

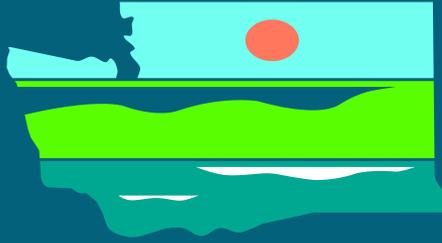
WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Welcome

Stormwater Site Plan Review

Ecology's 2005 Stormwater Management Manual for Western Washington





WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Instructors

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- Anne Dettelbach, Municipal Stormwater Specialist, NWRO
- Megan Darrow, Water Quality Inspector, NWRO

Workshop Purpose

- Provide guidance for reviewers using the 2005 Stormwater Management Manual for Western Washington (SWMMWW) on how to review Stormwater Site Plans (SSP)
 - Crosswalk the relevant sections of the Western Washington Phase II Municipal Stormwater Permit with review process
- 

General Agenda

- Describe the process to determine which Minimum Requirements apply to a specific project
- Review relevant requirements of the Municipal Stormwater Permit
- Acquaint Phase II Municipality's staff with the 2005 SWMMWW



General Agenda (2/2)

- Provide direction on how to confirm the following are designed in accordance with the Manual:
 - Stormwater Site Plan
 - BMPs and Flow Control
 - Source Controls
 - Construction Stormwater Pollution Prevention Plan (CSWPPP)
- Provide Case Study examples of Plan Review.

The Stormwater Problem

Stormwater is the leading contributor to water quality pollution in our urban and suburban waters.

- Garbage, trash, litter
- Dirt, soil and sediments
- Oils and road grime
- Nutrients that encourage algal growth and result in aquatic problems, such as low dissolved oxygen
- Metals (dissolved and particles that accumulate in the sediments)
- Toxic pollutants that accumulate in the sediments and in the food-chain
- Bacteria and pathogens



Washington State's General Stormwater NPDES Permits

➤ Construction

➤ Industrial

➤ 3 Municipal

Phase I (first issued in 1995)

Phase II Eastern WA

Phase II Western WA

- Issued February 2007, modified June 2009

- 116 cities & counties state-wide

What is a Municipal Separate Storm Sewer System (MS4)?

- Publicly owned or operated
- Discharges to surface waters
- Not a combined sewer system
- Not part of a sanitary sewer
- Designed or used for collecting or conveying stormwater
 - Public streets, curbs & gutters
 - Catch basins & storm drains
 - Ditches, swales and other man-made channels
 - Pipes
 - Detention/flow control facilities (ponds, vaults, etc.)
 - Treatment facilities (wet ponds, wet vaults, filters, etc.)



EPA's Six Minimum Measures in a Stormwater Management Program

1. Public Education and Outreach
 2. Public Involvement and Participation
 3. Illicit Discharge Detection and Elimination
 4. Construction Site Stormwater Runoff Control
 5. Post Construction Stormwater Management
 6. Pollution Prevention for Municipal Operations
- 

Control Runoff from New & Redevelopment, Construction Sites

By February 16, 2010, implement an ordinance or enforceable mechanism that addresses runoff from new development, redevelopment and construction sites in accordance with MS4 Permit requirements.

(S5.C.4.a.i)



Required Applicability

- Private and Public projects
- Discharges to the MS4 in the MS4 Permit coverage area
 - Local discretion to apply jurisdiction-wide
- Regulatory threshold of 1 acre or more of land disturbance (or smaller projects if part of a common plan of development or sale)
 - Local variation: “existing local requirements to apply stormwater controls at smaller sites or at lower thresholds...shall be retained.”

Required Content – Appendix 1

➤ Exemptions

➤ Definitions

➤ Thresholds (3 nested sets of thresholds)

- Regulatory threshold for triggering local drainage review
- Project thresholds for determining the applicability of Minimum Requirements
- Project thresholds for triggering the construction of a treatment or flow control facility

➤ Adjustments and Exceptions/Variations

- Criteria for granting, public notice requirements, and record-keeping for annual reporting

Required Content – Appendix 1

➤ Minimum Requirements (1/3)

1. Prepare a Stormwater Site Plan
 2. Prevent Construction Pollution and Develop a Construction SWPPP
 - all 12 minimum measures must be addressed
 3. Control Sources of Pollution
 4. Preserve Natural Drainage Systems and Outfalls
 5. Manage Stormwater On-Site
- 

Required Content – Appendix 1

➤ Minimum Requirements (2/3)

6. Treat Runoff

- Enhanced treatment for industrial, commercial, multi-family and roadway land uses
- Basic treatment allowed if initial receiving water is designated

7. Control Flows

- N/A for designated flow exempt receiving waters
- Western WA Flow Control Standard (3 potentially applicable pre-developed conditions)
- Local government may develop alternative flow control standards through Basin Planning

Required Content – Appendix 1

➤ Minimum Requirements (3/3)

8. Protect Wetlands

- Maintain the hydrologic conditions, hydrotrophic vegetation and substrate characteristics to support existing and designated uses

9. Plan for System O&M

- Note numbering difference between SWMMWW and the Permit's Appendix 1



Required Content – Appendix 1

➤ Basin or Watershed Planning

- SWMMWW Minimum Requirement #9
 - Project proponents must comply with locally-adopted (and Ecology-approved) basin plans for applicable standards or more stringent requirements
- Permit Appendix 1: Basin Plans may modify Treatment, Flow Control or Wetlands standards
 - Formally adopted by all relevant jurisdictions
 - All regulations called for in the plan are in effect
 - Ecology has approved the Basin Plan
- Basin Plans are developed under the leadership of local governments (not project proponents)

Required Content – SWMMWW Option (S5.C.4.a.ii)

- Site planning process
- BMP selection criteria
- BMP design criteria

For all of the above, you have the option to cite Ecology's 2005 *Stormwater Management Manual for Western Washington* as sole documentation to meet this requirement...

...Probably this is why most of you are here today!

Required Allowance for “Low Impact Development”

- Provisions to allow non-structural preventative actions and source reduction approaches, such as Low Impact Development
 - Local discretion on how this is implemented now
 - Advisory committee process underway to refine this requirement

Required Capabilities for Implementation

- Review all stormwater site plans.
- Legal authority for inspections.
- Conduct specified construction and installation-related inspections.
- Use an escalating enforcement strategy to respond to non-compliance.
- Keep good records of your work!

Note these NPDES implementation requirements are triggered on projects that meet the Regulatory Threshold.

DEFINITIONS



Impervious Surface

A hard surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development.

A hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development



Types of Impervious Surfaces

- Gravel Roads/parking lots
- Roof Tops
- Walkways
- Patios
- Concrete or asphalt paving



New Development

- Land disturbing activities that are conversions from timber land to other uses
- Structural development, including construction or installation of a building or other structure
- Creation of impervious surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW
- Projects meeting the definition of redevelopment shall not be considered new development.

Redevelopment ^(1/2)

- On a site that is already substantially developed (>35% of existing impervious surface coverage), the creation or addition of impervious surfaces;
- The expansion of a building footprint or addition or replacement of a structure;



Redevelopment (2/2)

- Structural development including construction, installation or expansion of a building or other structure
- Replacement of impervious surface that is not part of a routine maintenance activity



Replaced Impervious Surface

- For structures, the removal and replacement of any exterior impervious surfaces or foundation.
- For other impervious surfaces, the removal down to bare soil or base course and replacement.



Effective Impervious Surface

Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system.

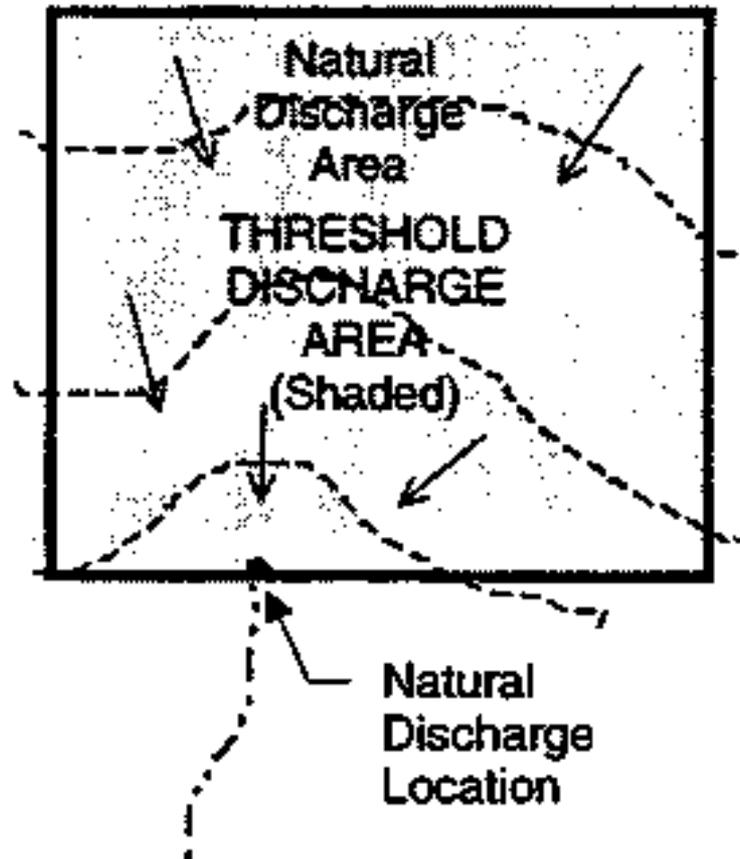


Threshold Discharge Area (TDA)

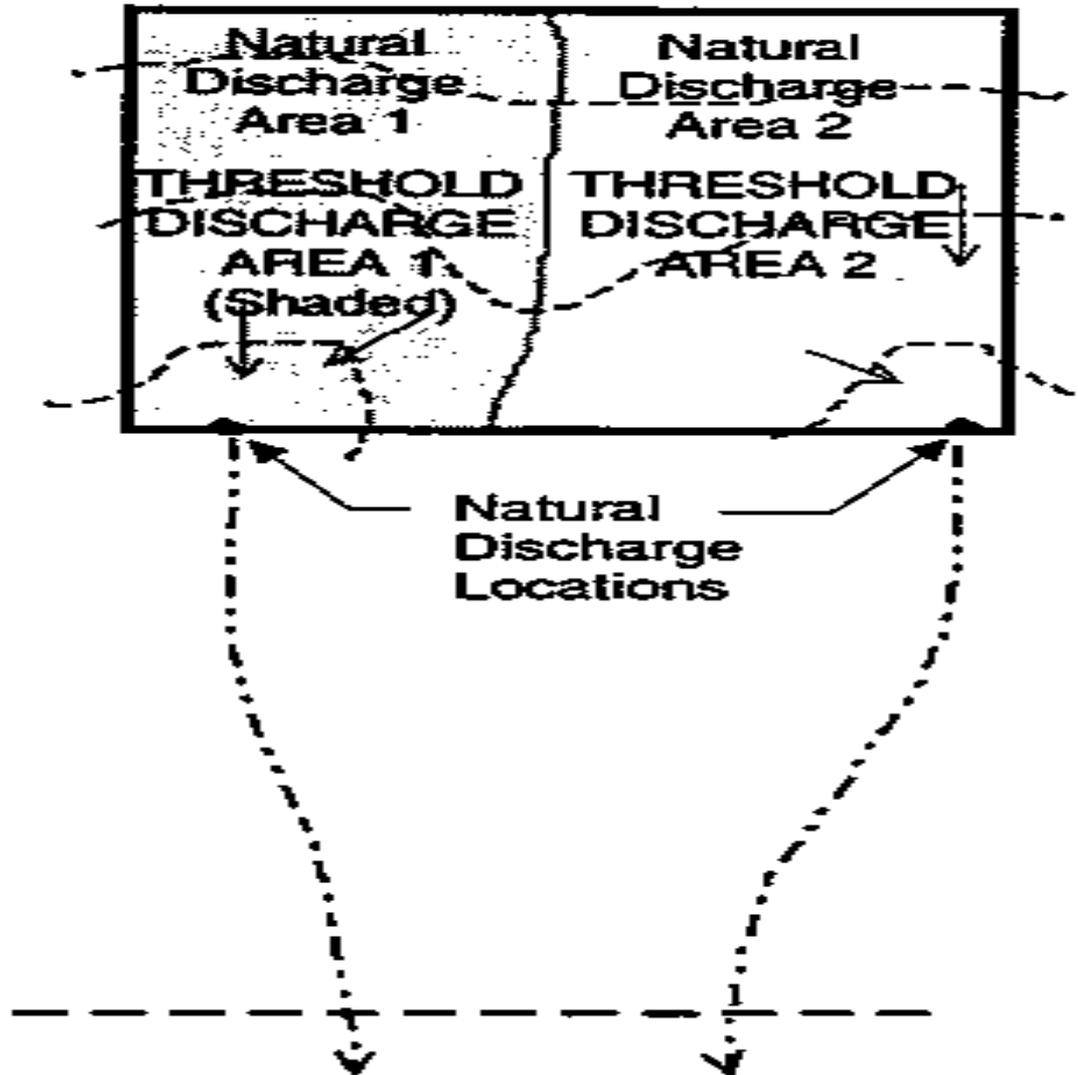
An on-site area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flowpath).



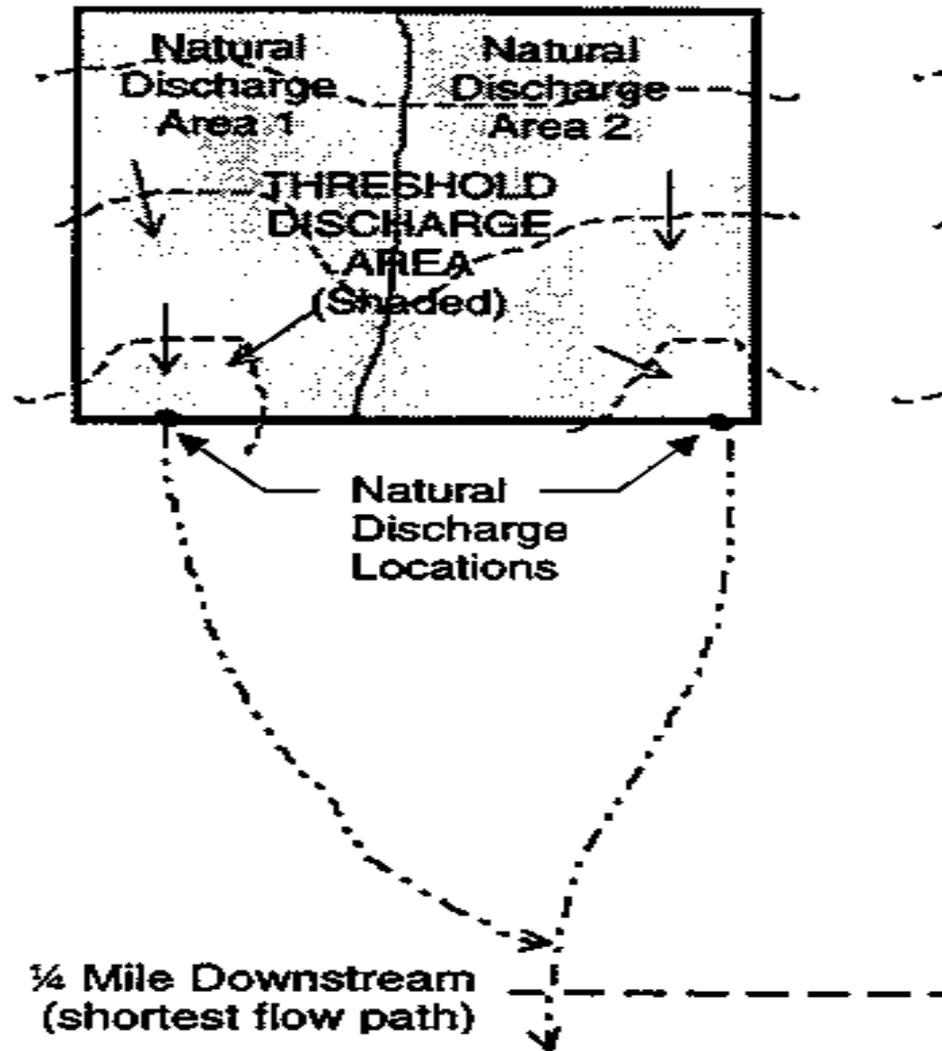
**Example of a Project Site
with a Single Natural
Discharge and a Single
Threshold Discharge Area**



