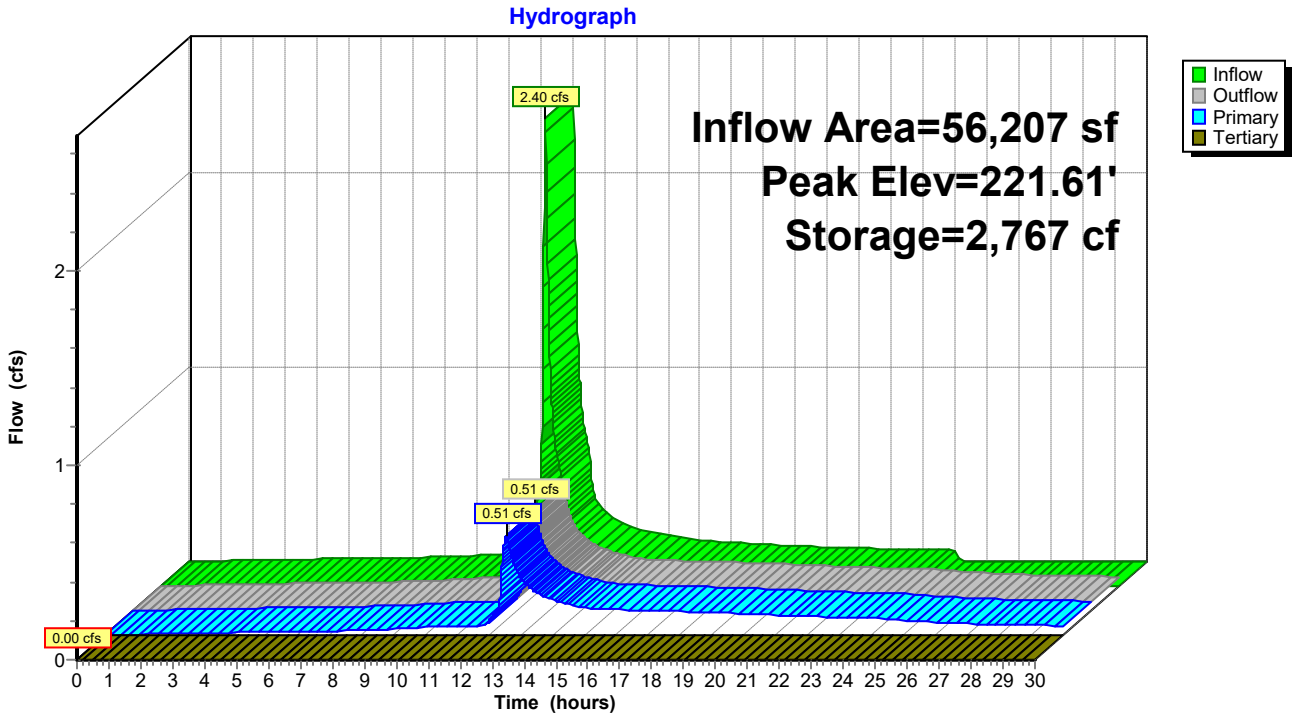
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
217.99	740	0.0	0	0	740
218.00	740	30.0	2	2	741
219.50	740	30.0	333	335	886
219.51	740	20.0	1	337	887
220.00	740	100.0	363	699	934
221.00	1,326	100.0	1,019	1,718	1,531
222.00	2,795	100.0	2,015	3,734	3,008
223.00	4,855	100.0	3,778	7,511	5,079

Device	Routing	Invert	Outlet Devices
#1	Primary	215.50'	**15.0" Round Culvert** L= 1.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 215.50' / 215.25' S= 0.2500 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	215.50'	**4.0" Round Culvert** L= 66.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 215.50' / 215.25' S= 0.0038 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#3	Device 2	217.99'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 210.00'
#4	Tertiary	222.00'	**11.0' long x 6.0' 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) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#5	Primary	221.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.51 cfs @ 12.57 hrs HW=221.61' TW=215.68' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.14 cfs of 10.92 cfs potential flow)
  - **2=Culvert** (Passes 0.14 cfs of 0.53 cfs potential flow)
    - **3=Exfiltration** (Controls 0.14 cfs)
- **5=Orifice/Grate** (Weir Controls 0.37 cfs @ 1.08 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=217.99' TW=212.00' (Dynamic Tailwater)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P-PR: Sand Filter Bed #1



Summary for Pond 2P-PR: Sand Filter Bed #2

Inflow Area = 43,283 sf, 26.57% Impervious, Inflow Depth = 0.81" for 10-yr event
Inflow = 0.23 cfs @ 12.93 hrs, Volume= 2,907 cf
Outflow = 0.06 cfs @ 16.46 hrs, Volume= 2,907 cf, Atten= 76%, Lag= 211.6 min
Primary = 0.06 cfs @ 16.46 hrs, Volume= 2,907 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 221.48' @ 16.46 hrs Surf.Area= 825 sf Storage= 950 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 225.5 min (1,218.9 - 993.4)

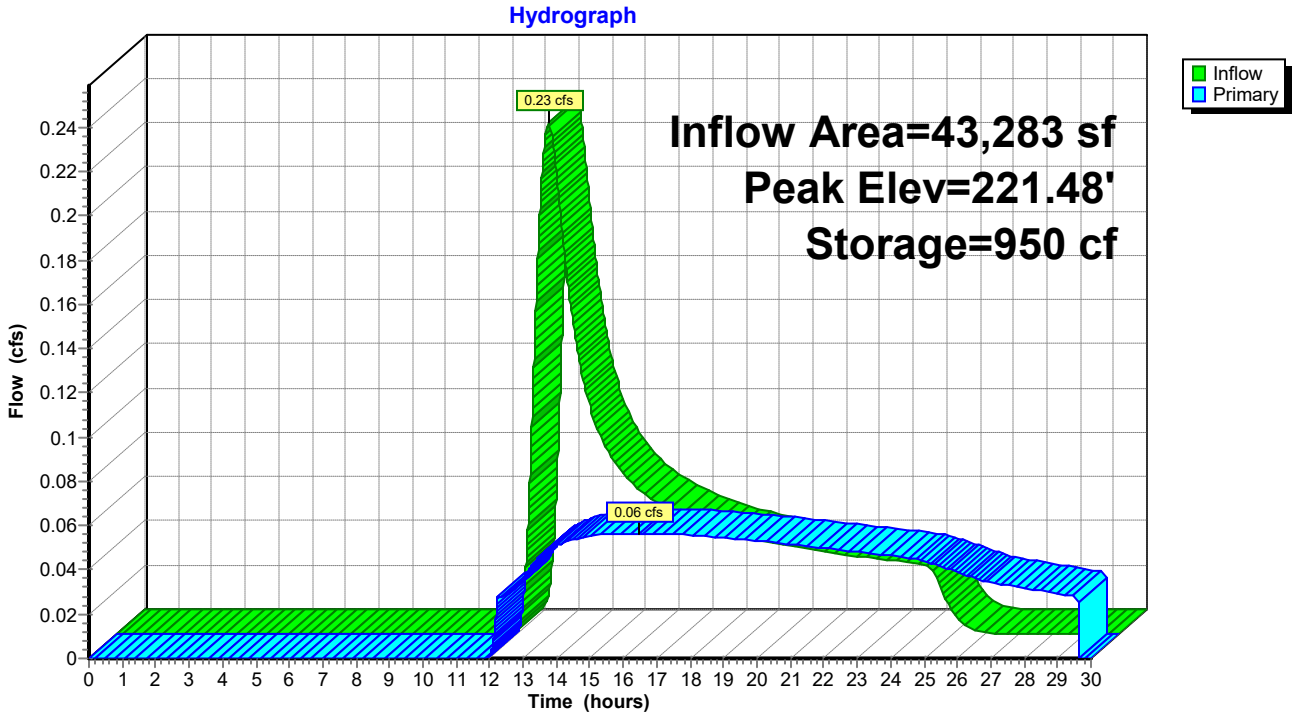
Volume	Invert	Avail.Storage	Storage Description
#1	218.49'	3,460 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.49	500	0.0	0	0	500
218.50	500	30.0	1	1	501
220.49	500	30.0	299	300	659
220.50	500	100.0	5	305	659
221.00	657	100.0	288	593	822
222.00	1,026	100.0	835	1,428	1,205
223.00	3,245	100.0	2,032	3,460	3,429

Device	Routing	Invert	Outlet Devices
#1	Primary	217.00'	**15.0" Round Culvert** L= 192.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.00' / 215.50' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	217.00'	**4.0" Round Culvert** L= 197.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 217.00' / 215.50' S= 0.0076 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#3	Device 2	218.49'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 210.00'
#4	Device 1	222.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.06 cfs @ 16.46 hrs HW=221.48' TW=215.50' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.06 cfs of 8.48 cfs potential flow)
  - **2=Culvert** (Passes 0.06 cfs of 0.28 cfs potential flow)
    - **3=Exfiltration** (Controls 0.06 cfs)
  - **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P-PR: Sand Filter Bed #2