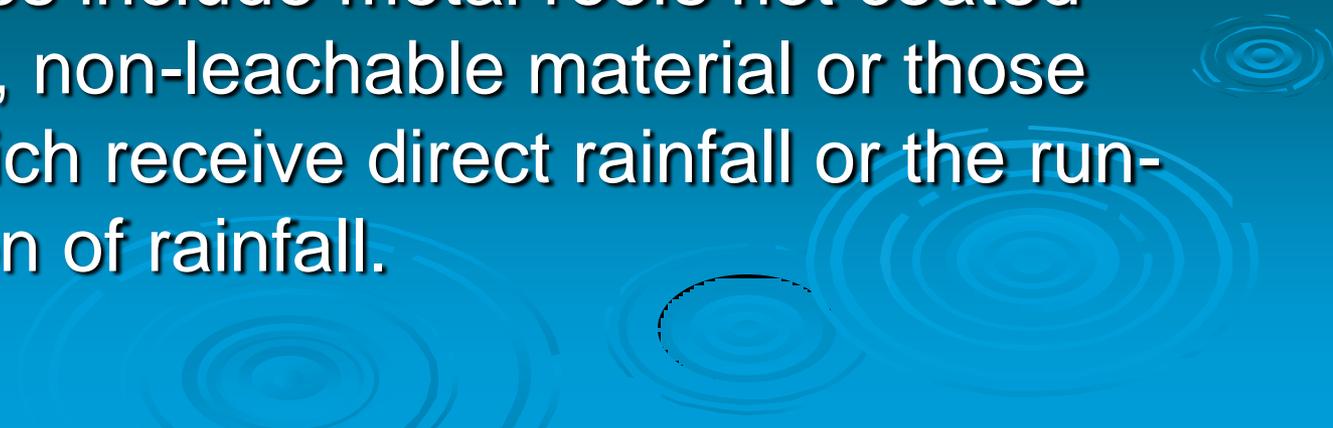
**Example of a Project Site
with Multiple Natural
Discharges and Multiple
Threshold Discharge Areas**



**Example of a Project Site
with Multiple Natural
Discharges and a Single
Threshold Discharge Area**



Pollution Generating Impervious Surfaces (PGIS)

- Impervious surfaces are considered a significant source of pollutants in stormwater runoff when used for the following:
 - Vehicular use
 - Industrial activities
 - Storage of erodible or leachable materials
 - Other sources include metal roofs not coated with an inert, non-leachable material or those surfaces which receive direct rainfall or the run-on or blow-on of rainfall.
- 

Non-Pollution Generating Impervious Surfaces (NPGIS)

- Impervious surfaces not considered PGIS:
 - Wood, asphalt shingle, clay, and metal roofs protected by inert, non-leachable material
 - Patios/decks
 - Walkways around buildings



Source Control BMP

A structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants.

➤ Two types

- Structural Source Control BMPs
- Operational Source Control BMPs



Minimum Requirements in SWMMWW

- Discussed Permit Minimum Requirements earlier
- Note different combinations of these requirements will apply to a project.
- Next specific information on Manual Minimum Requirements



Minimum Requirements

- Determined from Flow Charts (Vol. I Figures 2.2 and 2.3, plus 1 acre exemption chart)
- Detailed discussion in Vol. 1. Sections 2.4.1 and 2.4.2



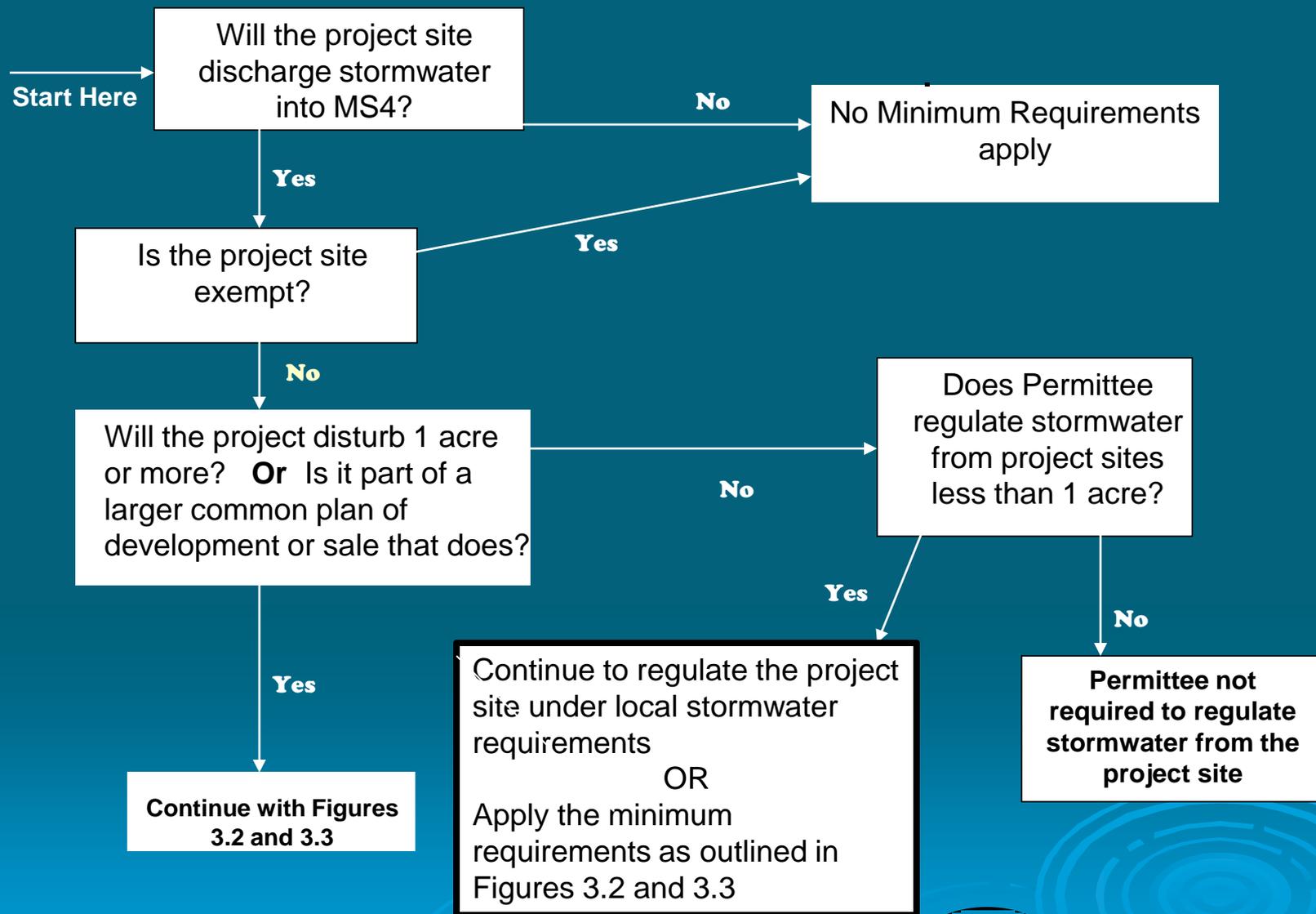
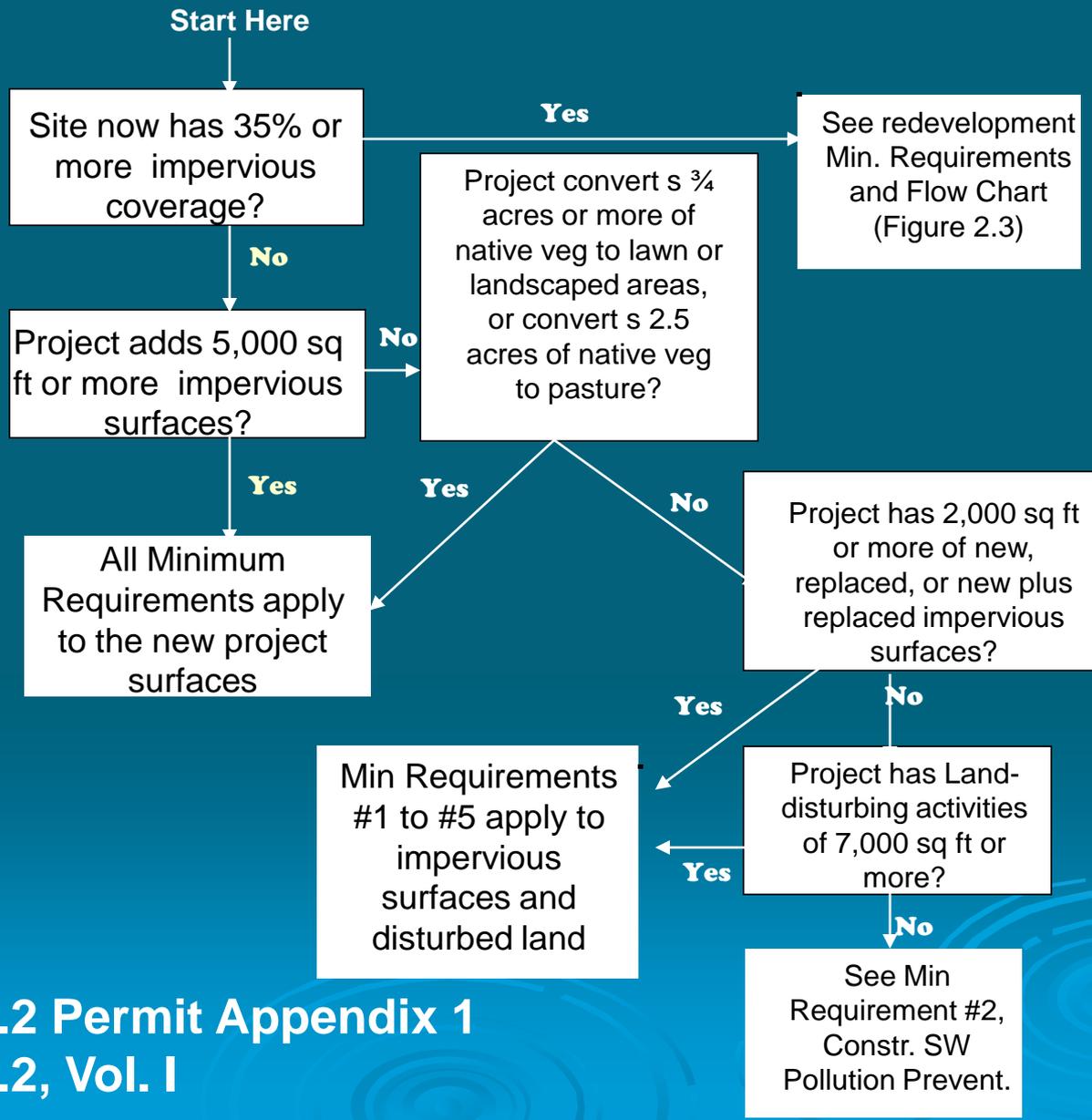


Figure 3.1, Phase II Permit, Appendix 1



**Figure 3.2 Permit Appendix 1
Figure 2.2, Vol. I**

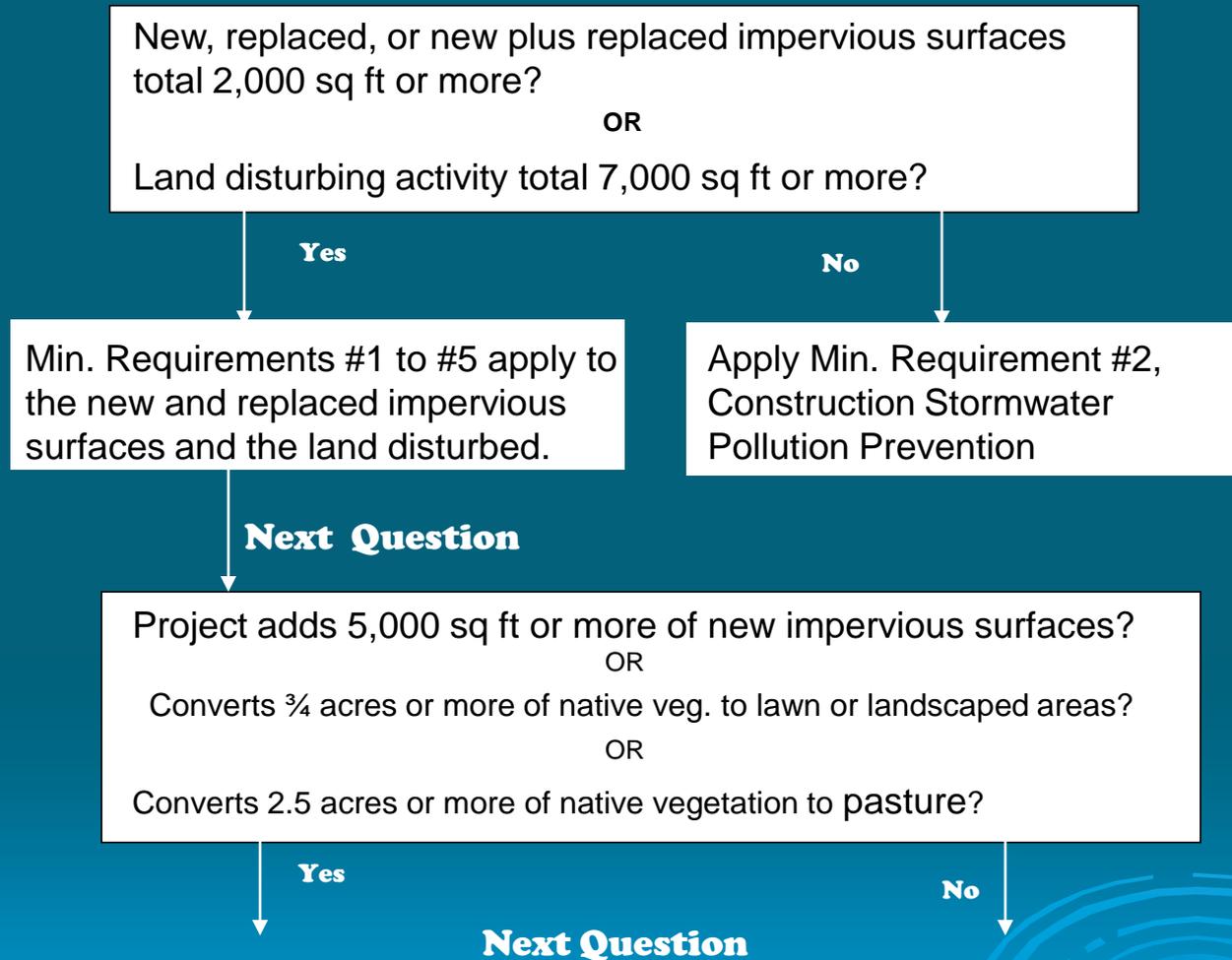


Figure 3.3 Permit Appendix 1
Figure 2.3, Vol. I

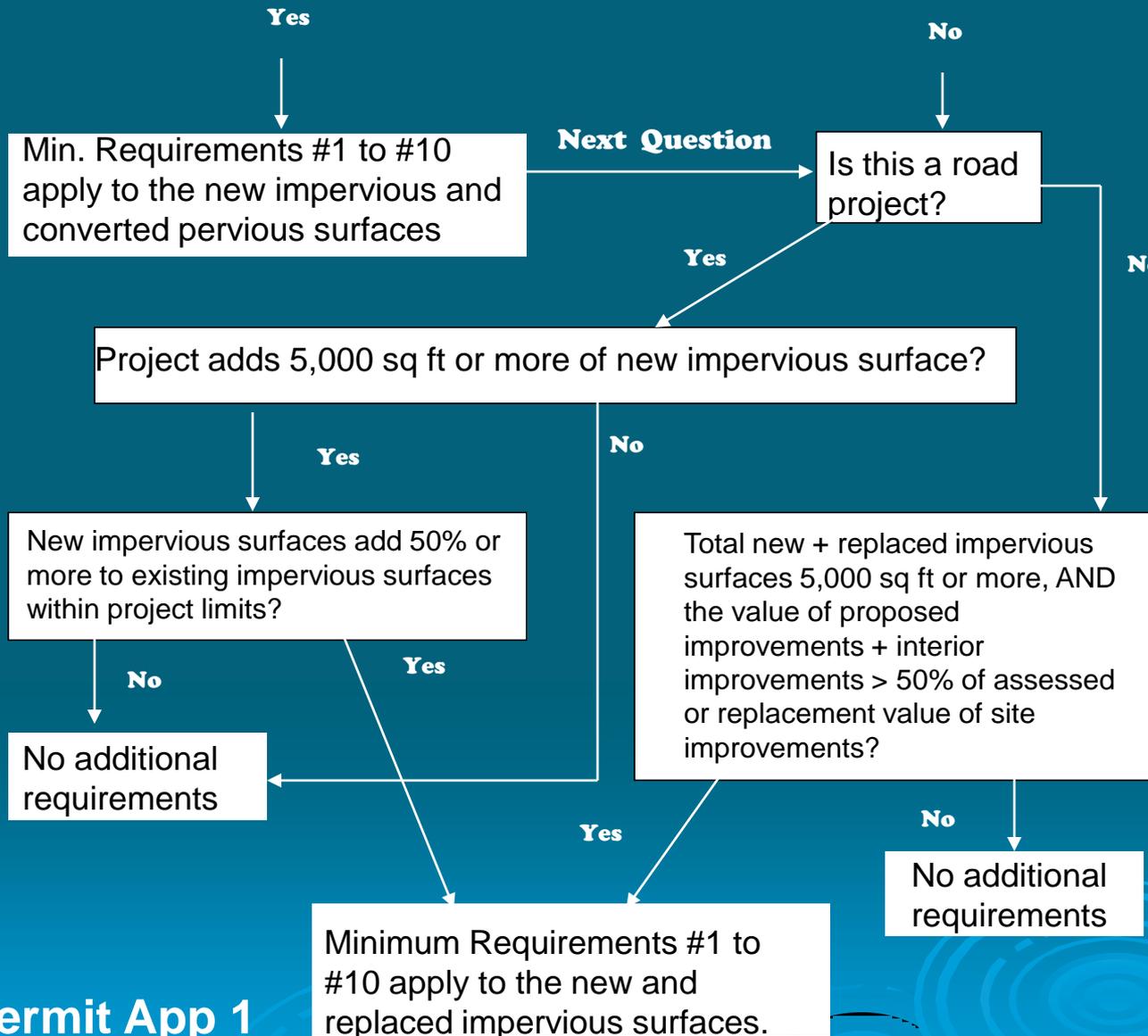


Figure 3.3 Permit App 1
Figure 2.3, Vol. I

MR 1: Preparation of SSP

New Development

- < Minimum initial thresholds of 2,000 sq ft new Imp.
- 2,000 – 5,000 sq ft Imp. + replaced impervious surface or > 7,000 sq ft land disturbing activities
- >5,000 sq ft Imp. or > $\frac{3}{4}$ acre native to lawn or >2.5 acres native to pasture

Minimum Requirements

- Only MR 2 applies
- MR 1 - 5 apply
- MR 1 - 10 apply

Vol. I, Section 2.5.1

MR 1: Preparation of SSP

Re-development

- <2,000 sq ft Imp. or < 7,000 sq ft disturbed area
- 2,000 to 5,000 Imp. or >7,000 sq ft disturbed area
- > 5,000 sq ft + improvements > 50% of assessed land or replacement value of existing site

Minimum Requirements

- MR 2 only
- MR 1 - 5 apply
- MR 1-10 apply

Suggested SSP Format

(All Section references in Vol. I)

1. Information on Existing Conditions (3.1.1.)
2. Development Layout (3.1.2)
3. Off-site Analysis (3.1.3)
4. Determine Applicable Minimum Requirements (3.1.4)
5. Permanent Stormwater Control Plan (3.1.4)
6. Construction Stormwater Pollution Prevention Plan (SWPPP) (3.1.5)

MR 2: Construction SWPPP

- Vol. I, Section 2.5.2
- Attachment to SSP
- Minimum thresholds of 2,000 sq ft new plus replaced impervious surface and 7,000 sq ft land disturbance
- 12 Elements to SWPPP



MR 3: Source Control

- Vol. I, Section 2.5.3
- Prevent stormwater from coming into contact with pollutants
- Applicable and Recommended Operational & Structural BMPs for Commercial /Industrial Projects



MR 4: Natural Drainage Systems

- Vol. I, Section 2.5.4
- Preserve and utilize natural drainage systems to the fullest extent



MR 5: On-Site Stormwater Management

- Vol. I, Section 2.5.5
- Use inexpensive practices on individual properties to reduce the amount of disruption of the natural hydrologic characteristics of the site
- Roof downspout dispersion and infiltration
- Soil Quality and depth
- Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13

http://soilsforsalmon.org/pdf/Soil_BMP_Manual.pdf

MR 6: Runoff Treatment

- Vol. I, Section 2.5.6 includes design storm information
 - Threshold: 5,000 sq ft effective PGIS in a TDA.
 - Reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms
 - Discharge to Basic Treatment Water Bodies (Vol. V, Appendix A)
- 
- The background of the slide features several concentric, light blue circular ripples that resemble water droplets hitting a surface, positioned in the lower right and bottom center areas.

MR 7: Flow Control ^(1/2)

- Vol. I, Section 2.5.7
- Thresholds: 10,000 sq ft of Effective Impervious Surfaces in a TDA or 0.1 cfs increase in 100 yr flow frequency
- Prevent increases in the stream channel erosion rates (50% 2-year to 100% 50-year storm)



MR 7: Flow Control (2/2)

- Continuous Simulation Model (WWHM)
- Closed Depression (Vol. III, Section 2.4)
- Discharge to Flow Control Exempt Water Bodies listed in (Vol. I Appendix E)



MR 8: Wetlands Protection

- Vol. I, Section 2.5.8
- Applies only to projects that discharge to a wetland
- Ensure that wetlands receive the same level of protections as any other waters of the state



MR 9: Basin/Watershed Protection

- Vol. I, Section 2.5.9
- Different than Permit discussion of Basins
- Plan may apply basin specific requirements for erosion control, source control, treatment, flow control, and O&M
- Must be a formally adopted Basin Plan by all Municipalities located within the Basin and approved by Ecology

MR 10: Operation and Maintenance

- Vol. I, Section 2.5.10
- Provide O&M Manual for all stormwater facilities and BMPs
- Identify person responsible for providing O&M



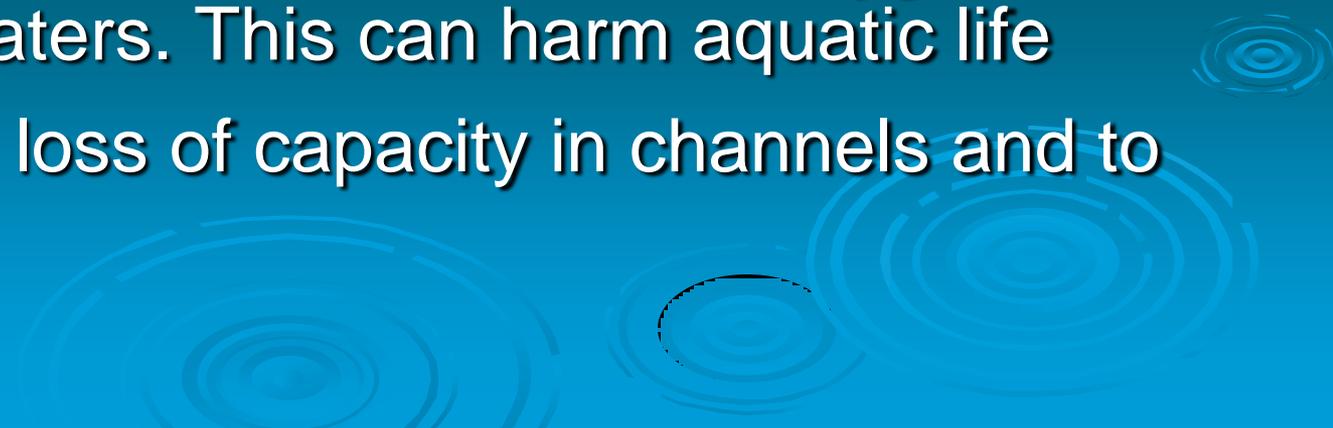
Minimum Requirement #2 The
12 Elements of the
Construction SWPPP
-A Plan Reviewers Guide



Introduction to the SWPPP

- Construction SWPPP involves temporary stormwater controls applicable only during construction
- Stormwater Site Plan describes the permanent stormwater controls
- Management of soils in runoff is the major issue being dealt with during construction and with the SWPPP

Why is Soil a Pollutant?

- Clogs fish gills and affects insects ability to breath
 - Blocks sunlight, traps heat
 - Fills spawning gravels and habitat
 - Contains nutrients – phosphorus and nitrogen – can lower the amount of dissolved oxygen in receiving waters. This can harm aquatic life
 - Can lead to loss of capacity in channels and to flooding
- 

Why is Concrete a Pollutant

- Curing concrete coming into contact with stormwater
- High pH
- Fish Kills



When Reviewing, Think Critically

- Presentation does not cover all scenarios - overview with some examples
- Each site is unique and special - no “one size fits all”
- SWMMWW provides various BMP options
- Jurisdictions will establish submittal requirements for the Narrative, Drawings, and Notes
- Novice to professional submittals
- Think like water – know your area (soils, slopes, receiving water, etc.)



What is being reviewed ?

1. Narrative – a stand-alone document describing the work being done during construction
 2. Plans and Specifications for the temporary construction stormwater controls
 3. The location of the information will vary by project
- 

The Narrative

- A written statement to explain and justify the pollution prevention decisions made for a particular project.
- Explains existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings.
- Examples: phasing of clearing, timing for installation of permanent stormwater controls, etc.



Drawings and Notes – Site Plan

Should Describe:

- Where and when the various BMPs should be installed
- The performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved (or in the narrative)
- Use in combination with the Stormwater Site Plan



Information from SSP

- Acreage and outlines of all drainage basins
- Existing stormwater drainage to and from the site
- Routes of existing, temporary construction
- Permanent future flows at all discharge points



SWMMWW: Volume 1: Section 2.5.2: Minimum Requirement #2

12 Elements of the SWPPP

(pp. 2-15 to 2-24)



Element 1: Preserve Vegetation / Mark Clearing Limits

Confirm:

- Clearly delineated on plan and works with topography
- Note included to mark limits prior to beginning clearing
- Critical Areas, buffers, tree retention areas included
- Method of marking: fence, flagging, etc.

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-2 to 4-7)

- BMP C101: Preserving Natural Vegetation
- BMP C102: Buffer Zones
- BMP C103: High Visibility Plastic or Metal Fence
- BMP C104: Stake and Wire Fence

Element 1: Mark Clearing Limits and Preserve Vegetation

- BMP C102: Buffer Zones
- BMP C104: Stake and Wire Fence
- BMP C233: Silt Fence



Element 2: Establish Construction Access

Confirm:

- Limited to one route, if possible
- Stabilized with a pad of quarry spalls, crushed rock, or other equivalent BMP
- Wheel wash or tire baths if warranted
- Note on drawing or in Narrative: Public roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-8 to 4-12)

- BMP C105: Stabilized Construction Entrance
- BMP C106: Wheel Wash
- BMP C107: Construction Road/Parking Area Stabilization

Quarry Spill Entrance



- BMP C105:
Stabilized Construction
Entrance

Element 3: Control Flow Rates

Confirm:

- Downstream properties and waterways protected
- Note on drawing or in Narrative: Stormwater retention or detention facilities constructed as one of the first steps in grading
- Note on drawing or in Narrative: If permanent infiltration or bioretention structures are used for flow control, these need to be protected from sediment accumulation during construction
- Peak flow has been factored in sizing

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-102 to 4-105)

- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond

Sediment Trap

- BMP C240: Sediment Trap
- BMP C209: Outlet Protection
- BMP C121: Mulching



Element 4: Install Sediment Controls

Confirm: Presence, location and sequencing of BMPs:

- Silt Fence (installed at bottom of slope)
 - Storm Drain Inlet Protection
 - Straw Wattles
 - Check Dams and Sediment Trap(s)
 - Portable Water Storage Tanks
 - Detention Pond or Vault (at start of project)
- 

Sediment Control

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-89 to 4-117)

- BMP C230: Straw Bale Barrier
- BMP C231: Brush Barrier
- BMP C232: Gravel Filter Berm
- BMP C233: Silt Fence
- BMP C234: Vegetated Strip
- BMP C235: Straw Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration

Element 4: Install Sediment Controls



- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C209: Outlet Protection
- BMP C241: Temporary Sediment Pond

Sandbag Check dams



- BMP C207: Check Dams

Wire-backed Silt Fence



- BMP C233 Silt Fence

Element 5. Stabilize Soils

Confirm: Exposed and un-worked soils shall be stabilized with appropriate combination of BMPs:

Check sequencing.

- temporary and permanent seeding
- sod and hydro-seed
- mulching
- plastic covering
- erosion control fabrics and matting (3:1, H:V)
- early application of gravel base on areas to be paved
- dust control

Element 5. Stabilize Soils

Verify Note: Soil can remain exposed and un-worked for:

- Summer (May 1- Sept. 30): 7 Days (ASAP)
- Winter (Oct. 1- April 30): 2 Days (ASAP)

Note: Stabilize soils before a holiday or weekend if needed based on the weather forecast

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-13 to 4-55)

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C123: Plastic Covering
- BMP C124: Sodding
- BMP C125: Topsoiling
- BMP C126: Polyacrylamide for Soil Erosion Protection
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C140: Dust Control
- BMP C180: Small Project Construction Stormwater Pollution Prevention

Straw Mulch and Erosion Control Blankets



- BMP C121 Mulching
- BMP C122 Nets and Blankets

Straw Mulch on Slope



- BMP C121 Mulching

Element 6: Protect Slopes

Verify: Cut and fill slopes are designed and constructed in a manner that will minimize erosion from water at top of slope

- Collect drainage at top of slope and discharge safely
- Reduced length of slope with terracing and diversions
- Reduced slope steepness
- Note: Roughening slope surfaces (e.g., track walking)
- Use of combinations of above BMPs with Straw wattles, EC blankets, Check dams, etc.



Protect Slopes

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-13 to 4-78)

- BMP C120: Temporary and Permanent Seeding
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C204: Pipe Slope Drains
- BMP C205: Subsurface Drains
- BMP C206: Level Spreader
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)



Erosion Control Blankets

- BMP C122: Nets and Blankets



Straw, Wattle and EC Blankets



- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C235: Straw Wattles

Grass on slope



Element 7: Protect Drain Inlets

Check for Note:

- To be installed in all storm drain inlets made operable during construction
- Inspect and Maintain

Suggested BMP

- **BMP C220: Storm Drain Inlet Protection**



Element 8: Stabilize Channels and Outlets

Ensure: Plan includes armoring materials adequate to prevent erosion of :

- channels and outlets
- adjacent stream banks (WDFW - HPA)
- Slopes
- calculations for on-site conveyance matches pipe/ditch sizing

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-63 to 4-80)

- **BMP C202: Channel Lining**
- **BMP C209: Outlet Protection**

Lined Outlet and Channel

BMP C209: Outlet Protection



BMP C202 Channel Lining



Element 9. Control Pollutants

Verify:

- Location of Wheel Washes and Concrete Washout (On-site treatment or sanitary sewer with written permission)
- Note: Fueling Operations (Spill Prevention and Clean-up Plan)
- Note: Chemical and Solvent Stored Under Cover
- Note: Fertilizers and Pesticides (Prevented from Entering Surface Waters)

Suggested BMPs (Vol. II, Chapter. 4, pp. 4-43 to 4-44)

- BMP C151: Concrete Handling
- BMP C152: Sawcutting and Surfacing Pollution Prevention
- See Vol. IV – Source Control BMPs

Secondary Containment

BMP C153: Material Delivery Storage and Containment



Concrete Washout

- BMP 151: Concrete Handling



Sawcutting

BMP C152: Saw Cutting and Surfacing Pollution Prevention



Element 10: Control De-Watering

Check for Plan in Narrative:

- Infiltration (location OK?, Vegetation? Slopes?)
 - Transport offsite (Approved location)
 - On-site chemical treatment (Copy of Request for Chemical Treatment to Ecology)
 - Note: Sanitary sewer discharge with written local approval
 - Sedimentation bag –small volumes-low concentration only (Discharge to?)
 - Note: Keep highly turbid or contaminated dewatering water separate from stormwater.
- 

Pond Dewatering and Filtration



- BMP C250:Construction Stormwater Chemical Treatment
- BMP C251:Construction Stormwater Filtration

Vault Dewatering



Well-point Dewatering



Infiltration



Element 11: Maintain BMPs

Ensure there are Notes that address the following:

- Inspection
- Repair
- Replacement
- Add additional BMPs as needed



Element 12: Manage the Project

Verify Notes:

- Phased to the maximum degree practicable.
- Inspection of BMPs (By CESCL)
- Updating construction SWPPP is required.
- May see monitoring and sampling as required in Ecology CSWGP



Final Thoughts

The Construction SWPPP:

- A starting point – should provide flexibility and combinations of BMPs
 - Will likely change several times during build out based on site conditions
 - Should be easy to follow – simple over complex
 - Combination of BMPs
 - Stress source control over sediment control
- 