Summary for Pond OCS-1: Outlet to Existing Depression

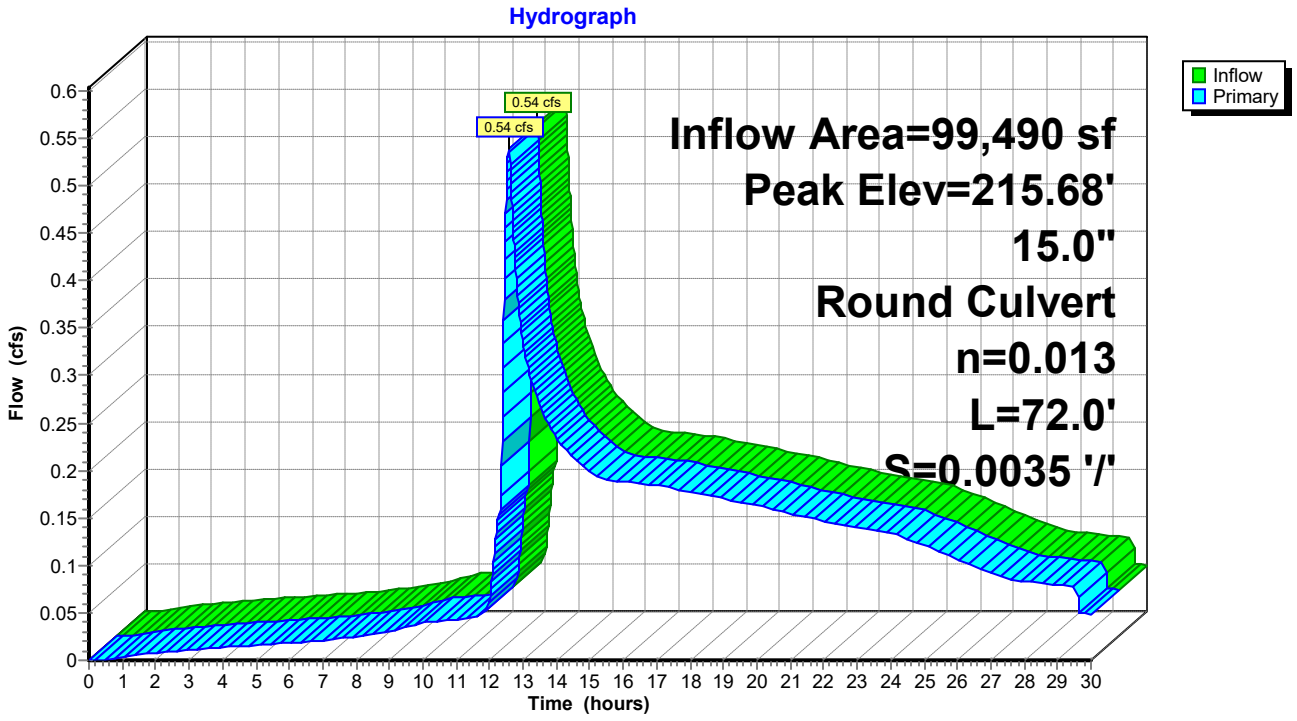
Inflow Area = 99,490 sf, 40.43% Impervious, Inflow Depth > 1.36" for 10-yr event
Inflow = 0.54 cfs @ 12.57 hrs, Volume= 11,234 cf
Outflow = 0.54 cfs @ 12.57 hrs, Volume= 11,234 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.54 cfs @ 12.57 hrs, Volume= 11,234 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 215.68' @ 12.57 hrs
Flood Elev= 222.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	215.25'	**15.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 215.25' / 215.00' S= 0.0035 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.54 cfs @ 12.57 hrs HW=215.68' TW=212.77' (Dynamic Tailwater)
1=Culvert (Barrel Controls 0.54 cfs @ 2.12 fps)

Pond OCS-1: Outlet to Existing Depression



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S-PR: Proposed Runoff Area=48,047 sf 42.79% Impervious Runoff Depth=4.14"
Flow Length=210' Tc=6.0 min CN=62 Runoff=4.71 cfs 16,570 cf

Subcatchment 2S-PR: Proposed Runoff Area=43,283 sf 26.57% Impervious Runoff Depth=3.06"
Flow Length=207' Tc=58.2 min CN=53 Runoff=1.13 cfs 11,055 cf

Subcatchment 3S-PR: Proposed Runoff Area=8,160 sf 100.00% Impervious Runoff Depth=8.50"
Tc=6.0 min CN=98 Runoff=1.44 cfs 5,780 cf

Pond 1P: Existing Ground Depression - Peak Elev=218.19' Storage=15,623 cf Inflow=4.71 cfs 32,217 cf
Discarded=0.33 cfs 20,974 cf Primary=0.00 cfs 0 cf Outflow=0.33 cfs 20,974 cf

Pond 1P-PR: Sand Filter Bed #1 Peak Elev=222.14' Storage=4,157 cf Inflow=6.15 cfs 22,350 cf
Primary=3.24 cfs 20,943 cf Tertiary=1.44 cfs 672 cf Outflow=4.68 cfs 21,616 cf

Pond 2P-PR: Sand Filter Bed #2 Peak Elev=222.21' Storage=1,686 cf Inflow=1.13 cfs 11,055 cf
Outflow=1.11 cfs 10,602 cf

Pond OCS-1: Outlet to Existing Depression Peak Elev=218.19' Inflow=3.27 cfs 31,545 cf
15.0" Round Culvert n=0.013 L=72.0' S=0.0035 '/' Outflow=3.27 cfs 31,545 cf

Total Runoff Area = 99,490 sf Runoff Volume = 33,405 cf Average Runoff Depth = 4.03"
59.57% Pervious = 59,270 sf 40.43% Impervious = 40,220 sf

Summary for Subcatchment 1S-PR: Proposed Subcatchment 1 (East Side)

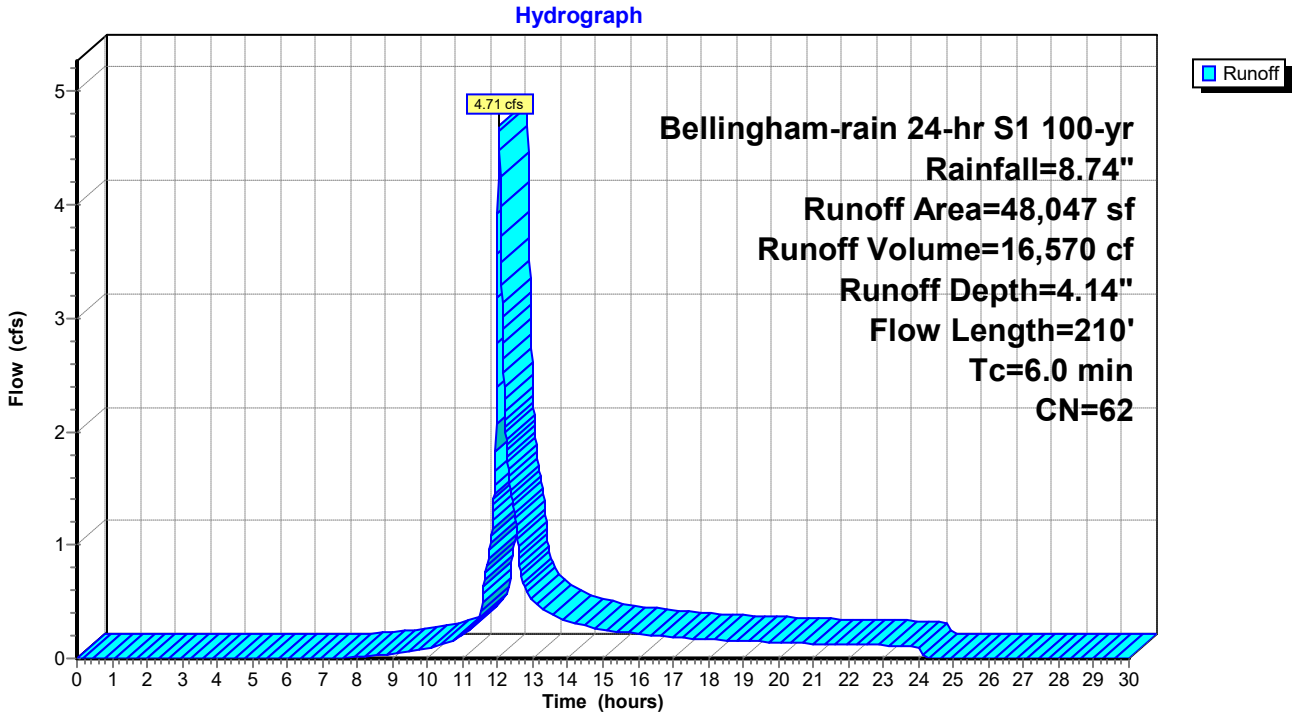
Runoff = 4.71 cfs @ 12.04 hrs, Volume= 16,570 cf, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 100-yr Rainfall=8.74"

Area (sf)	CN	Description
4,835	98	Unconnected roofs, HSG A
15,682	98	Paved parking, HSG A
87	83	Paved roads w/open ditches, 50% imp, HSG A
17,555	39	>75% Grass cover, Good, HSG A
9,888	30	Woods, Good, HSG A
48,047	62	Weighted Average
27,487		57.21% Pervious Area
20,561		42.79% Impervious Area
4,835		23.52% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	35	0.0200	0.97		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 2.40"
0.9	95	0.0150	1.84		**Shallow Concentrated Flow, SCF 1** Grassed Waterway Kv= 15.0 fps
1.7	80	0.0027	0.78		**Shallow Concentrated Flow, SCF 2** Grassed Waterway Kv= 15.0 fps
3.2	210	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S-PR: Proposed Subcatchment 1 (East Side)



Summary for Subcatchment 2S-PR: Proposed Subcatchment 2 (West Side)

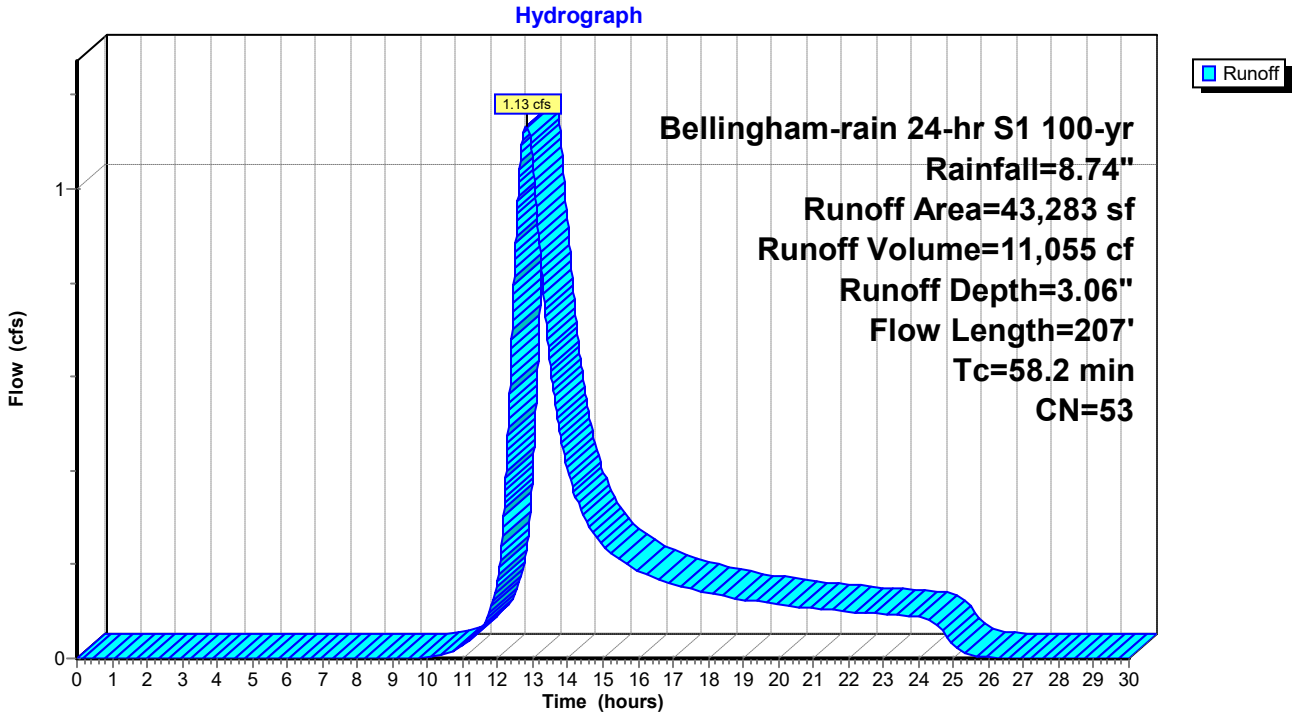
Runoff = 1.13 cfs @ 12.81 hrs, Volume= 11,055 cf, Depth= 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 100-yr Rainfall=8.74"