New Development Case Study

- Focus on the document review process, not the specific engineering design decisions



Initial Review for Completeness

- Existing Site Hydrology
 - Proposed Site Hydrology
 - Permanent Stormwater Control Plan
 - Discussion of Minimum Requirements
 - Construction SWPPP
 - Engineering Calculations
- 

New Development Submittal Table of Contents

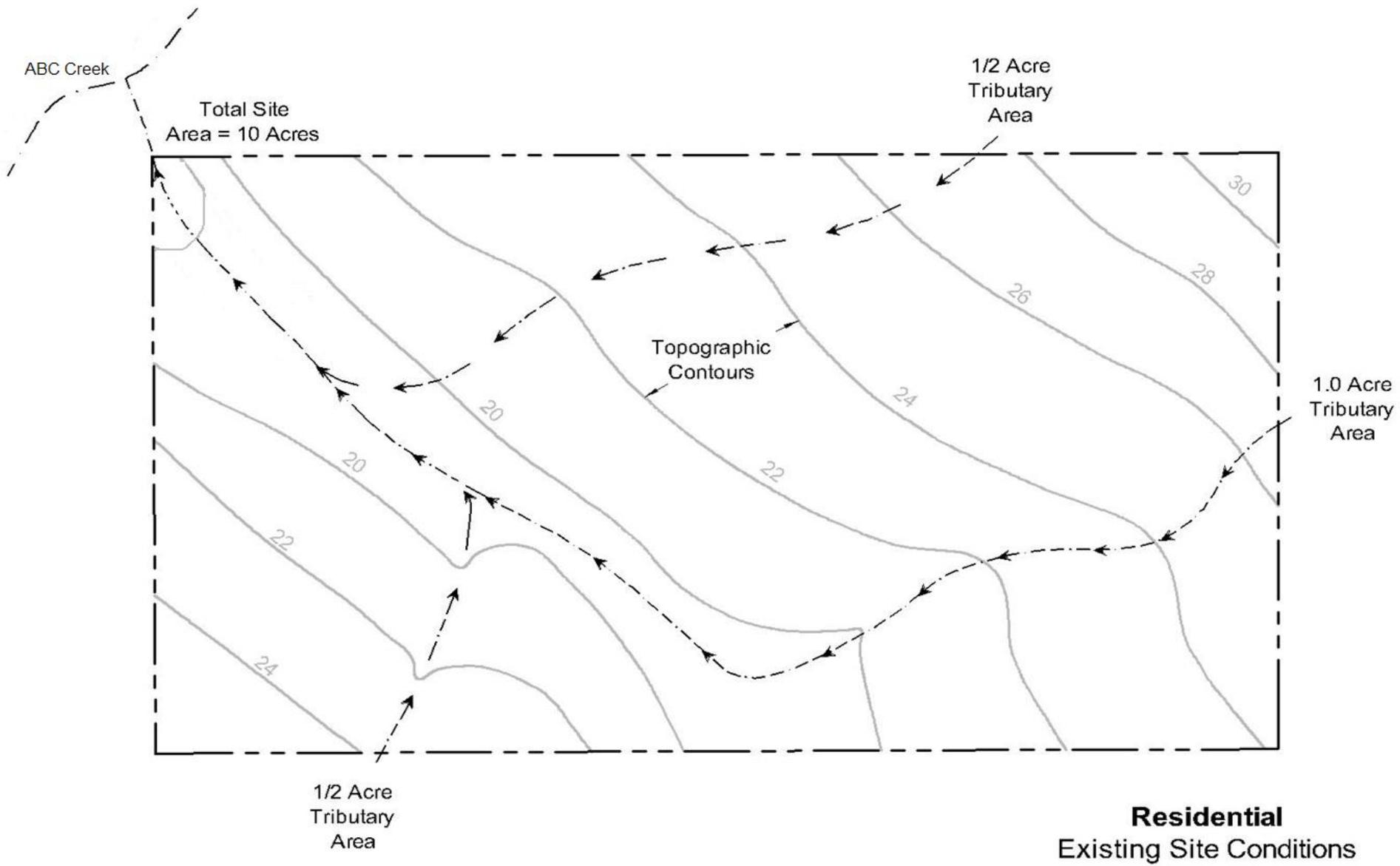
- *Project Overview*
- *Existing Conditions Summary*
- *Off-site Analysis*
- *Permanent Stormwater Control Plan
(including MR discussion)*
- *Construction SWPPP*
- *Additional Information*



Project Overview

The project is a 50 Lot Subdivision in Thurston County located near the intersection of Marvin Road and 56th Ave NE. Entrance to the subdivision is in the NW corner of the site with four cul-de-sacs providing access to the properties. Total size of the project is 10 acres with a minimum lot size of 5,000 sq ft.

Approximately 20, 000 square feet of land has been set aside for the stormwater control facilities.



Existing Conditions Summary ^(1/2)

There are three small drainages upstream of the site (2 at 0.5 acre, 1 at 1.0 acre) flow across the project site. The three intermittent streams join and the single drainage way leaves the site and discharges into ABC Creek approximately 1,000 feet downstream of the project site.

ABC Creek is a fish-bearing stream as determined by a review of the creek. A structure located downstream of the site near the creek's discharge into ABC Lake is a barrier for fish passage. Without that barrier, fish should be able to move up ABC Creek to within 500 feet of the project site.

Existing Conditions Summary (2/2)

Elevations on the site vary between 18 and 30 feet MSL draining primarily to the NW.

Existing site soils are classified as C soils and the annual high groundwater level is approximately 8 feet below the surface. The site has not been previously developed and currently consists of second growth fir.

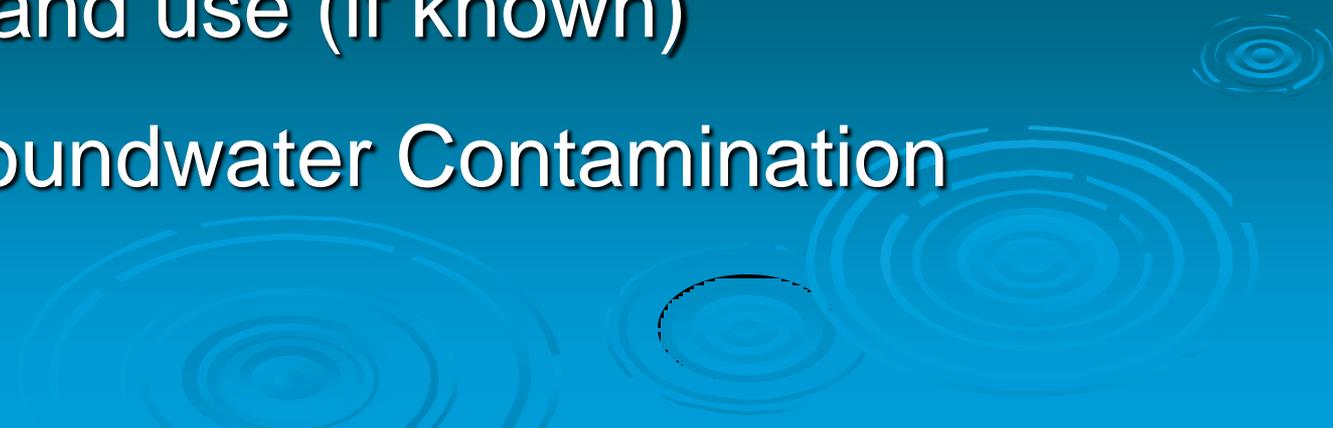
There are no wetlands, either on the project site or for 1 mile downstream of the project site. There are no basin plans that apply to this site and the ultimate receiving water is not nutrient limited and has no TMDL values assigned.

Attachments for Existing Conditions

- *Detailed Topographic Map of Site*
- *Map of drainages and discharge point*
- *Site Soils Report*



Confirm Existing Conditions Submittal

- Topographic Map of Site
 - Existing Development
 - Site Soils
 - Vegetative cover
 - Previous land use (if known)
 - Soil or Groundwater Contamination
- 

Off-site Analysis of Impacts to ABC Creek (1/2)

- *Runoff from the site currently drains to Creek, located approximately 1,000 feet downstream of the property.*
- *There will be no change in the drainage off-site between the project site and ABC Creek.*
- *The alignment from the property to ABC Creek is an intermittent stream with a well-defined channel.*
- *The channel is adjacent to “B” Street and collects runoff from the street for the full length of the channel.*
- *The channel is a grass-lined ditch maintained by City crews.*
- *Capacity of the ditch is significantly greater than the peak discharge rate from the site as determined by the WWHM results and an analysis of the ditch capacity (see attached off-site Analysis Report).*

Off-site Analysis (2/2)

ABC Creek

- *Is well-established*
- *Passes under “B” St. - receives flows from channel paralleling “B” St*
- *Is protected from high velocity water from the roadside ditch through the presence of riprap bedding on the Creek’s bottom and sides.*
- *Has peak flows more than 25 times the peak flow anticipated from the channel and the proposed development site.*
- *Has capacity sufficient to pass the peak flows anticipated (see Off-site Analysis Report).*
- *Has no obstructions to flow that will cause a backwater condition.*

Detailed calculations in the Off-site Analysis Report continued downstream of the point where ABC Creek passed under “B” Street for an additional 1,000 feet. A qualitative review of ABC Creek was completed for 1 mile below the confluence.

Confirm Off-site Analysis Submittal

- See Vol. I Section 2.6.2
- Can be included in report or in separate document



Permanent Stormwater Control Plan (1/2)

Permanent stormwater controls on the project site will consist of catch basins along the street connected by underground piping. The stormwater will pass through a detention pond prior to being treated in a sand filter vault. The detention and treatment facilities were sized using the WWHM ver. 3 program.

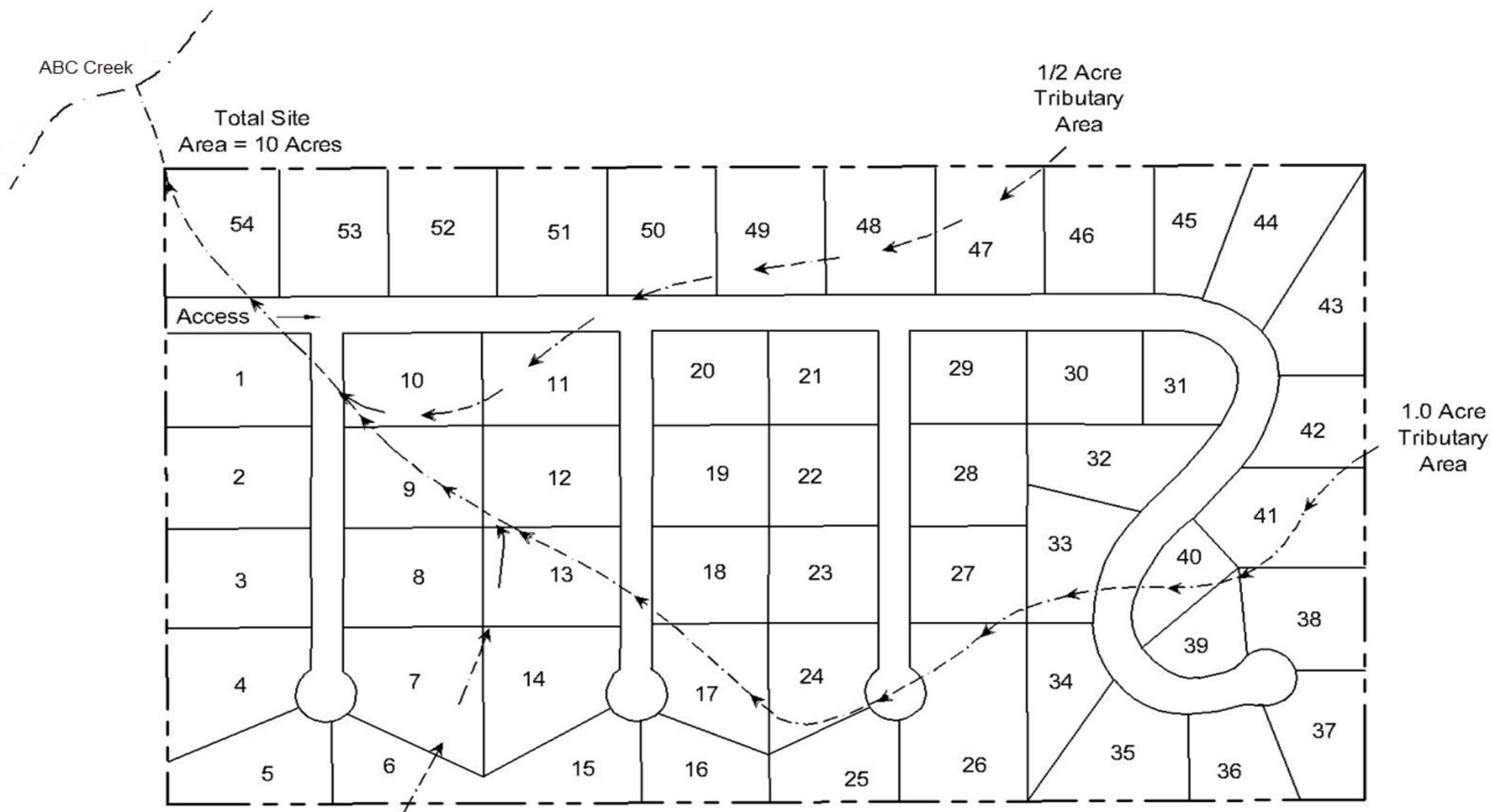
Two of the three off-site areas that currently flow across the project site are collected in the stormwater piping and passed through the detention pond and treatment facility. One area is caught at the property boundary and connected to the treatment bypass line.

Permanent Stormwater Control Plan (2/2)

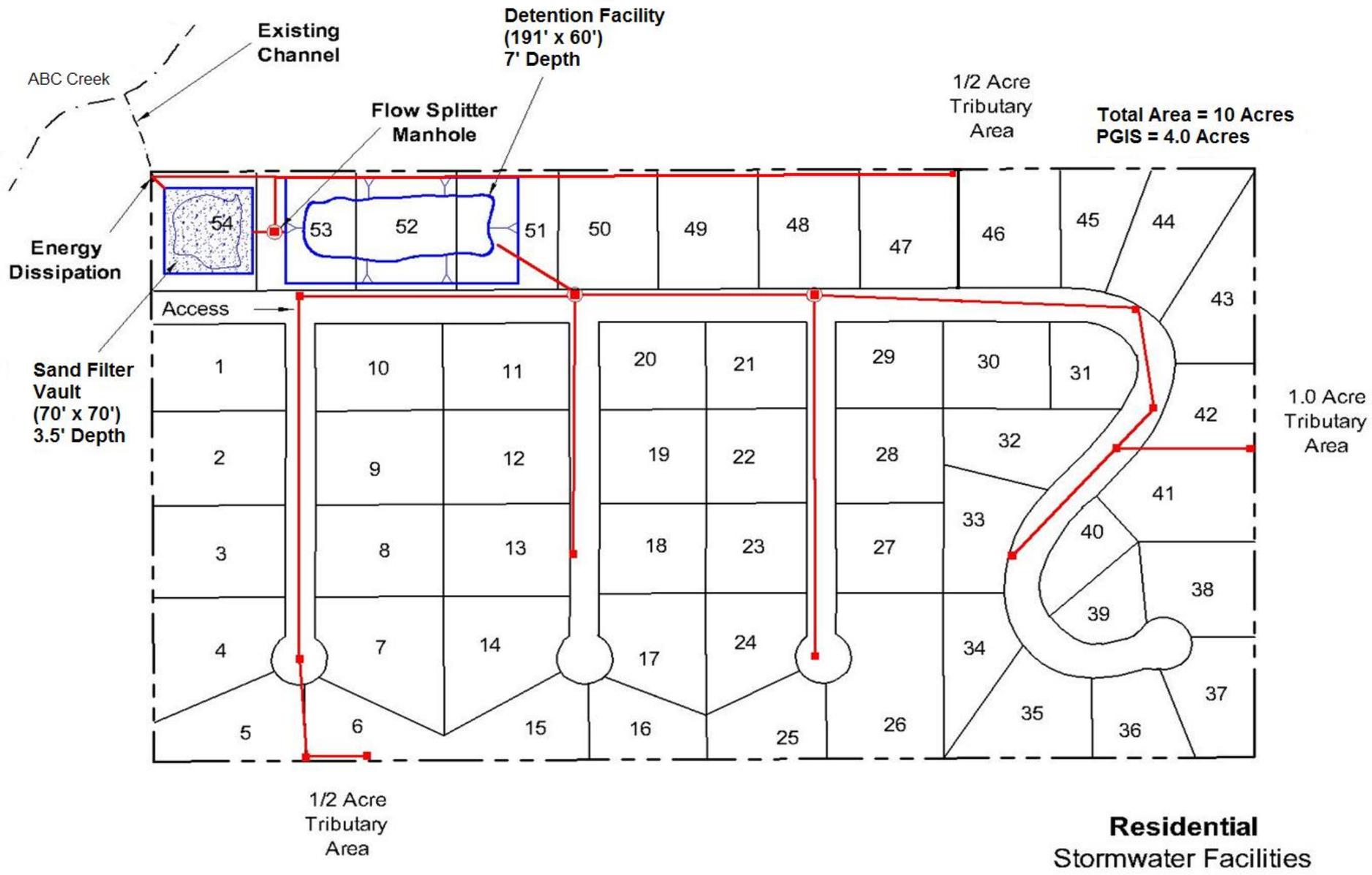
Piping was sized using the rational method to determine the anticipated flow rates and to pass 100-year event with no backwater.

Plan and profile drawings for the collection system, the detention pond, and the sand filter vault are included in the submittal. A copy of the WWHM output is also provided.

All 10 of the minimum requirements have been addressed in this document. Table 1 contains the necessary information used to move through the flow charts for Figures 3.1 and 3.2 in the Permit (Figure 2.2 in the SWMMWW). Copies of the flow charts are attached for your review.



Residential C
Site Improvements



Drainage Areas

| Item | Pre-Developed | Developed |
|---|---------------|---|
| Total project area | 10 acres | 10 acres |
| Area of off-site forest combining with on-site runoff | 2 acres | 1.5 acres |
| Total area used by WWHM in runoff calculations | 12 acres | 9.2 acres |
| Impervious area (% of site) | 0% | 43.30% |
| Area of new impervious PGIS Surfaces (roads, sidewalks, driveways, pond etc.) | 0.0 acres | 4.0 acres (roads; 2.2 acre, sidewalks: 1.0 acres, driveways; 0.3 acres, pond; 0.5 acre) |
| Area of new impervious NPGIS Surfaces (roofs, patios, etc.) | 0.0 acres | 0.0 acres in model (infiltrated on site), total of 2.3 acres on-site |
| Converted pervious surfaces (forest to lawn) | 0.0 acres | 3.7 acres |

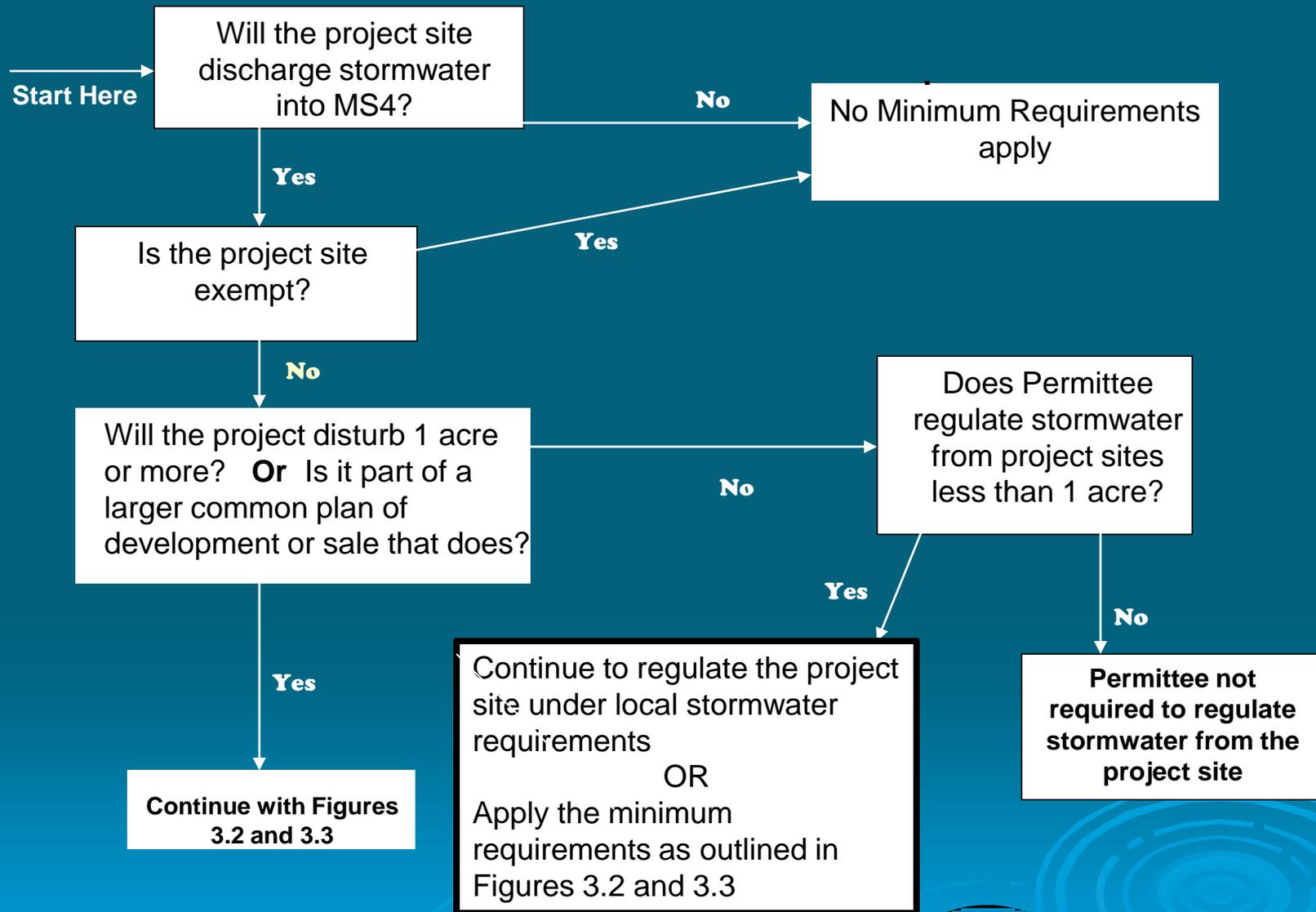
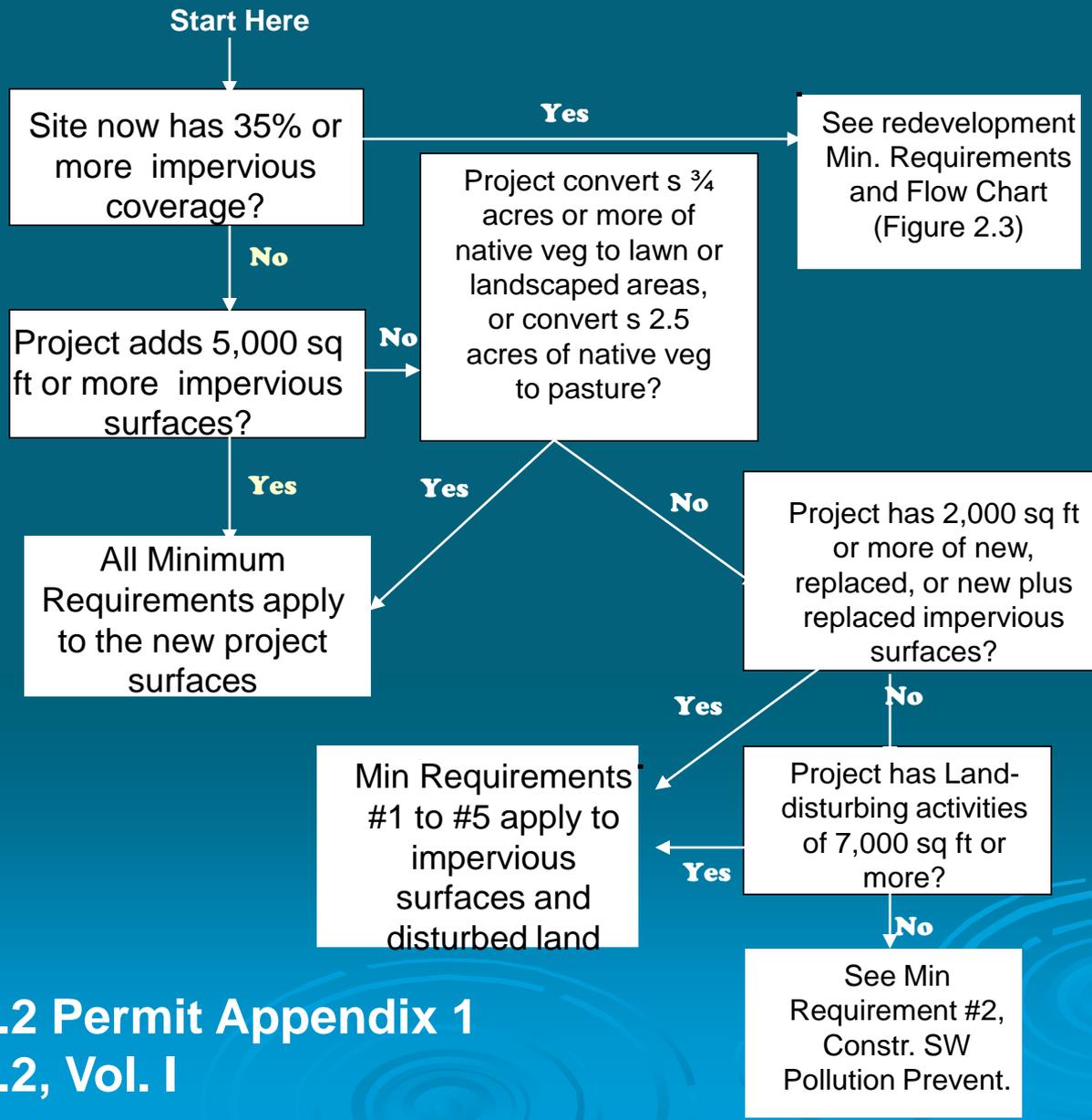


Figure 3.1, Phase II Permit, Appendix 1



**Figure 3.2 Permit Appendix 1
Figure 2.2, Vol. I**

Confirm Flow Chart Selection Process & Results

Apply MR 1 through 10 to all new impervious surfaces and converted pervious surfaces

- See Vol. I Section 2.4.1
- Suggest having proponent submit copy of Flowcharts



Detailed Plan Review

Each of the 10 Minimum Requirements are discussed below:



MR 1 Stormwater Site Plan

This document and attachments make up the Stormwater Site Plan required in MR 1.

The Construction Plans and Specs are included in the attachments.



MR 2 Construction SWPPP

The Construction Stormwater Pollution Prevention Plan is included in this submittal as an attachment. Construction drawings and specifications are an additional attachment.



MR 2 Construction SWPPP

- Detailed discussion earlier
- Vol. II covers the Construction SWPPP
- Section 3.1 covers Guidelines
- Section 3.2 lists a procedure
- Chapter 4 lists source control and runoff BMPs

MR 3 Source Control

- *Since this is a residential project, there are no specific Source Controls as required by MR 3.*



MR 3 Source Control

- Source Control BMPs Vol. IV Chapter 2
- Can skip if project is residential (Vol. I, Section 4.2)
- Applies to Commercial/Industrial projects



MR 4 Preservation of Natural Drainages (1/2)

Runoff from the site following construction of the permanent stormwater control facilities occurs at the same location as the existing conditions. Runoff from approximately 2 acres of undisturbed area upstream of the project will continue to pass through the project site, within the collection system. This runoff will be treated and detained as appropriate.

The existing channels for the runoff from upstream properties is intermittent based on rainfall and do not have a regular channel. Thus, the design of the roads and lots did not take into account existing drainage ways across the site, but maintained the discharge location from the site only.

MR 4 Preservation of Natural Drainages (2/2)

The outfall from the treatment facility has been designed to decrease the flow velocity from the site to a level that will not cause any erosion at the outfall and in the channel between the site and the confluence with ABC Creek.



MR 4 Preservation of Natural Drainages

- Involves site design
- On-site drainages & drainages that pass through site
- Identify streams that need to maintain existing land cover



MR 5 On-site Stormwater Management

On-site stormwater management will be accomplished through on-site infiltration (BMP T5.10) of NPGIS runoff from rooftops of the houses and replacement of surface soil in accordance with BMP T5.13 (form attached). There is more than five feet of elevation difference between the bottom of the infiltration trenches and the annual high groundwater level. The houses will be constructed of materials that result in NPGIS runoff from the rooftops. See the attached soils report for further information on the ability to infiltrate runoff from the roof.

There is insufficient flow path on the individual home sites to use flow dispersion.

MR 5 On-site Stormwater Management

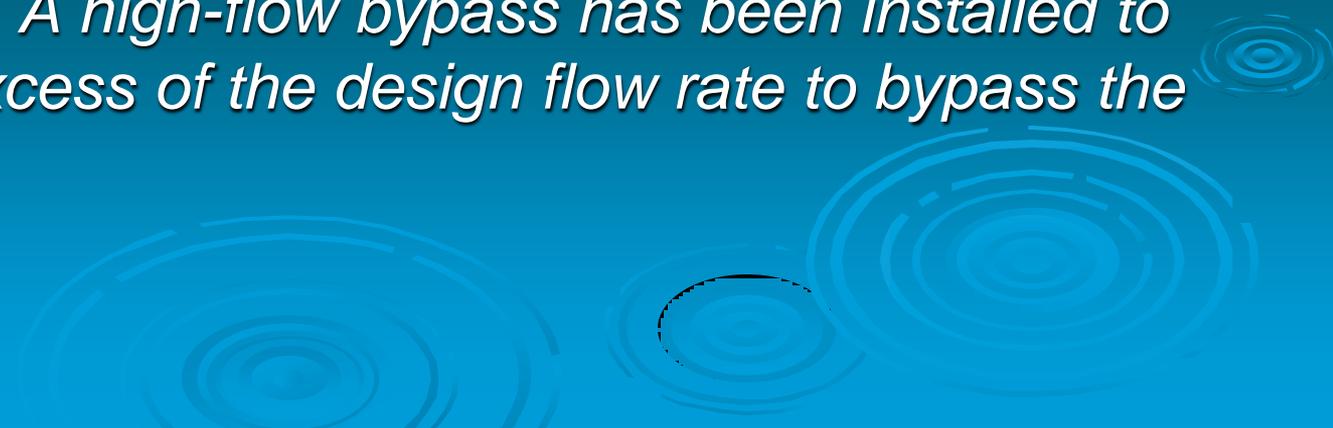
- Vol. III Chapter 3 for Flow Control
 - NPGIS Dispersion and Infiltration
- Vol. V Chapter 5 for Treatment
 - PGIS Dispersion and Infiltration
 - Soil Quality and Depth
- Submit Soil Management Plan Form



MR 6 Runoff Treatment (1/10)

The third level Threshold for MR6 is met on this project. There is more than 5,000 sq ft of Effective PGIS surface in a TDA.

Runoff treatment for the site is provided by a sand filter installed immediately downstream of the detention facility (discussed in the next section). The sand filter has been designed to treat the full 2-year discharge from the detention pond. A high-flow bypass has been installed to allow flows in excess of the design flow rate to bypass the sand filter.