Area (sf)	CN	Description
11,369	98	Paved parking, HSG A
261	83	Paved roads w/open ditches, 50% imp, HSG A
15,884	39	>75% Grass cover, Good, HSG A
958	80	>75% Grass cover, Good, HSG D
14,767	30	Woods, Good, HSG A
44	77	Woods, Good, HSG D
43,283	53	Weighted Average
31,784		73.43% Pervious Area
11,500		26.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
57.0	100	0.0100	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 2.40"
0.1	19	0.1580	5.96		**Shallow Concentrated Flow, SCF 1** Grassed Waterway Kv= 15.0 fps
1.1	88	0.0080	1.34		**Shallow Concentrated Flow, SCF 2** Grassed Waterway Kv= 15.0 fps
58.2	207	Total			

Subcatchment 2S-PR: Proposed Subcatchment 2 (West Side)



Summary for Subcatchment 3S-PR: Proposed Subcatchment 3 - PFAS Bldg Roof

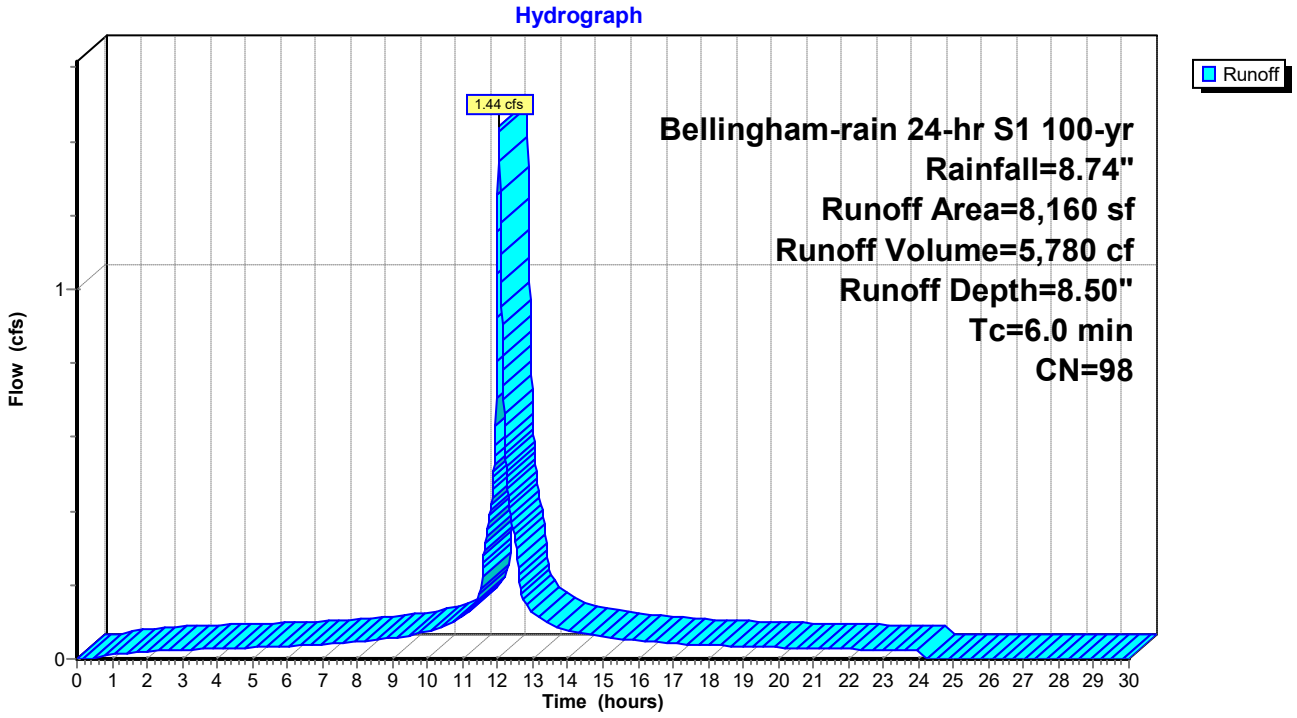
Runoff = 1.44 cfs @ 12.04 hrs, Volume= 5,780 cf, Depth= 8.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Bellingham-rain 24-hr S1 100-yr Rainfall=8.74"

Area (sf)	CN	Description
8,160	98	Unconnected roofs, HSG A
8,160		100.00% Impervious Area
8,160		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 3S-PR: Proposed Subcatchment 3 - PFAS Bldg Roof



Summary for Pond 1P: Existing Ground Depression - Modified in PR

Inflow Area = 99,490 sf, 40.43% Impervious, Inflow Depth > 3.89" for 100-yr event
Inflow = 4.71 cfs @ 12.10 hrs, Volume= 32,217 cf
Outflow = 0.33 cfs @ 18.50 hrs, Volume= 20,974 cf, Atten= 93%, Lag= 384.0 min
Discarded = 0.33 cfs @ 18.50 hrs, Volume= 20,974 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 218.19' @ 18.50 hrs Surf.Area= 4,855 sf Storage= 15,623 cf
Flood Elev= 221.50' Surf.Area= 8,367 sf Storage= 37,062 cf

Plug-Flow detention time= 442.8 min calculated for 20,974 cf (65% of inflow)
Center-of-Mass det. time= 258.1 min (1,216.4 - 958.3)

Volume	Invert	Avail.Storage	Storage Description
#1	212.00'	50,199 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

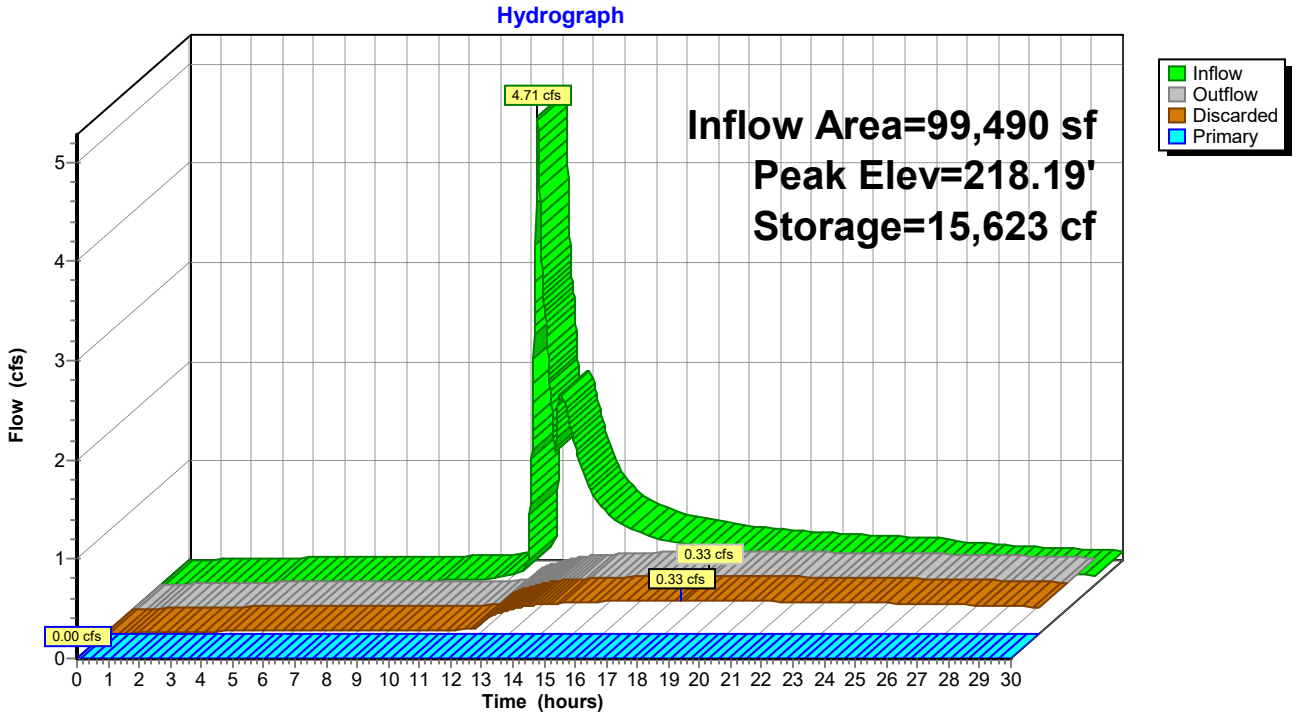
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
212.00	483	0	0	483
214.00	1,785	2,131	2,131	1,805
216.00	3,112	4,836	6,967	3,177
218.00	4,692	7,750	14,717	4,817
220.00	6,547	11,188	25,905	6,746
221.50	8,367	11,158	37,062	8,623
222.00	50,000	13,137	50,199	50,257

Device	Routing	Invert	Outlet Devices
#1	Primary	221.50'	**24.2' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	212.00'	**2.400 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 200.00'

Discarded OutFlow Max=0.33 cfs @ 18.50 hrs HW=218.19' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.33 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.00' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Existing Ground Depression - Modified in PR