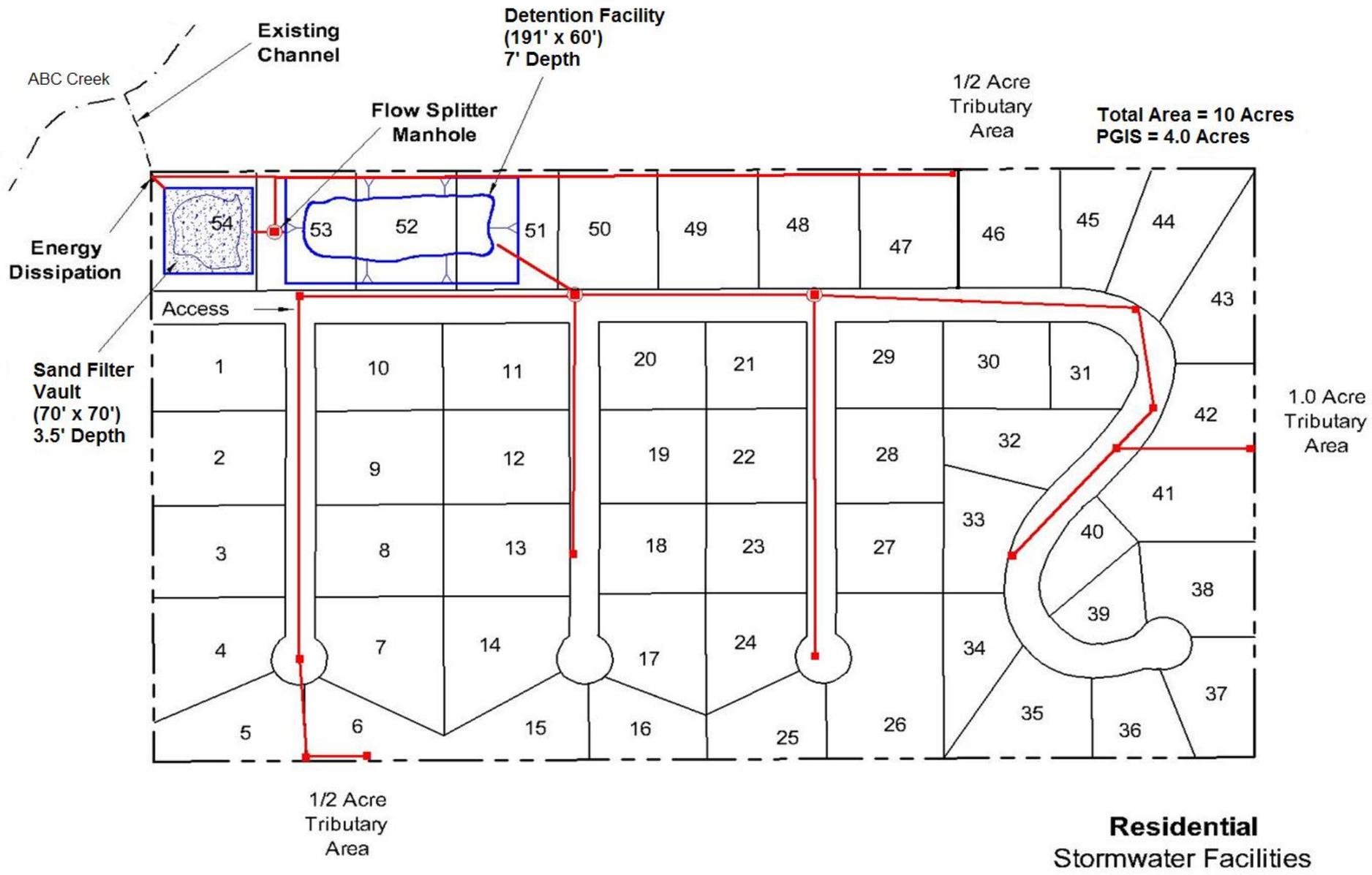
MR 6 Runoff Treatment (2/10)

On-site soils do not meet the site-suitability requirements as defined in Vol. III, Section 3.3.7 for the use of infiltration for water quality treatment.

Based on the flowchart Vol. V, Figure 2.1, and the supporting guidance this project does not require oil treatment, Phosphorus Control, or Enhanced Treatment.

The water quality facility has been designed for Basic Treatment only.





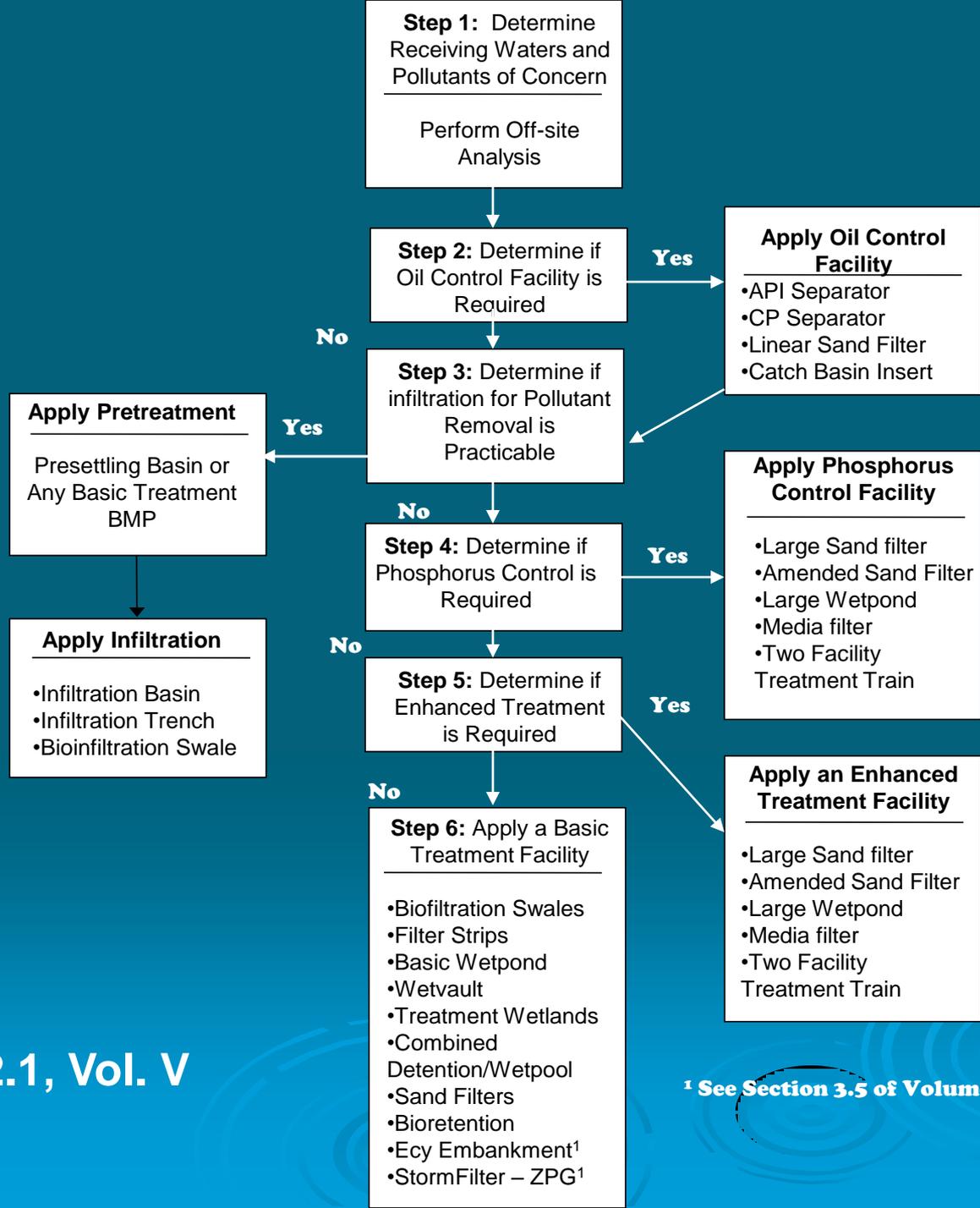


Figure 2.1, Vol. V

¹ See Section 3.5 of Volume V for more information

Treatment Menu Assistance (5/10)

- Additional guidance on each box in flow chart in Vol. V, Chapters 2 and 3.
 - Oil Control: “high-use sites”
 - Phosphorus Control: Local Municipality, basin plan, or receiving water TMDL
 - Enhanced Treatment: Non-Residential discharge to fish bearing water bodies.



MR 6 Runoff Treatment (6/10)

Design Criteria in Volume V Section 8.6 has been used to size the sand filter.

Table 2 lists the resulting design dimensions and long-term treatment efficiency for the sand filter.

The facility meets the water quality requirement of treating 91% of the annual runoff.



MR 6 Runoff Treatment (7/10)

| Item | Value |
|--|--|
| Type of Treatment | Sand Filter, Immediately Downstream of Detention |
| Length to Width Ratio | 1:1 |
| Length and width | 70' x 70' |
| Side slopes | Vertical |
| Effective Depth | 3.5 feet |
| Riser Height and Diameter | 2.5 feet tall and with 24" diameter riser |
| Simulation Results | |
| Area draining to facility | 9.2 acres |
| Design Flow Rate (Full 2-year discharge from Detention Pond) | 0.308 cfs |
| Volume to Pond | 788.42 ac-ft |
| Volume filtered | 782.34ac-ft |
| Percent filtered | 99.23% |

MR 6 WWHM Output (8/10)

WWHM3 New Dev treat

File Edit View Help

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

ELEMENTS

Move Elements

Save x,y Load x,y

X: 40 Y: 42

Sand Filter 1 Mitigated

Facility Name: Sand Filter 1

Outlet 1: 0 Outlet 2: 0 Outlet 3: 0

Downstream Connections: 0 0 0

Facility Type: Sand Filter

Precipitation Applied to Facility Quick Filter

Evaporation Applied to Facility

Facility Bottom Elevation (ft): 0

Facility Dimensions

| | |
|-------------------|-----|
| Bottom Length | 70 |
| Bottom Width | 70 |
| Effective Depth | 3.5 |
| Left Side Slope | 0 |
| Bottom Side Slope | 0 |
| Right Side Slope | 0 |
| Top Side Slope | 0 |

Infiltration: YES

Hydraulic Conductivity(in/hr): 1

Filter material depth(ft): 1.5

Total Volume Filtered(acre-ft): 782.384

Total Volume Through Riser(acre-ft): 6.04

Total Volume (acre-ft): 788.424

Percent Filtered: 99.23

Outlet Structure

| | |
|--------------------|-------------|
| Riser Height (ft) | 2.5 |
| Riser Diameter(in) | 24 |
| Riser Type | Notched |
| Notch Type | Rectangular |
| Notch Height (ft) | 2 |
| Notch Width (ft) | 1 |

| Orifice Number | Diameter (In) | Height (Ft) | QMax (cfs) |
|----------------|---------------|-------------|------------|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 |

Filter Storage Volume at Riser Head: .398

Pond Increment: 0.10

Show Pond Table: Open Table

MR 6 Runoff Treatment (9/10)

- Design flow or volume criteria Vol. I Section 2.5.7
- Vol. V contains site design criteria for approved technologies (Site Suitability Criteria)
- Treatment type selection flow chart (Vol. V, Fig. 2.1 and text)
- Treatment Design Criteria in Vol. V for each type of facility

MR 6 Runoff Treatment (10/10)

- Basic Treatment Receiving Waters (Vol. V, App A)
- Information on selection procedure provided by proponent, confirm from WWHM



MR 7 Flow Control (1/7)

This project meets the third level Threshold for MR 7 with more than 10,000 sq ft of Effective Impervious surface in the TDA.

Flow control is being installed upstream of the treatment system. All runoff that enters the collection system will pass through a detention pond located in the NW corner of the project site. Information on the areas used in the mitigated analysis in WWHM are also included in Table 1.

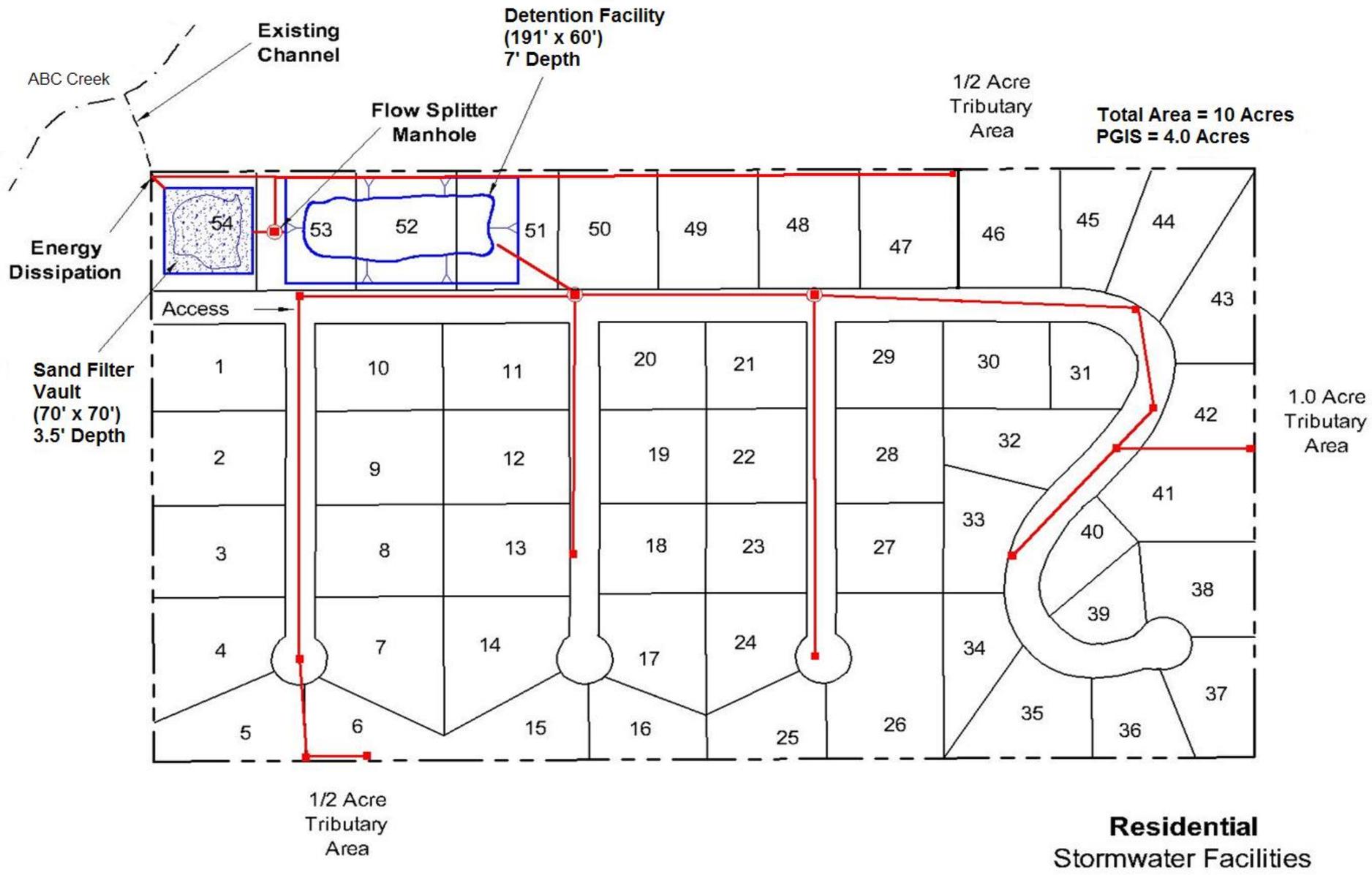
WWHM software provided the calculation engine for the detention pond sizing calculations.

MR 7 Flow Control (2/7)

The area controlled by the detention pond totals 9.2 acres, a decrease from the original 12 acres, accomplished through two actions:

1) Runoff from the offsite area north of the project site (0.5 acres) has been intercepted and directed through underground piping to the bypass line around the treatment plant, allowing runoff to leave the site uncontrolled

2) Runoff from NPGIS roofs (2.3 acres) will be directly infiltrated from the roof downspouts on each lot. These two actions decrease the area controlled by the detention pond by a total of 2.8 acres, reducing the total area flowing to the treatment pond to 9.2 acres from the original 12.0 acres.



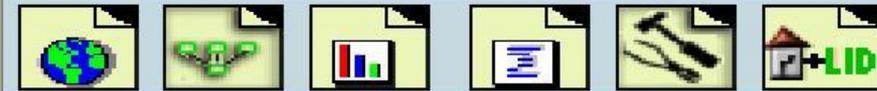
MR 7 Flow Control (4/7)

| Item | Value |
|--|--------------------------|
| Type of Pond | Trapezoidal |
| Length to Width Ratio | 3:1 |
| Side slopes (H:V) | 3:1 |
| Depth of Pond | 5 feet |
| Type of Discharge Structure | 18" Riser with 1 orifice |
| Riser Height | 6 feet |
| Resulting Pond | |
| Bottom Length | 191 feet |
| Bottom Width | 64 feet |
| Size of Orifice and Maximum Discharge Rate | 1.98 inches, 0.23 cfs |
| Volume below Top of Riser | 1.44 Acre-ft |

MR 7 Flow Control (5/7)

WWHM3 New Dev treat

File Edit View Help



Schematic

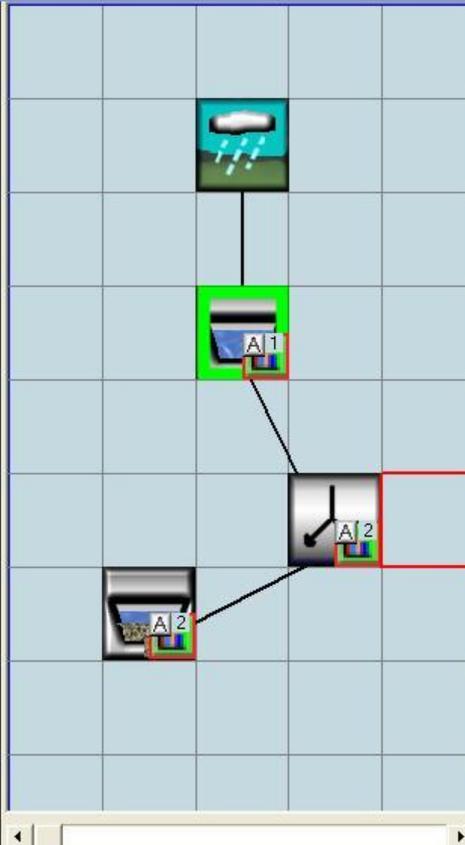
SCENARIOS

Predeveloped

Mitigated

Run Scenario

ELEMENTS



Move Elements



Save x,y

Load x,y

X 40

Y 30

Trapezoidal Pond 1 Mitigated

Facility Name

Trapezoidal Pond 1

Downstream Connections

Outlet 1
Flow Splitter 1

Outlet 2

0

Outlet 3

0

Facility Type

Trapezoidal Pond

Precipitation Applied to Facility

Auto Pond

Quick Pond

Evaporation Applied to Facility

Facility Bottom Elevation (ft)

0

Facility Dimensions

Bottom Length (ft)

191

Bottom Width (ft)

64

Effective Depth (ft)

5

Left Side Slope (H/V)

3

Bottom Side Slope (H/V)

3

Right Side Slope (H/V)

3

Top Side Slope (H/V)

3

Facility Dimension Diagram

Infiltration

NO

Outlet Structure

Riser Height (ft)

4

Riser Diameter(in)

18

Riser Type

Notched

Notch Type

Rectangular

Notch Height (ft)

1.32

Notch Width (ft)

0.1412

Orifice Number

Diameter (In)

Height (Ft)

QMax (cfs)

1

1.98

0

0.23024

2

0

0

0

3

0

0

0

Pond Volume at Riser Head (acre-ft) 1.445

Pond Increment

0.10

Show Pond Table

Open Table

Use Tide Gate?

NO

MR 7 Flow Control (6/7)

- WWHM (continuous storm)
- Design Criteria for facilities
 - Detention Facilities (Vol. III Section 3.2)
 - Infiltration Facilities (Vol. III Section 3.3)



MR 7 Flow Control (7/7)

- WWHM Report not complete, need supplemental info from within WWHM
- Flow Control Exempt Water Bodies listed in (Vol. I App E)



WWHM Issues (1/4)

Pond Hydraulic Table

| Stage(ft) | Area(acr) | Volume(acr-ft) | Dschrg(cfs) | Infilt(cfs) |
|-----------|-----------|----------------|-------------|-------------|
| 0.000 | 0.281 | 0.000 | 0.000 | 0.000 |
| 0.056 | 0.283 | 0.016 | 0.024 | 0.000 |
| 0.111 | 0.285 | 0.031 | 0.034 | 0.000 |
| 0.167 | 0.287 | 0.047 | 0.042 | 0.000 |
| 0.222 | 0.288 | 0.063 | 0.049 | 0.000 |
| 0.278 | 0.290 | 0.079 | 0.054 | 0.000 |
| 0.333 | 0.292 | 0.096 | 0.059 | 0.000 |
| 0.389 | 0.294 | 0.112 | 0.064 | 0.000 |
| 0.444 | 0.296 | 0.128 | 0.069 | 0.000 |
| 0.500 | 0.298 | 0.145 | 0.073 | 0.000 |
| 0.556 | 0.300 | 0.161 | 0.077 | 0.000 |
| 0.611 | 0.302 | 0.178 | 0.080 | 0.000 |
| 0.667 | 0.304 | 0.195 | 0.084 | 0.000 |
| 0.722 | 0.306 | 0.212 | 0.088 | 0.000 |
| 0.778 | 0.308 | 0.229 | 0.091 | 0.000 |
| 0.833 | 0.310 | 0.246 | 0.094 | 0.000 |

WWHM Issues (2/4)

WWHM3 New Dev treat

File Edit View Help



Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

ELEMENTS



Move Elements



Save x,y

Load x,y

X 40

Y 30



Trapezoidal Pond 1

| Stage (ft) | Area (acres) | Storage (acre-ft) | Dschrg (cfs) | Infilt (cfs) |
|------------|--------------|-------------------|--------------|--------------|
| 0.000000 | 0.280624 | 0.000000 | 0.000000 | 0.000000 |
| 0.055556 | 0.282578 | 0.015645 | 0.024269 | 0.000000 |
| 0.111111 | 0.284537 | 0.031398 | 0.034322 | 0.000000 |
| 0.166667 | 0.286501 | 0.047260 | 0.042035 | 0.000000 |
| 0.222222 | 0.288471 | 0.063231 | 0.048538 | 0.000000 |
| 0.277778 | 0.290445 | 0.079312 | 0.054267 | 0.000000 |
| 0.333333 | 0.292424 | 0.095503 | 0.059447 | 0.000000 |
| 0.388889 | 0.294409 | 0.111804 | 0.064210 | 0.000000 |
| 0.444444 | 0.296398 | 0.128215 | 0.068643 | 0.000000 |
| 0.500000 | 0.298393 | 0.144737 | 0.072807 | 0.000000 |
| 0.555556 | 0.300393 | 0.161370 | 0.076746 | 0.000000 |
| 0.611111 | 0.302398 | 0.178114 | 0.080491 | 0.000000 |
| 0.666667 | 0.304408 | 0.194970 | 0.084071 | 0.000000 |
| 0.722222 | 0.306423 | 0.211938 | 0.087503 | 0.000000 |
| 0.777778 | 0.308443 | 0.229017 | 0.090807 | 0.000000 |
| 0.833333 | 0.310468 | 0.246209 | 0.093994 | 0.000000 |
| 0.888889 | 0.312499 | 0.263514 | 0.097076 | 0.000000 |
| 0.944444 | 0.314534 | 0.280932 | 0.100064 | 0.000000 |
| 1.000000 | 0.316575 | 0.298462 | 0.102965 | 0.000000 |
| 1.055556 | 0.318621 | 0.316107 | 0.105786 | 0.000000 |
| 1.111111 | 0.320671 | 0.333865 | 0.108535 | 0.000000 |
| 1.166667 | 0.322727 | 0.351737 | 0.111215 | 0.000000 |
| 1.222222 | 0.324788 | 0.369723 | 0.113832 | 0.000000 |
| 1.277778 | 0.326854 | 0.387825 | 0.116390 | 0.000000 |
| 1.333333 | 0.328926 | 0.406041 | 0.118894 | 0.000000 |
| 1.388889 | 0.331002 | 0.424372 | 0.121345 | 0.000000 |
| 1.444444 | 0.333083 | 0.442819 | 0.123748 | 0.000000 |
| 1.500000 | 0.335170 | 0.461381 | 0.126106 | 0.000000 |
| 1.555556 | 0.337262 | 0.480060 | 0.128420 | 0.000000 |
| 1.611111 | 0.339358 | 0.498855 | 0.130693 | 0.000000 |
| 1.666667 | 0.341460 | 0.517767 | 0.132927 | 0.000000 |



WWHM Issues (3/4)

Sand Filter Hydraulic Table

| Stage(ft) | Area(acr) | Volume(acr-ft) | Dschrg(cfs) | Infilt(cfs) |
|-----------|-----------|----------------|-------------|-------------|
| 0.000 | 0.112 | 0.000 | 0.000 | 0.000 |
| 0.039 | 0.112 | 0.004 | 0.000 | 0.000 |
| 0.078 | 0.112 | 0.009 | 0.000 | 0.000 |
| 0.117 | 0.112 | 0.013 | 0.000 | 0.000 |
| 0.156 | 0.112 | 0.017 | 0.000 | 0.000 |
| 0.194 | 0.112 | 0.022 | 0.000 | 0.000 |
| 0.233 | 0.112 | 0.026 | 0.000 | 0.000 |
| 0.272 | 0.112 | 0.031 | 0.000 | 0.000 |
| 0.311 | 0.112 | 0.035 | 0.000 | 0.000 |
| 0.350 | 0.112 | 0.039 | 0.000 | 0.000 |
| 0.389 | 0.112 | 0.044 | 0.000 | 0.000 |
| 0.428 | 0.112 | 0.048 | 0.000 | 0.000 |

WWHM Issues (4/4)

WWHM3 New Dev treat

File Edit View Help

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

ELEMENTS

Move Elements

X: 40

Y: 42

Sand Filter 1

| Stage (ft) | Area (acres) | Storage (acre-ft) | Dschrg (cfs) | Infilt (cfs) |
|------------|--------------|-------------------|--------------|--------------|
| 0.000000 | 0.112489 | 0.000000 | 0.000000 | 0.000000 |
| 0.038889 | 0.112489 | 0.004375 | 0.000000 | 0.116367 |
| 0.077778 | 0.112489 | 0.008749 | 0.000000 | 0.119307 |
| 0.116667 | 0.112489 | 0.013124 | 0.000000 | 0.122248 |
| 0.155556 | 0.112489 | 0.017498 | 0.000000 | 0.125189 |
| 0.194444 | 0.112489 | 0.021873 | 0.000000 | 0.128129 |
| 0.233333 | 0.112489 | 0.026247 | 0.000000 | 0.131070 |
| 0.272222 | 0.112489 | 0.030622 | 0.000000 | 0.134011 |
| 0.311111 | 0.112489 | 0.034996 | 0.000000 | 0.136951 |
| 0.350000 | 0.112489 | 0.039371 | 0.000000 | 0.139892 |
| 0.388889 | 0.112489 | 0.043746 | 0.000000 | 0.142833 |
| 0.427778 | 0.112489 | 0.048120 | 0.000000 | 0.145773 |
| 0.466667 | 0.112489 | 0.052495 | 0.000000 | 0.148714 |
| 0.505556 | 0.112489 | 0.056869 | 0.001379 | 0.151655 |
| 0.544444 | 0.112489 | 0.061244 | 0.031201 | 0.154595 |
| 0.583333 | 0.112489 | 0.065618 | 0.080107 | 0.157536 |
| 0.622222 | 0.112489 | 0.069993 | 0.142288 | 0.160477 |
| 0.661111 | 0.112489 | 0.074367 | 0.215344 | 0.163417 |
| 0.700000 | 0.112489 | 0.078742 | 0.297844 | 0.166358 |
| 0.738889 | 0.112489 | 0.083117 | 0.388811 | 0.169299 |
| 0.777778 | 0.112489 | 0.087491 | 0.487518 | 0.172239 |
| 0.816667 | 0.112489 | 0.091866 | 0.593400 | 0.175180 |
| 0.855556 | 0.112489 | 0.096240 | 0.706001 | 0.178121 |
| 0.894444 | 0.112489 | 0.100615 | 0.824941 | 0.181061 |
| 0.933333 | 0.112489 | 0.104989 | 0.949899 | 0.184002 |
| 0.972222 | 0.112489 | 0.109364 | 1.080597 | 0.186943 |
| 1.011111 | 0.112489 | 0.113738 | 1.216794 | 0.189883 |
| 1.050000 | 0.112489 | 0.118113 | 1.358277 | 0.192824 |
| 1.088889 | 0.112489 | 0.122488 | 1.504854 | 0.195765 |
| 1.127778 | 0.112489 | 0.126862 | 1.656354 | 0.198705 |
| 1.166667 | 0.112489 | 0.131237 | 1.812622 | 0.201646 |

What about Conveyance?

- Conveyance is not addressed in the manual.
- Provide a review of conveyance capacity using a method that calculates flow rate for individual basins
- WWHM will not provide this information



MR 8 Wetlands Protection (1/2)

There are no wetlands on the project site or downstream of the project site



MR 8 Wetlands Protection (2/2)

- Applies only to projects who discharge to a wetland
- Established in Vol. I Section 2.5.8
- Guidance in Vol. I App D, Guide Sheet 1B
- Must comply with State and Federal Requirements



MR 9 Basin/Watershed Planning (1/2)

There are no existing Basin/Watershed plans covering the project site or the downstream drainage, thus no additional regulations are placed on the project.



MR 9 Basin/Watershed Planning *(2/2)*

- May apply more or less stringent requirements
 - Applies when Basin/Watershed Plan formally adopted by local governments
 - Confirm that the more stringent requirements are being met
- 
- The background of the slide features several concentric, light blue circular ripples that resemble water droplets hitting a surface, scattered across the bottom right and bottom center areas.

MR 10 Operations & Maintenance (1/2)

Operation and Maintenance procedures for the collection system, the detention pond, and the sand filter are included as an attachment to this document.



MR 10 Operations & Maintenance (2/2)

- O&M for all new facilities
- Vol. V Section 4.6 has detailed information for each type of facility



Attached Documents (1/2)

- *Topographic mapping of existing Site*
 - *Construction Plans and Specifications for Stormwater Facilities*
 - *Off-site Analysis*
 - *Soils Report*
- 

Attached Documents (2/2)

- *Permit Applications in Process*
 - *Building Permit*
 - *Clearing Permit*
 - *Endangered Species Act (ESA)*
 - *Hydraulic Permit Approvals (HPA)*

- *Operation & Maintenance Manual*



Redevelopment Case Study

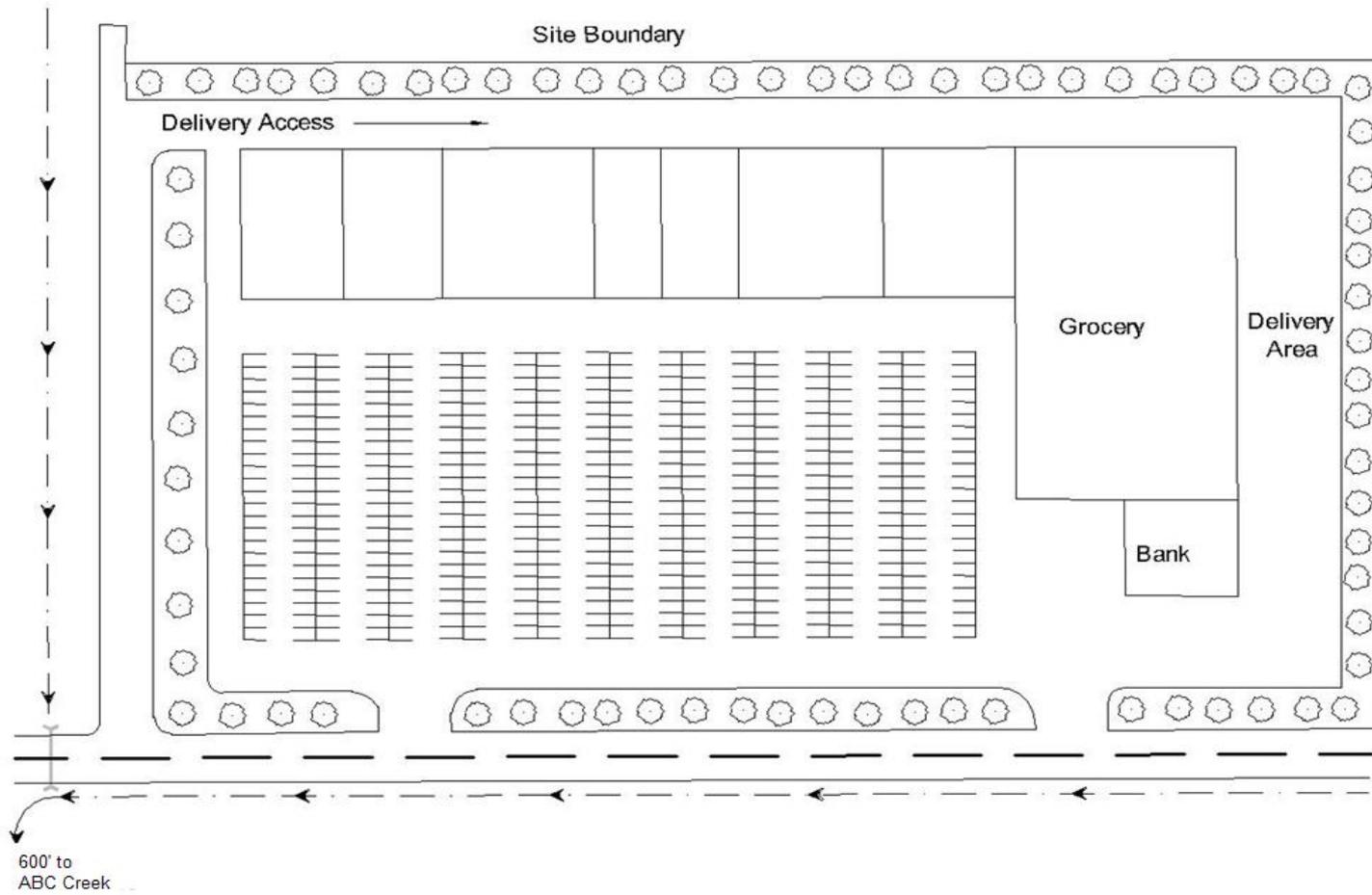
- Commercial/Industrial Project
- Similar to New Development
- Differences in MR 3, MR 6, and MR 7