Summary for Pond 1P-PR: Sand Filter Bed #1

Inflow Area = 56,207 sf, 51.10% Impervious, Inflow Depth = 4.77" for 100-yr event
Inflow = 6.15 cfs @ 12.04 hrs, Volume= 22,350 cf
Outflow = 4.68 cfs @ 12.10 hrs, Volume= 21,616 cf, Atten= 24%, Lag= 3.4 min
Primary = 3.24 cfs @ 12.10 hrs, Volume= 20,943 cf
Tertiary = 1.44 cfs @ 12.10 hrs, Volume= 672 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 222.14' @ 12.10 hrs Surf.Area= 3,058 sf Storage= 4,157 cf

Plug-Flow detention time= 109.4 min calculated for 21,616 cf (97% of inflow)
Center-of-Mass det. time= 90.1 min (922.0 - 831.9)

Volume	Invert	Avail.Storage	Storage Description
#1	217.99'	7,511 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

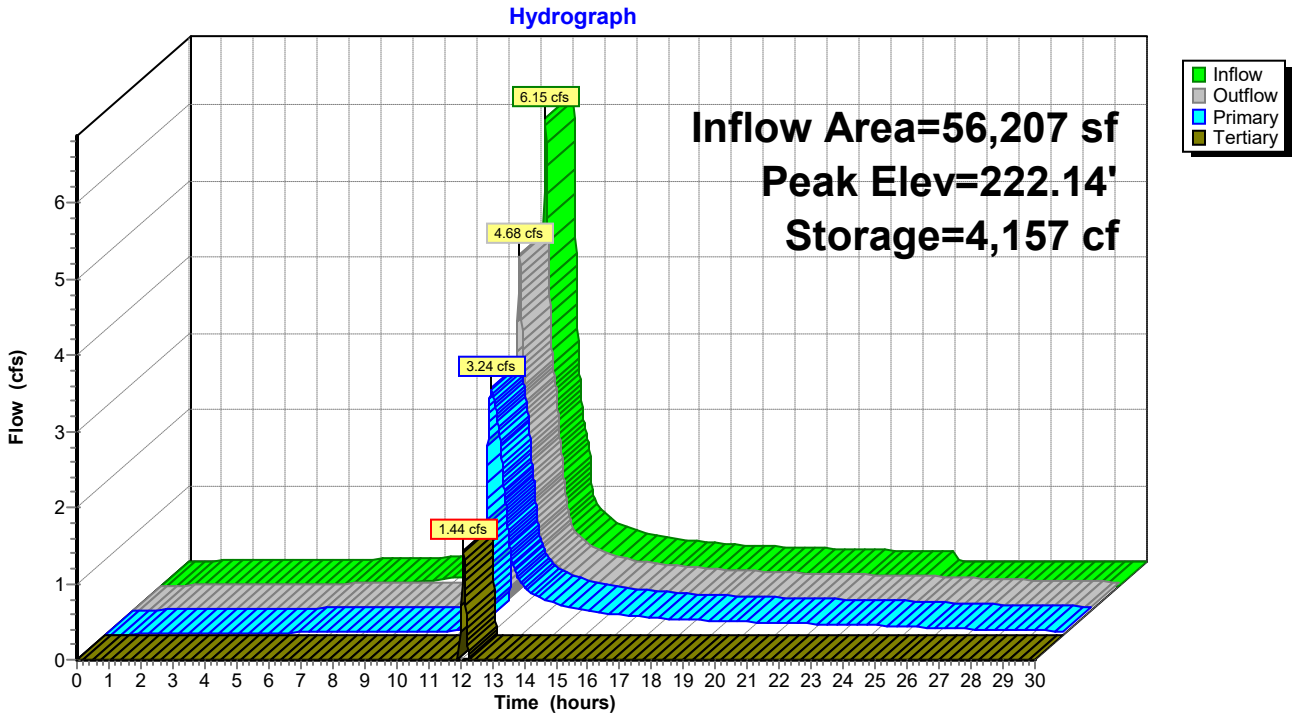
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
217.99	740	0.0	0	0	740
218.00	740	30.0	2	2	741
219.50	740	30.0	333	335	886
219.51	740	20.0	1	337	887
220.00	740	100.0	363	699	934
221.00	1,326	100.0	1,019	1,718	1,531
222.00	2,795	100.0	2,015	3,734	3,008
223.00	4,855	100.0	3,778	7,511	5,079

Device	Routing	Invert	Outlet Devices
#1	Primary	215.50'	**15.0" Round Culvert** L= 1.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 215.50' / 215.25' S= 0.2500 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	215.50'	**4.0" Round Culvert** L= 66.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 215.50' / 215.25' S= 0.0038 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#3	Device 2	217.99'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 210.00'
#4	Tertiary	222.00'	**11.0' long x 6.0' 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) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#5	Primary	221.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.24 cfs @ 12.10 hrs HW=222.14' TW=216.49' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.20 cfs of 11.10 cfs potential flow)
  - **2=Culvert** (Passes 0.20 cfs of 0.51 cfs potential flow)
    - **3=Exfiltration** (Controls 0.20 cfs)
- **5=Orifice/Grate** (Orifice Controls 3.04 cfs @ 3.87 fps)

Tertiary OutFlow Max=1.43 cfs @ 12.10 hrs HW=222.14' TW=214.24' (Dynamic Tailwater)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 1.43 cfs @ 0.90 fps)

Pond 1P-PR: Sand Filter Bed #1



Summary for Pond 2P-PR: Sand Filter Bed #2

Inflow Area = 43,283 sf, 26.57% Impervious, Inflow Depth = 3.06" for 100-yr event
Inflow = 1.13 cfs @ 12.81 hrs, Volume= 11,055 cf
Outflow = 1.11 cfs @ 12.92 hrs, Volume= 10,602 cf, Atten= 2%, Lag= 6.6 min
Primary = 1.11 cfs @ 12.92 hrs, Volume= 10,602 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 222.21' @ 12.92 hrs Surf.Area= 1,396 sf Storage= 1,686 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 94.4 min (1,032.2 - 937.9)

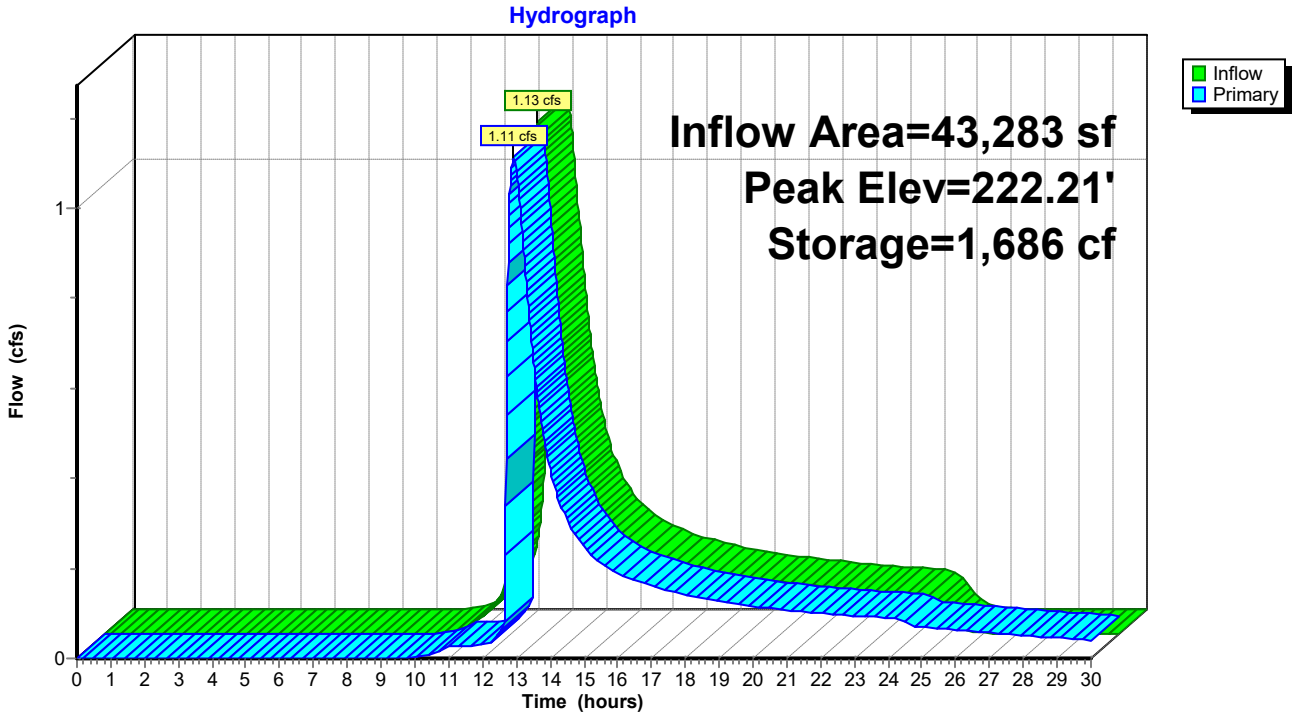
Volume	Invert	Avail.Storage	Storage Description
#1	218.49'	3,460 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.49	500	0.0	0	0	500
218.50	500	30.0	1	1	501
220.49	500	30.0	299	300	659
220.50	500	100.0	5	305	659
221.00	657	100.0	288	593	822
222.00	1,026	100.0	835	1,428	1,205
223.00	3,245	100.0	2,032	3,460	3,429

Device	Routing	Invert	Outlet Devices
#1	Primary	217.00'	**15.0" Round Culvert** L= 192.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.00' / 215.50' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	217.00'	**4.0" Round Culvert** L= 197.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 217.00' / 215.50' S= 0.0076 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#3	Device 2	218.49'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 210.00'
#4	Device 1	222.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.11 cfs @ 12.92 hrs HW=222.21' TW=216.81' (Dynamic Tailwater)
- **1=Culvert** (Passes 1.11 cfs of 9.07 cfs potential flow)
  - **2=Culvert** (Passes 0.09 cfs of 0.30 cfs potential flow)
    - **3=Exfiltration** (Controls 0.09 cfs)
  - **4=Orifice/Grate** (Weir Controls 1.02 cfs @ 1.51 fps)

Pond 2P-PR: Sand Filter Bed #2



Summary for Pond OCS-1: Outlet to Existing Depression

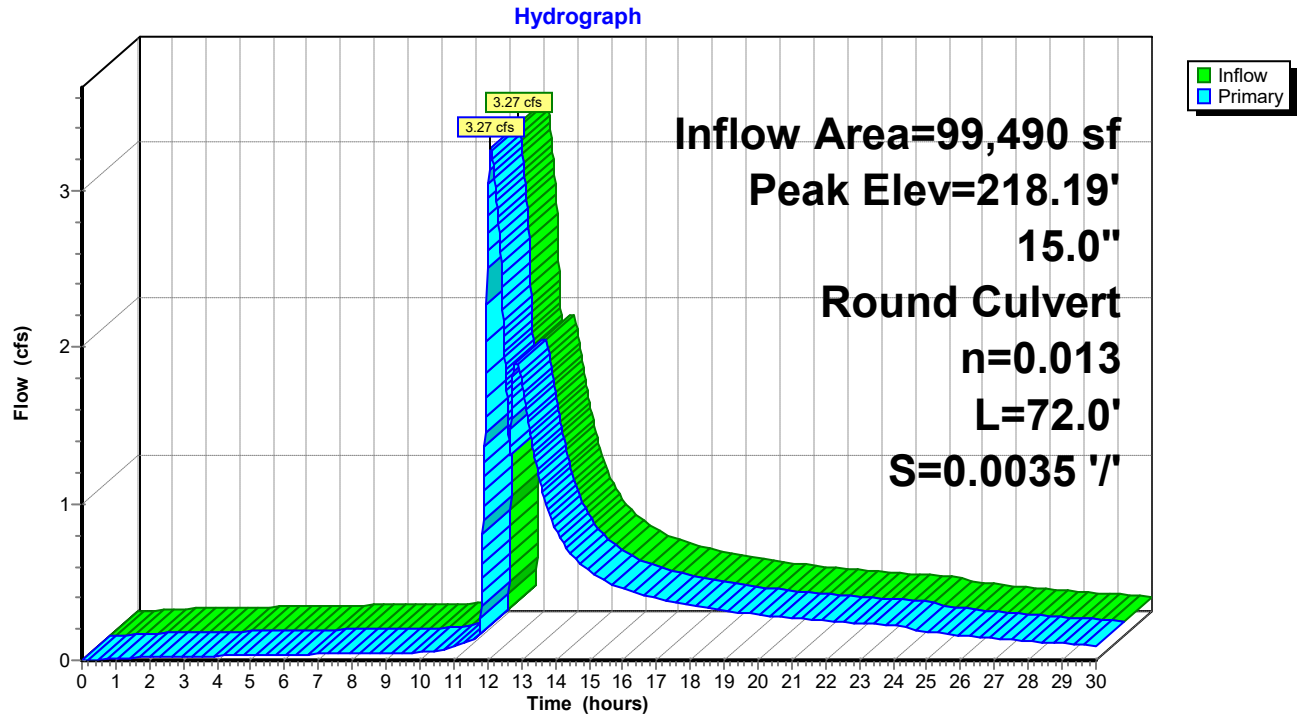
Inflow Area = 99,490 sf, 40.43% Impervious, Inflow Depth > 3.80" for 100-yr event
Inflow = 3.27 cfs @ 12.10 hrs, Volume= 31,545 cf
Outflow = 3.27 cfs @ 12.10 hrs, Volume= 31,545 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.27 cfs @ 12.10 hrs, Volume= 31,545 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 218.19' @ 18.46 hrs
Flood Elev= 222.00'

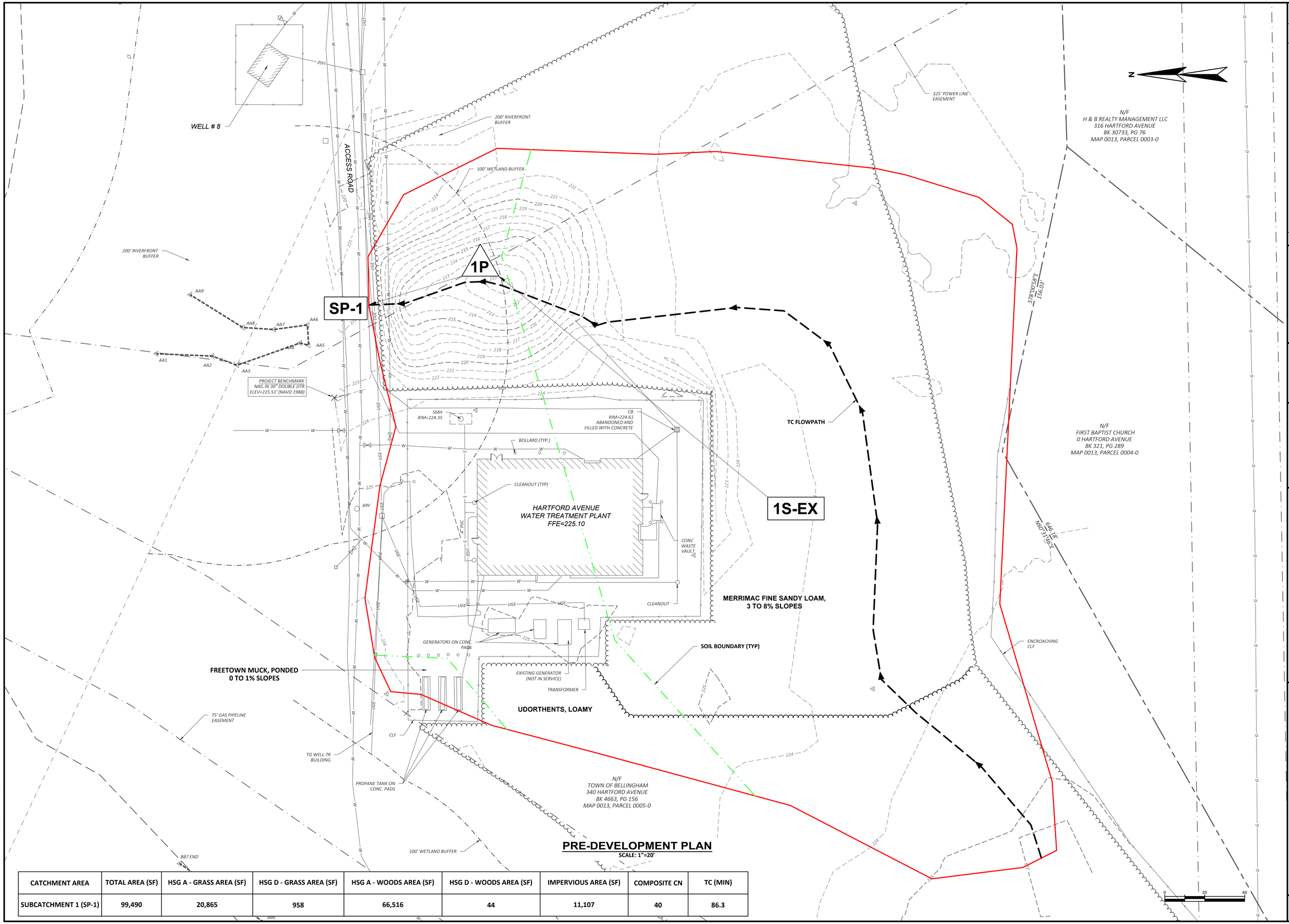
Device	Routing	Invert	Outlet Devices
#1	Primary	215.25'	**15.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 215.25' / 215.00' S= 0.0035 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.27 cfs @ 12.10 hrs HW=216.49' TW=214.24' (Dynamic Tailwater)
1=Culvert (Barrel Controls 3.27 cfs @ 3.35 fps)

Pond OCS-1: Outlet to Existing Depression



Appendix C – Stormwater Figures



PRE-DEVELOPMENT PLAN

SCALE: 1"=20'

CATCHMENT AREA	TOTAL AREA (SF)	HSG A - GRASS AREA (SF)	HSG D - GRASS AREA (SF)	HSG A - WOODS AREA (SF)	HSG D - WOODS AREA (SF)	IMPERVIOUS AREA (SF)	COMPOSITE CN	TC (MIN)
SUBCATCHMENT 1 (SP-1)	99,490	20,865	958	66,516	44	11,107	40	86.3

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			

PROJECT NO: 21796
DESIGNED: C.DAIGLE
CAD COORD: C.MERRICK
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 90% DESIGN REVIEW

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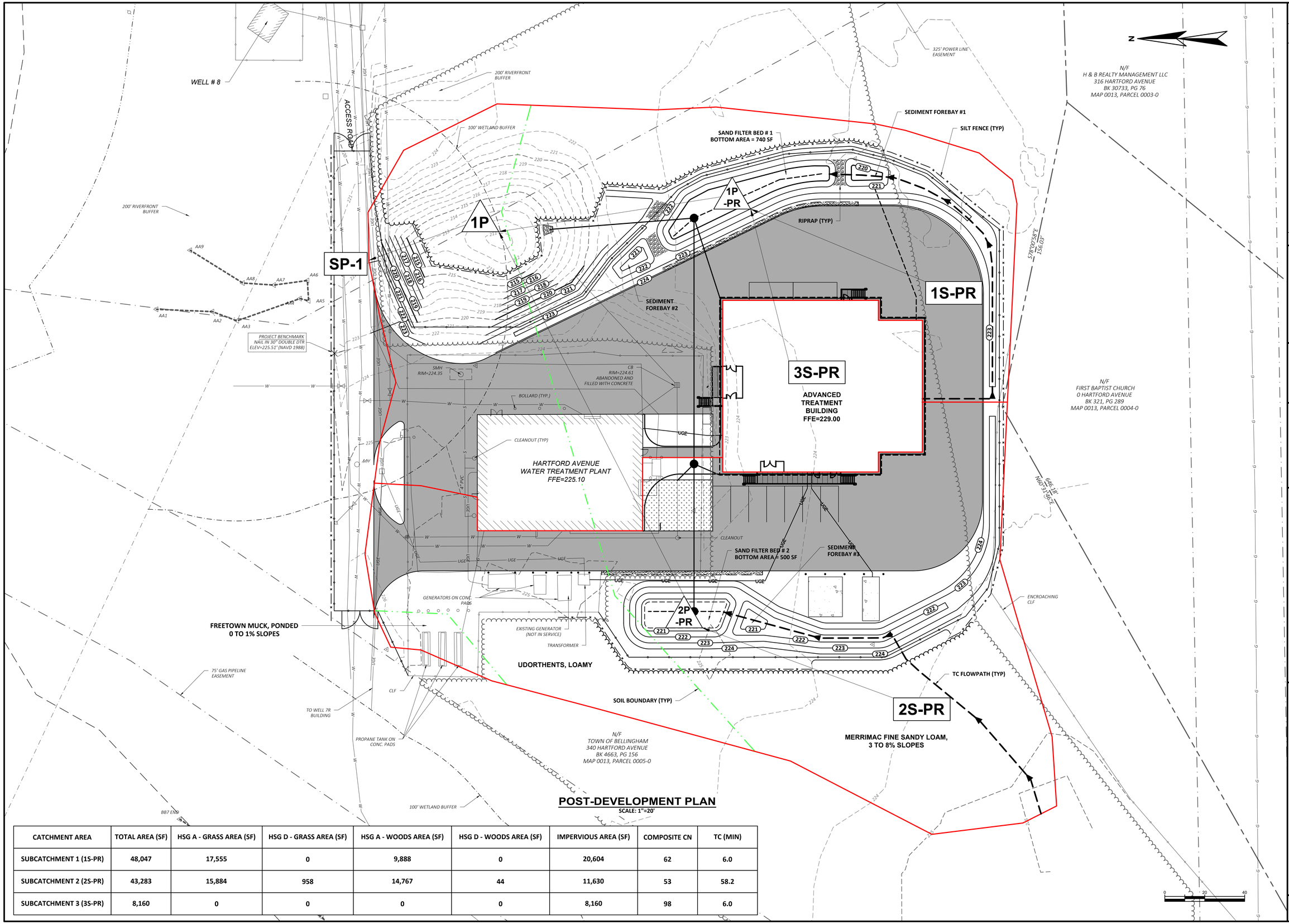
BELLINGHAM, MASSACHUSSETS
HARTFORD AVENUE
WATER TREATMENT PLANT PFAS UPGRADES

PRE-DEVELOPMENT PLAN

DRAWING
FIGURE 1



POST-DEVELOPMENT PLAN

SCALE: 1"=20'

CATCHMENT AREA	TOTAL AREA (SF)	HSG A - GRASS AREA (SF)	HSG D - GRASS AREA (SF)	HSG A - WOODS AREA (SF)	HSG D - WOODS AREA (SF)	IMPERVIOUS AREA (SF)	COMPOSITE CN	TC (MIN)
SUBCATCHMENT 1 (1S-PR)	48,047	17,555	0	9,888	0	20,604	62	6.0
SUBCATCHMENT 2 (2S-PR)	43,283	15,884	958	14,767	44	11,630	53	58.2
SUBCATCHMENT 3 (3S-PR)	8,160	0	0	0	0	8,160	98	6.0

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			
6			

PROJECT NO: 21796
DESIGNED: C.DAIGLE
CAD COORD: C.MERRICK
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 90% DESIGN REVIEW

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BELLINGHAM, MASSACHUSSETS
HARTFORD AVENUE
WATER TREATMENT PLANT PFAS UPGRADES

POST-DEVELOPMENT PLAN

DRAWING
FIGURE 2

Appendix D – TSS Removal Worksheet

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Bellingham, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Drainage Channel	**0.00**	**1.00**	**0.00**	**1.00**
Sediment Forebay	**0.25**	**1.00**	**0.25**	**0.75**
Sand Filter	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 21796
Prepared By: CAD
Date: 1/20/2025

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

Appendix E – Long Term Pollution Prevention Plan

LONG TERM POLLUTION PREVENTION PLAN

Hartford Ave Water Treatment Plant PFAS Upgrades
Bellingham, MA

In compliance with Standard 4 of the Massachusetts Stormwater Standards, a Long-Term Pollution Prevention Plan has been created for the Hartford Ave Water Treatment Plant PFAS Upgrades project. The following management measures will address proper procedures for a variety of activities that could take place on the site.

1. **Housekeeping:**
   Proper housekeeping is the first step to reduce the potential for pollution. This entails keeping up with disposal of any waste generated by the site and using proper disposal methods. The plant operator is encouraged to reduce the storage of materials outdoors and to maintain an orderly site.

2. **Storing Materials and Waste Products:**
   Proper storage of materials and waste is important to reduce potential for pollution. Chemicals, paint, fuel, and any other pollutants shall not be stored outdoors. The pump station operator is encouraged to use proper housekeeping measures to reduce the chance of a spill indoors or outdoors. Spill kits shall always be available on site in the event of a spill and shall be kept in a convenient and accessible location.

3. **Vehicle Washing:**
   Outdoor car washing has the potential to result in high loads of nutrients, metals and hydrocarbons as the detergent-rich water used to wash vehicles flows into stormwater conveyances. Given the proximity of the site to critical waters, outdoor car washing shall be prohibited on the site.

4. **Routine Inspection and Maintenance of Stormwater BMPs:**
   Inspection and maintenance of stormwater BMP's is critical to ensure proper function. Inspection and maintenance tasks shall be carried out in accordance with the schedule outlined in the Operation and Maintenance Plan developed for the site.

5. **Spill Prevention and Response:**
   Spills shall be prevented to the maximum extent feasible through use of approved materials for transport and transfer of fuels and chemicals. Construction equipment and fuel/chemical delivery equipment shall be inspected prior to entering the site to identify any deficiencies. Defective equipment shall not be allowed onsite at any time. In order to prepare for a spill, spill containment and cleanup kits, appropriate for the materials used on site shall be present and accessible at all times. Plant operators and

chemical delivery personnel shall be trained on spill prevention and response specific to materials used onsite.

Spill Response: In the event of a spill, the following procedures shall be followed:

- Stop operations
- Identify the product - check container design, warning labels, markings, etc.
- Prevent personnel from approaching the site and keep them at a distance sufficiently removed that they will not be injured by, or cause, a fire or explosion.
- Stop the flow at the source.
- Obtain a spill kit and try to prevent the spread of the spill.
- Assess the extent of the spill and determine if MassDEP should be called for emergency response.
- Report the spill to the plant operator and provide basic information such as location of spill and amount.
- Report the spill to federal and local authorities as necessary.

Emergency Contact Information:

Agency	Phone Number
Bellingham DPW Director – Jesse Riedle	(508) 966-5816
Fire or Police Department (Emergency)	911
Fire Department (Non-Emergency)	(508) 966-1112
Police (Non-Emergency)	(508) 966-1515
MassDEP Emergency Response	(888) 304-1133
MassDEP Spill Reporting	(617) 292-5500

6. **Landscaping Maintenance:**
   This management measure seeks to control the storm water impacts of landscaping and lawn care practices to reduce nutrient loadings and the amount of storm water runoff generated from lawns. These practices can benefit the environment by reducing water use; decreasing energy use and minimizing runoff that transports sediment and pollutants. The following lawn and landscaping management practices will be encouraged:
   a. Mow lawns at the highest recommended height;
   b. Minimize lawn size and maintain existing native vegetation;
   c. Water only when necessary;

7. **Storage and Use of fertilizers, herbicides, and pesticides:**
   The use of fertilizers, herbicides and pesticides shall be prohibited.

8. **Pet Waste Management:**
   Significant loading of pet waste has the potential to impact water quality of waterways if not managed properly. Pet waste is not anticipated to be a problem for this site as it will not be a permanent residence for pets. If pets are allowed on site, owners shall be required to pick up any waste and dispose of it in a proper manner.

9. **Operation and Management of Sanitary Waste:**
   A new tight tank will be utilized to manage sanitary flows.

10. **Proper Management of Snow and deicing Chemicals:**
    Proper management of snow is an important task to ensure proper function of stormwater BMP's. Snow storage shall not be permitted within stormwater BMP's. The use of deicing chemicals is specifically prohibited. Sand is the only acceptable method for dealing with icy conditions and use shall be minimized. Sand storage shall only be permitted in a stabilized container to prevent discharge to wetlands or waterbodies.

Operation and Maintenance Plan

The permanent stormwater BMP's used at the Hartford Ave Water Treatment Facility require a long-term operation and maintenance plan to ensure proper function. The following sections address the maintenance requirements of each BMP and establish the responsibility for ensuring each task is completed.

1.1 Responsible Party

The BMP's are not part of the public stormwater system and will, therefore be maintained by the water treatment plant operator. Contact info for the responsible party is listed below:

Jesse Riedle
Director of Department of Public Works
Town of Bellingham
(508) 966-5816

1.2 Description of Stormwater BMPS

Three types of BMP's are proposed to achieve the required level of stormwater treatment and infiltration. Pea gravel diaphragms and sediment forebays are proposed for pretreatment prior to discharge into the sand filter beds.

1.2.1 Pea Gravel Diaphragm

A pea gravel diaphragm is a type of pretreatment level spreader for sheet flows. The pea gravel diaphragms are 1-foot wide, and 2-feet deep trench backfilled with clean washed pea gravel and lined with filter fabric. The diaphragm serves two purposes. First, it acts as a pretreatment device, settling out sediment particles before they reach the sand filter beds. Second, it acts as a level spreader, maintaining sheet flow as runoff flows out of the diaphragm toward the detention basin.

1.2.2 Sediment Forebay

A sediment forebay is a post-construction measure consisting of an excavated pit, bermed area and a stone weir designed to slow incoming stormwater runoff and facilitate gravity separation of suspended solids. A majority of flow entering the sand filter beds will first be pretreated through a sediment forebay, with the remainder being pretreated through a pea gravel diaphragm.

1.2.3 Sand Filter Bed

Sand filter beds are designed to improve water quality by straining pollutants through a filtering media and by settling pollutants on top of the sand bed. The sand filter beds are also designed with storage above the filter media to hold stormwater to allow solids to settle before flows move through the filter media. The sand filter beds will reduce local and downstream flooding while providing treatment. The sand filter beds have an impermeable liner which allows for temporary runoff storage. The impermeable liner is necessary to meet Zone I wellhead protection area infiltration restrictions. On top of the impermeable liner is a 6" underdrain with a flow regulating orifice embedded in 18-inches of a sand filter layer. On top of the sand filter layer is 6-inches of loamy sand. The storage above these layers contains the capacity to hold flows from up to the 100-year design storm event for its contributing impervious area without overflowing.

1.3 Maintenance Requirements

Maintenance requirements specific to the proposed BMP's have been established in accordance with the Massachusetts Stormwater Handbook. The Long Term Maintenance Schedule table below details the long-term maintenance requirements for each BMP.

Long Term Maintenance Schedule

BMP	Activity	Frequency
Swale	Remove sediment and debris.	Annually.
	Mow.	As needed.
	Repair areas of erosion and revegetate.	As needed, but no less than once per year.
	Re-seed.	As necessary.
Pea Gravel Diaphragm	Inspect and remove debris.	Twice per year and after every major storm.
Sediment Forebay	Inspect sediment forebays for accumulated sediment and debris,	Monthly;
	Remove Sediment and Debris.	Two to four times per year.
Sand Filter Bed	Examine outlet structure for evidence of clogging.	Twice per year.
	Mow embankments and emergency spillway.	Twice per year.
	Remove trash and debris.	Twice per year.
	Remove sediment from the basin.	Once every five years.
	Inspect sand filter and remove sediment, trash, and debris. Replace parts of sand filter that have been penetrated by finer sediments as needed.	Twice per year.
Riprap	Clean out vegetation and organic matter	As needed.

Additional information related to the extent of each maintenance activity can be found in the Massachusetts Stormwater Handbook. All maintenance activities shall be documented by filling out the Inspection Maintenance Checklist and tracked on the Stormwater Maintenance Log which can be found in Appendix F

1.3.1 Snow Storage

In accordance with the Bellingham bylaws and the Massachusetts stormwater standards, snow shall not be stored in stormwater BMPs. Snow storage shall only be permitted in areas identified on the plans. These areas have been strategically located to allow for snow melt/runoff to be subject to the complete stormwater treatment train to ensure pollutants are removed in accordance with Town and State requirements.

Appendix F – Inspection, Maintenance and O&M Forms

Inspection and Maintenance Checklist

Category: **Stormwater BMP** Type:

Location: _____

Date: _____ Time: _____Inspector: _____Weather:_____

Recent Large Rainfall Event □ Yes □ No Rainfall Depth: _____ Event Date:_____

□ **UNIT AREA**

Area Accessible: □ Yes □ No Comment: _____
Sink Holes: □ Yes □ No Comment: _____
Corrective Action Needed: _____
Corrective Action Taken: _____Date:_____

□ **FLOATABLE DEBRIS/ORGANIC MATTER**

Floatables present? □Yes □No If yes, to what extent? _____
Corrective Action Needed: _____
Corrective Action Taken: _____Date:_____

□ **SEDIMENT MEASUREMENT**

Sediment Depth: _____ Note: if the sediment depth is 2 feet or more, removal is necessary.
Corrective Action Needed: _____
Corrective Action Taken: _____Date:_____

NOTES:

Describe any incidents of non-compliance not listed above:

Note: Any maintenance performed as a result of this inspection should be recorded on the maintenance log.

Inspector Signature: _____ Date: _____

Stormwater BMP Maintenance Log

Date	Initials	BMP	Sediment Depth Measured	Volume of Sediment Removed	Site Activity and Comments

INSPECTION AND MAINTENANCE REPORT FORM

TO BE COMPLETED EVERY 14 DAYS AND/OR WITHIN 24 HOURS OF
A RAINFALL EVENT OF 0.5 INCHES OR MORE

SITE STABILIZATION

Inspector:_____ Date:_____

Days Since Last Rainfall:_____ Amount of Last Rainfall:____ Inches

Area	Date since last disturbed	Stabilized? (yes/no)	Stabilized with	Condition

Contractor's Superintendent: _____ Date:_____

Stabilization Action Required:

_____
_____
_____
_____
_____
_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

SILT FENCE

Inspector: _____ Date: _____

Depth of material behind silt fence	Condition of landfill side slopes	Any evidence of overtopping of the silt fence?	Condition of drainage swales

Contractor's Superintendent: _____ Date: _____

Maintenance action required for silt fence:

_____
_____
_____
_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

STORMWATER STRUCTURES

Inspector: _____ Date: _____

Any evidence of erosion or sedimentation at culvert inlet or outlet?	Condition of riprap inlet and outlet aprons at culvert	Accumulation of silt or debris in stormwater storage area?

Contractor's Superintendent: _____ Date: _____

Maintenance action required for stormwater structures:

_____
_____
_____
_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

Inspector: _____ Date: _____

Contractor's Superintendent: _____

Changes required to the Construction Pollution Prevention Plan:

_____
_____
_____
_____

Reasons for changes:

_____
_____
_____
_____

I certify that the foregoing statements are, to the best of my knowledge, true and accurate.

Inspector
Signature: _____ Date: _____

Contractor's Superintendent
Signature: _____ Date: _____

Appendix G – Temporary & Permanent Stabilization Specifications

SECTION 02270

TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The work under this section shall include provision of all labor, equipment, materials and maintenance of temporary erosion control devices, as specified herein, as shown on the Drawings and as directed by the Engineer.
2. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices, or as required to control erosion that occurs during normal construction operations.
3. Construction operations shall comply with all federal, state and local regulations pertaining to erosion control.
4. Erosion control measures shall be in accordance with the Massachusetts Department of Environmental Protection's - Stormwater Management Standards - (referred to hereafter as MassDEP SMS) and "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas".
5. After awarding of or after being awarded the Contract, prior to commencement of construction activities, the Contractor will meet with the Engineer to discuss erosion control requirements and develop a mutual understanding relative to details of erosion control.

B. Design Criteria:

1. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
2. Stabilize disturbed earth surfaces in the shortest time and employ such temporary erosion control devices, as may be necessary, until such time as adequate soil stabilization has been achieved.

1.2 SUBMITTALS

A. The Contractor shall furnish the Engineer, in writing, his work plan giving proposed locations for storage of topsoil and excavated material, before beginning construction. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of his responsibility for completion of the work as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fiber Rolls:

1. The owner has a preference for fiber rolls (a.k.a. straw wattles) over hay bales for erosion control. Fiber rolls shall be minimum 9-inch diameter cylinders of

agricultural straw or rice straw wrapped in photodegradable black synthetic netting.

B. Silt Fencing
   1. Polyethylene, polypropylene, nylon, or polyester fabric supported by stakes spaced no greater than 6-feet apart.

C. Silt Sacks:
   1. Silt Sacks (or equivalent) shall be placed in downgradient catch basins to prevent sediment from entering the drainage system. Silt sacks shall be periodically cleaned while in use and must be cleaned prior to and after precipitation events. Applicants are advised they may be required to respond immediately for repair and maintenance at the request of the Town within two hours of notification.

D. Mulches:
   1. Straw or Salt Marsh Hay. Loose hay mulching is prohibited.

E. Mats and Nettings:
   1. Twisted Craft paper, yarn, jute, excelsior wood fiber mats, glass fiber and plastic film.
   2. Type and use shall be as specified in the SMS.

F. Baled Straw:
   1. At least 14" by 18" by 30" securely tied to form a firm bale, staked as necessary to hold the bale in place.

G. Sand Bags:
   1. Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

H. Permanent Seed:
   1. Conservation mix appropriate to the predominant soil conditions as specified in the SMS and subject to approval by the Engineer.

I. Temporary Seeding:
   1. Use species appropriate for soil conditions and season as specified in the SMS and subject to approval by the Engineer.

J. Water:
   1. The Contractor shall provide water and equipment to control dust, as directed by the Engineer.

K. Filter Fabrics:
   1. Filter fabric shall be of one of the commercially available brands such as Mirafi, Typar or equivalent. Fabric types for particular applications shall be approved by the Engineer prior to installation.

2.2 CONSTRUCTION REQUIREMENTS

A. Temporary Erosion Checks:
   1. Temporary erosion checks shall be constructed in ditches and other locations as necessary.
   2. Fiber rolls or siltation fence may be used in an arrangement to fit local conditions.

B. Temporary Berms:
   1. Temporary barriers shall be constructed along the toe of embankments when necessary to prevent erosion and sedimentation.

C. Temporary Seeding:

Areas to remain exposed for a time exceeding 3 weeks shall receive temporary seeding as indicated below:

Season	Seed	Rate
April 1 to June 1 Aug. 15 to Sept. 15	Annual Ryegrass	40 lbs/Acre
May 1 to June 30	Foxtail Millet	30 lbs/Acre
April 1 to July 1 Aug. 15 to Sept. 15	Oats	80 lbs/Acre
Aug. 15 to Oct. 15	Winter Rye	120 lbs/Acre
Nov. 1 to April 1	Mulch w/ dormant seed	80 lbs/Acre @ 50% seed rate increase

D. Mulch All Areas Receiving Seeding:
Use either wood cellulose fiber mulch (750 lbs/acre); or straw mulch with chemical tack (as per manufacturer's specifications). Wetting for small areas may be permitted. Biodegradable netting is recommended in areas to be exposed to drainage flow.

E. Erosion control matting for slopes and ditches shall be anchored with pegs and/or staples per manufacturer's recommendations. Contractor shall provide matting along the flowline of all ditches and swales having a longitudinal slope in excess of 0.01 ft/ft, and on all slopes in excess of 3(H) to 1(V).

F. Gravel aprons shall be installed at the entrance of construction sites where disturbance is over 4,000 square feet to prevent sediment from the construction site entering the roadway. Aprons shall be a minimum of 15 feet in length, and extend the width of the entrance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fiber Rolls (Straw Wattles):
Fiber rolls shall be staked securely into the ground and oriented perpendicular to the slope using wood takes. A minimum of 3 inches of the stake should stick out above the roll. Stakes shall be spaced 3 to 4 feet apart.

B. Silt Fencing:
Silt fence shall be erected in a continuous fashion from a single roll of fabric. The bottom of the fabric fence shall be buried sufficiently below the ground surface to prevent gaps from forming, usually 4 to 6 inches below ground surface. The fabric shall be installed on the upstream side of the stakes. Stakes shall be strong enough and tall enough to securely anchor the fabric to the ground. Stake spacing shall be no more than 10 feet apart for extra-strength fabric and 6 feet apart for standard

strength fabric. Maintenance of the fence is required during construction. Material shall be based on the synthetic fabric requirements as follows:

1. Filtering efficiency: 75% (minimum)
2. Tensile strength: Standard strength: 30lb/linear inch (minimum), Extra strength: 50 lb/linear inch (minimum)
3. Elongation: 20% (maximum)
4. Ultraviolet radiation: 90% (minimum)
5. Slurry flow rate: 0.3 gal/ft2/min (minimum)

C. Temporary Erosion Checks:

1. Temporary erosion checks shall be constructed in ditches and at other locations designated by the Engineer. The Engineer may modify the Contractor's arrangement of silt fences, bales and bags to fit local conditions.
2. Fiber rolls, baled straw, silt fences, or some combination, may be used in other areas, as necessary, to inhibit soil erosion.
3. Siltation fence shall be located and installed as shown on plans or as required to comply with all Federal, State and Local Regulations.
4. Sedimentation ponds shall be sited and constructed to the grades and dimensions as shown on the Drawings and will include drainage pipe and an emergency spillway.

D. Erosion control matting for slopes and ditches shall be installed where indicated on the Drawings and as required to stabilize the soil until permanent vegetative stabilization is established.

E. Maintenance:

Erosion control features shall be installed prior to excavation wherever appropriate. Temporary erosion control features shall remain in place and shall be maintained until a satisfactory growth of grass is established. The Contractor shall be responsible for maintaining erosion control features throughout the life of the construction contract. Maintenance will include periodic inspections by the Owner or Engineer for effectiveness of location, installation and condition with corrective action taken by the Contractor, as appropriate.

F. Removing and Disposing of Materials:

1. When no longer needed, material and devices for temporary erosion control shall be removed and disposed of upon approval by Engineer.
2. When removed, such devices may be reused in other locations, provided they are in good condition and suitable to perform the erosion control for which they are intended.
3. When dispersed over adjacent areas, the material shall be scattered to the extent that it causes no unsightly conditions nor creates future maintenance problems.
4. Sedimentation basins, if no longer required, will be filled in, the pipe removed, the surface loamed and grass cover shall be established.

END OF SECTION

SECTION 02485

LOAMING & SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, place, and test topsoil, seed, lime, and fertilizer where shown on the drawings and protect and maintain seeded areas disturbed by construction work, as directed by the Engineer.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS AND TESTING

A. Seed:
   1. Furnish the Engineer with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
   2. This certification shall appear in, or with, all copies of invoices for the seed.
   3. The certification shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates and certificates have been approved.
   4. Each lot of seed shall be subject to sampling and testing, at the discretion of the Engineer, in accordance with the latest rules and regulations under the Federal Seed Act.

B. Topsoil:
   1. Inform the Engineer, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished.
   2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
   3. Have soil samples tested by an independent soils testing laboratory, approved by the Engineer, at the Contractor's expense.
   4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing.
   5. Approval, by the Engineer, to use topsoil for the work will be dependent upon the results of the soils tests.

C. Lime & Fertilizer:
   1. Furnish the Engineer with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and minimum percentages of the material furnished that pass the 90 and 20 mesh sieves and the grade furnished.

2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the Engineer.
3. Sampling and testing shall be in accordance with the official methods of the Association of Official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the Engineer may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.4 DELIVERY, STORAGE & HANDLING

A. Seed:
   1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the Engineer.
   2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:
   1. Furnish all fertilizer in unopened original containers.
   2. Containers shall be labeled with the manufacturer's statement of analysis.

1.5 JOB CONDITIONS

A. Topsoil: Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition otherwise detrimental, in the opinion of the Engineer, to the proposed planting or to proper grading.

B. Seeding:
   1. Planting Seasons: The recommended seeding time is from April 1 to September 15. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted.
   2. Weather Conditions:
      a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.
      b. Stop the seeding work when, in the opinion of the Engineer, weather conditions are not favorable.
      c. Resume the work only when, in the opinion of the Engineer, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed:
   1. Provide the grass seed mixture approved by the Engineer, having the following composition:
      a. Park Mixture:
         i. 50 percent Creeping Red Fescue
         ii. 30 percent Kentucky Bluegrass

iii. 20 percent Annual Ryegrass
iv. Add 1 pound White or Dutch Clover per acre
v. No weed seeds allowed

b. Roadside Mixture:
i. 50 percent Creeping Red Fescue
ii. 15 percent Kentucky Bluegrass
iii. 5 percent White Clover
iv. 2 percent Red Top
v. 3 percent Birdsfoot Trefoil
vi. 25 percent Annual Ryegrass
vii. Add 1 pound of White or Dutch Clover per acre
viii. No weed seeds allowed

c. Lawn Areas:

i.	Kentucky 31 Fescue	25 percent
ii.	Chewing Fescue	15 percent
iii.	Creeping Red Fescue	15 percent
iv.	Pennfine Perennial Rye	25 percent
v.	Lynn Perennial Rye	10 percent
vi.	Common Annual Rye	10 percent
vii.	No weed seeds allowed	

2. Do not use seed which has become wet, moldy, or otherwise damaged in transit or during storage.

B. Topsoil:
1. Fertile, friable, natural topsoil typical of the locality, without admixture of subsoil, refuse or other foreign materials and obtained from a well-drained site. Mixture of sand, silt, and clay particles in equal proportions.
2. Free of stumps, roots, heavy of stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, weeds, sticks, brush or other deleterious matter.
3. Not less than 4 percent nor more than 20 percent organic matter.
4. Topsoil depth shall be 4-inches, unless otherwise indicated.

C. Lime:
1. Provide lime which is ground limestone containing not less than 85% of total carbonate and of such fineness that 90% will pass a No. 20 sieve and 50% will pass a No. l00 sieve.
2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. l00 sieve. No additional payment will be made to the Contractor for the increased quantity.

D. Fertilizer:
1. Provide a commercial fertilizer approved by the Engineer.
2. Provide fertilizer containing the following minimum percentage of nutrients by weight:
l0% Available phosphoric acid
l0% Available potash
l0% Available nitrogen (75% of the nitrogen shall be organic)

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment:
   1. Provide all equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
   2. Demonstrate to the Engineer that the equipment will apply materials at the specified rates.

B. Soil: Perform the following work prior to the application of lime, fertilizer or seed.
   1. Scarify the subgrade to a depth of 2 inches to allow the bonding of the topsoil with the subsoil.
   2. Apply topsoil to a depth of 4 inches or as directed on areas to be seeded.
   3. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges or depressions.
   4. Remove all objectionable material and form a finely pulverized seed bed.

3.2 PERFORMANCE

A. Grading:
   1. Grade the areas to be seeded as shown on the Drawings or as directed by the Engineer.
   2. Leave all surfaces in even and properly compacted condition.
   3. Maintain grades on the areas to be seeded in true and even conditions, including any necessary repairs to previously graded areas.

B. Placing Topsoil:
   1. Uniformly distribute and evenly spread topsoil on the designated areas.
   2. Spread the topsoil in such a manner that planting work can be performed with little additional soil preparation or tillage.
   3. Correct any irregularities in the surface resulting from topsoiling or other operations to prevent the formation of depressions where water may stand.
   4. Thoroughly till the topsoil to a depth of at least 3 inches by plowing, harrowing, or other approved method until the condition of the soil is acceptable to the Engineer. The surface shall be cleared of all debris and or stones one inch or more in diameter.

C. Placing Fertilizer:
   1. Distribute fertilizer uniformly at a rate determined by the soils test over the areas to be seeded.
   2. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.
   3. The incorporation of fertilizer may be a part of the tillage operation specified above.
   4. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

D. Placing Lime:
   1. Uniformly distribute lime immediately following or simultaneously with the incorporation of fertilizer.
   2. Distribute lime at a rate determined from the pH test, to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.

E. Seeding:
   1. Fine rake and level out any undulations or irregularities in the surface resulting from tillage, fertilizing, liming or other operations before starting seeding operations.
   2. Hydroseeding:
      a. Hydroseeding may be performed where approved and with equipment approved by the Engineer.
      b. Sow the seed over designated areas at a minimum rate of 5 pounds per 1000 square feet.
      c. Seed and fertilizing materials shall be kept thoroughly agitated in order to maintain a uniform suspension within the tank of the hydroseeder.
      d. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates.
   3. Drill Seeding:
      a. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.
      b. Sow the seed uniformly over the designated areas to a depth of l/2 inch and at a rate of 5 pounds per l,000 square feet.
   4. Broadcast Seeding:
      a. Broadcast seeding may be performed by equipment approved by the Engineer.
      b. Sow the seed uniformly over the designated areas at a rate of 5 pounds per l,000 square feet.
      c. Sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing.
      d. Cover the seed to an average depth of l/2 inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices.
      e. Do not perform broadcast seeding work during windy weather.

F. Compacting:
   1. Seeded areas must be raked lightly after sowing unless seeding is to be directly followed by application of an approved mulch.
   2. Compact the entire area immediately after the seeding operations have been completed.
   3. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.
   4. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
   5. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

G. Mulching for Permanent Seeding:

1. Apply mulch at the specified rate for the given type and as specified by the "Maine Erosion and Sedimentation Control Best Management Practices" prepared by the Maine DEP.
2. Erosion Control Mix must contain some soil.
3. Hydraulic mulches, such as paper mulch and cellulose fiber, can include seeds, fertilizer, or soil binders.

Maine	
Mulch Type	**Rate**
Straw	2 bales (70-90lbs)/1,000 SF
Erosion Control Mix	<3:1 Slope: 2 inches min. >3:1 Slope: 4 inches min.
Paper Mulch	5 lbs/1,000 SF
Cellulose Fiber	40 lbs/1,000 SF
Erosion Control Blankets	Per manufacturer's instructions
Wood Chips and Bark Mulch	3 inches min.

4. Apply mulch at the specified rate for the given type and as specified by the "New Hampshire Stormwater Manual, Volume 3: Erosion and Sediment Controls During Construction" prepared by the NHDES and Comprehensive Environmental Inc.

New Hampshire	
Mulch Type	**Rate**
Straw	2 bales, (70-90lbs)/1,000 SF
Wood Chips or Bark	2-6 inches, (460-920) lbs/1,000 SF
Erosion Control Mix	<15% Slope: 2 inches thick min. >15% Slope: 4 inches thick min.
Erosion Control Blankets	Per manufacturer's instructions
Wood Fiber Mulch	500 lbs/acre

3.3 PROTECTION & MAINTENANCE

A. Protection:
   1. Protect the seeded area against traffic or other use.
   2. Erect barricades and place warning signs as needed.

B. Maintenance:
   1. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Coordinate schedule for mowing with Engineer.
   2. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
   3. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding work is completed, and shall not necessarily related to Substantial Completion of the General Contract.
   4. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform

stand for the specified grasses, and shall continue until Acceptance by the Engineer of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by Engineer prior to use.

3.4 ACCEPTANCE

A. At final acceptance of the project all areas shall have a close stand of grass with no weeds present and no bare spots greater than three inches (3") in diameter over greater than five percent (5%) of the overall seeded area.

END OF SECTION

WRIGHT-PIERCE
Engineering a Better Environment

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