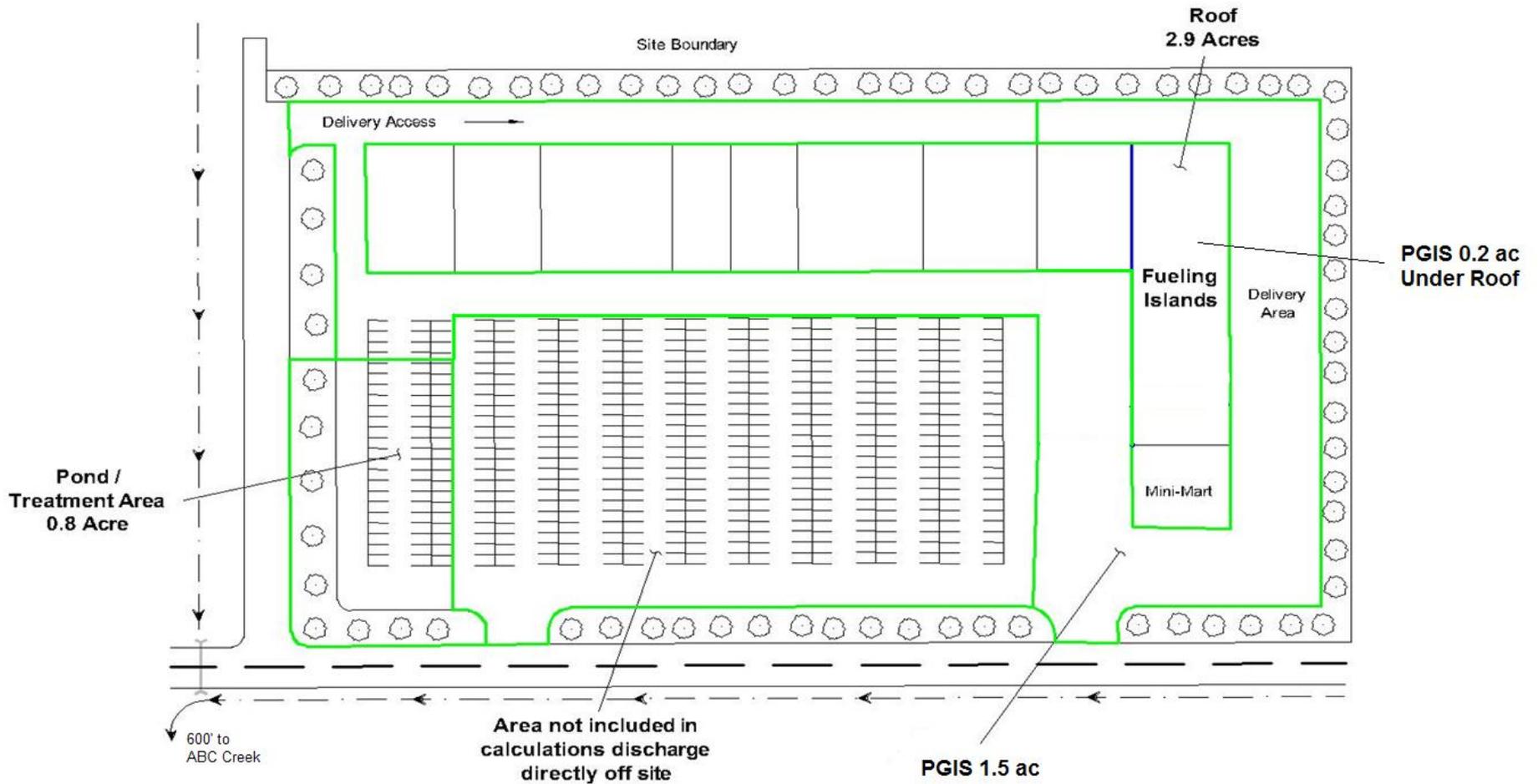
Follow Same Review Process

- Initial Review for Completeness
- Final Detailed Review

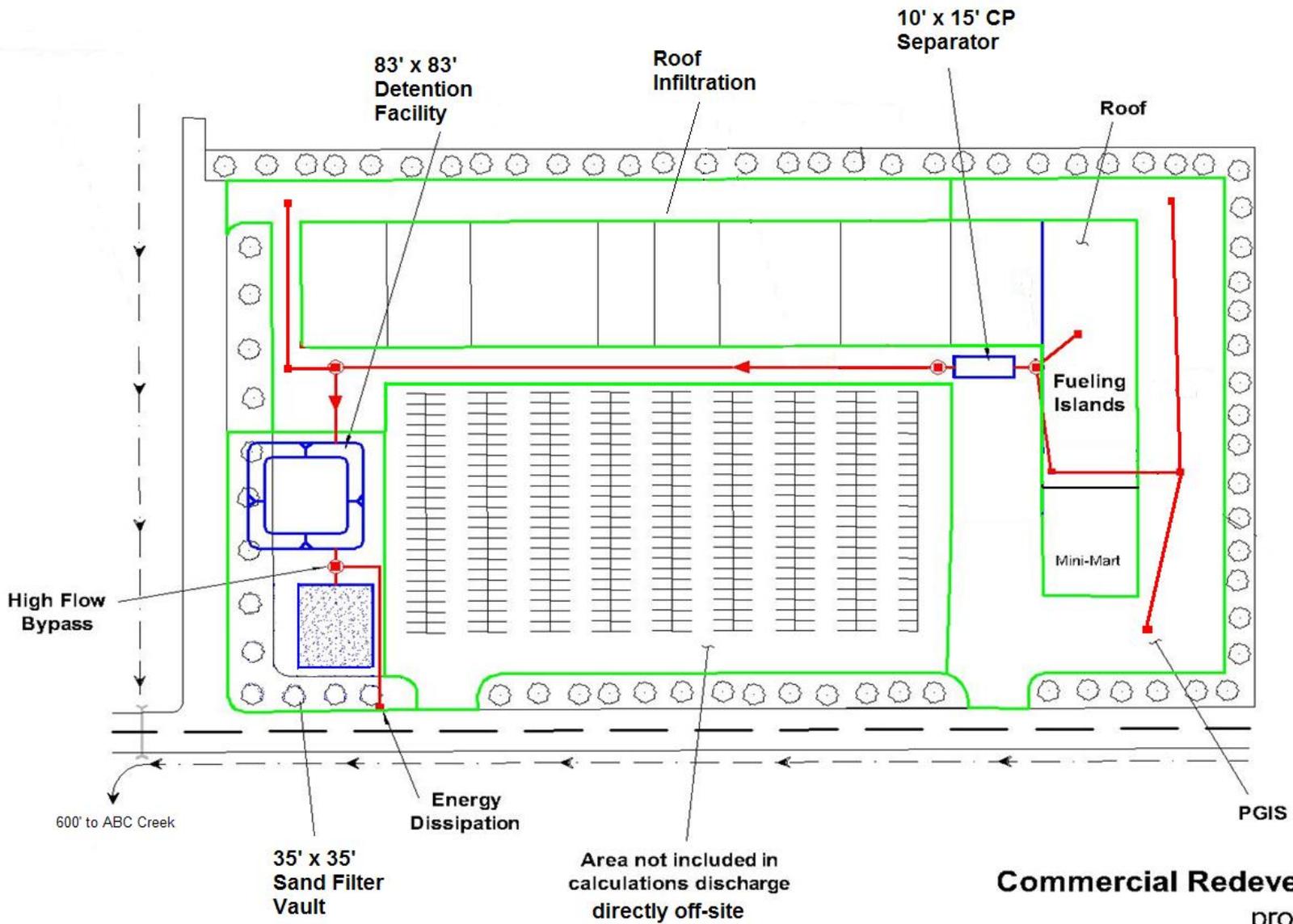




Commercial Redevelopment
Existing Site Conditions



Commercial Redevelopment Proposed Site Improvements



**Commercial Redevelopment
provements**

Drainage Areas

| Item | Pre-Developed | Developed |
|--|---------------|--|
| Total project area | 10 acres | 10 acres |
| Total area used by WWHM in runoff calculations. | 5.2 acres | 2.5 acres (2.3 acres open to rain, 0.2 acre under roof covering, but subject to blow-on) |
| Area of existing Asphalt not changed | 4.8 acres | 4.8 acres |
| Impervious area (% of site) | 100 % | 100% |
| Area of new/replaced impervious PGIS Surfaces (roads, sidewalks, driveways, pond etc.) | 0.0 acres | 2.3 acres |
| Area of new impervious NPGIS Surfaces (roofs, patios, etc.) | 0.0 acres | 0.0 acres in model (infiltrated on site), total of 2.9 acres on-site |

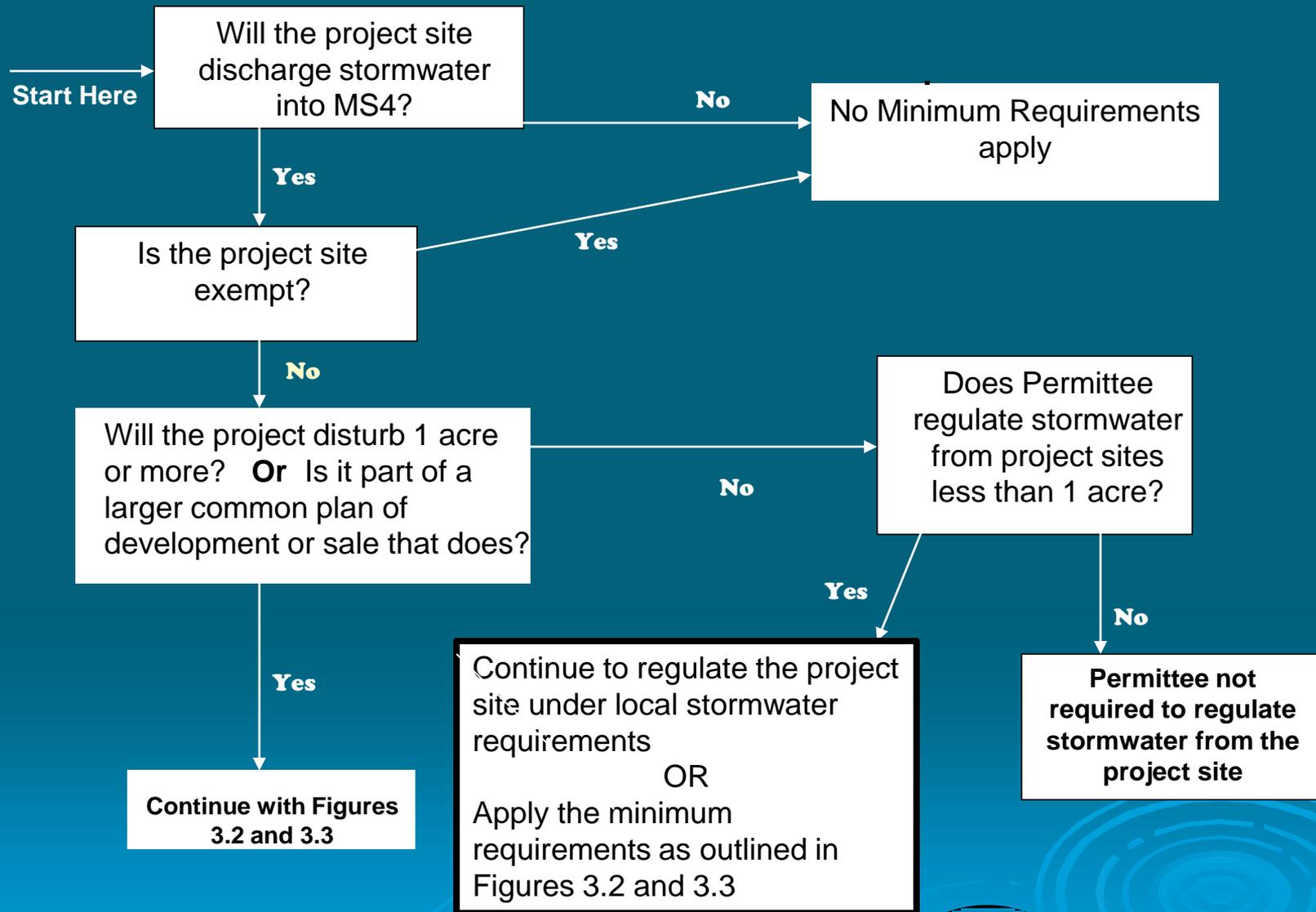
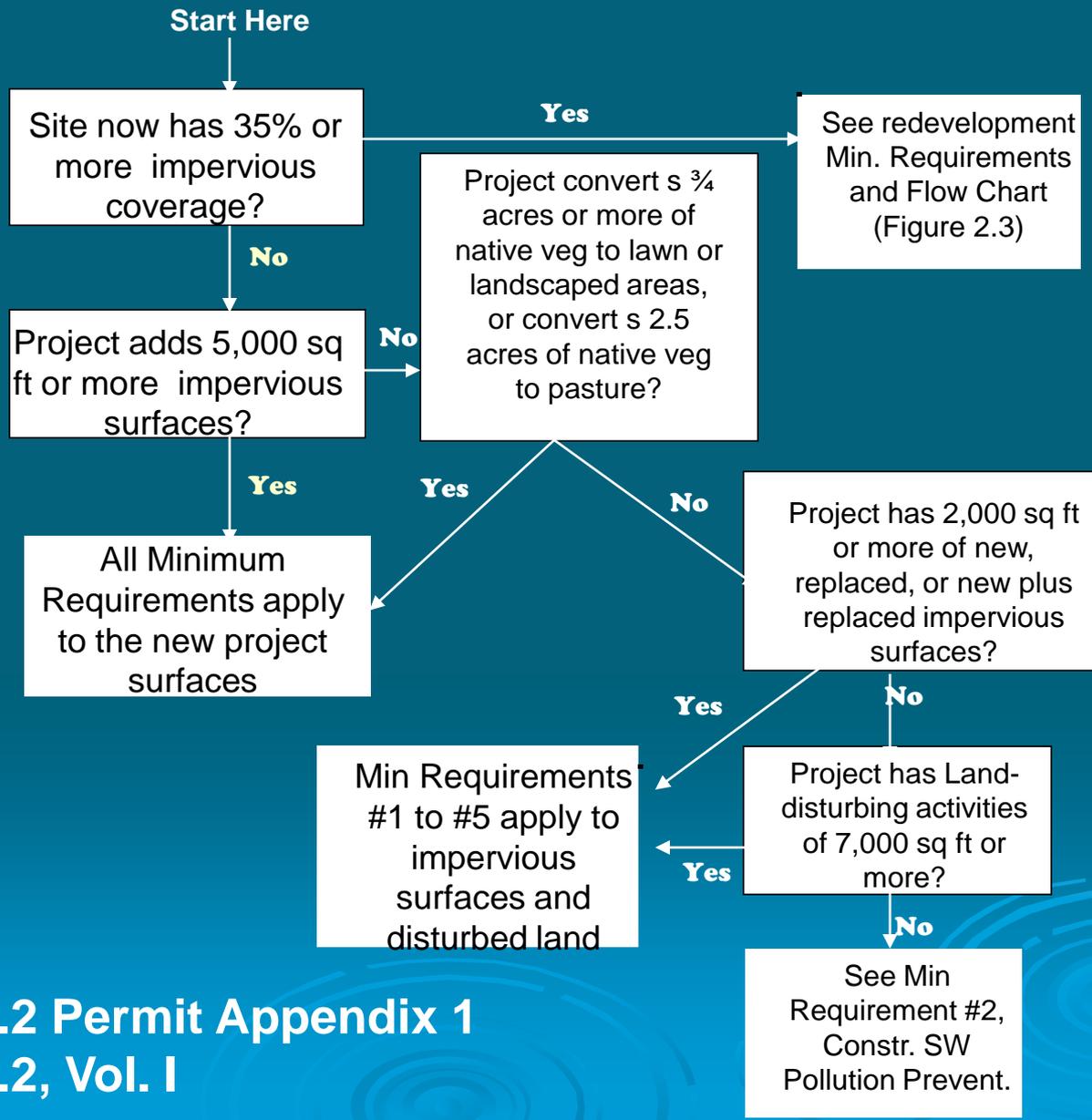


Figure 3.1, Phase II Permit, Appendix 1



**Figure 3.2 Permit Appendix 1
Figure 2.2, Vol. I**

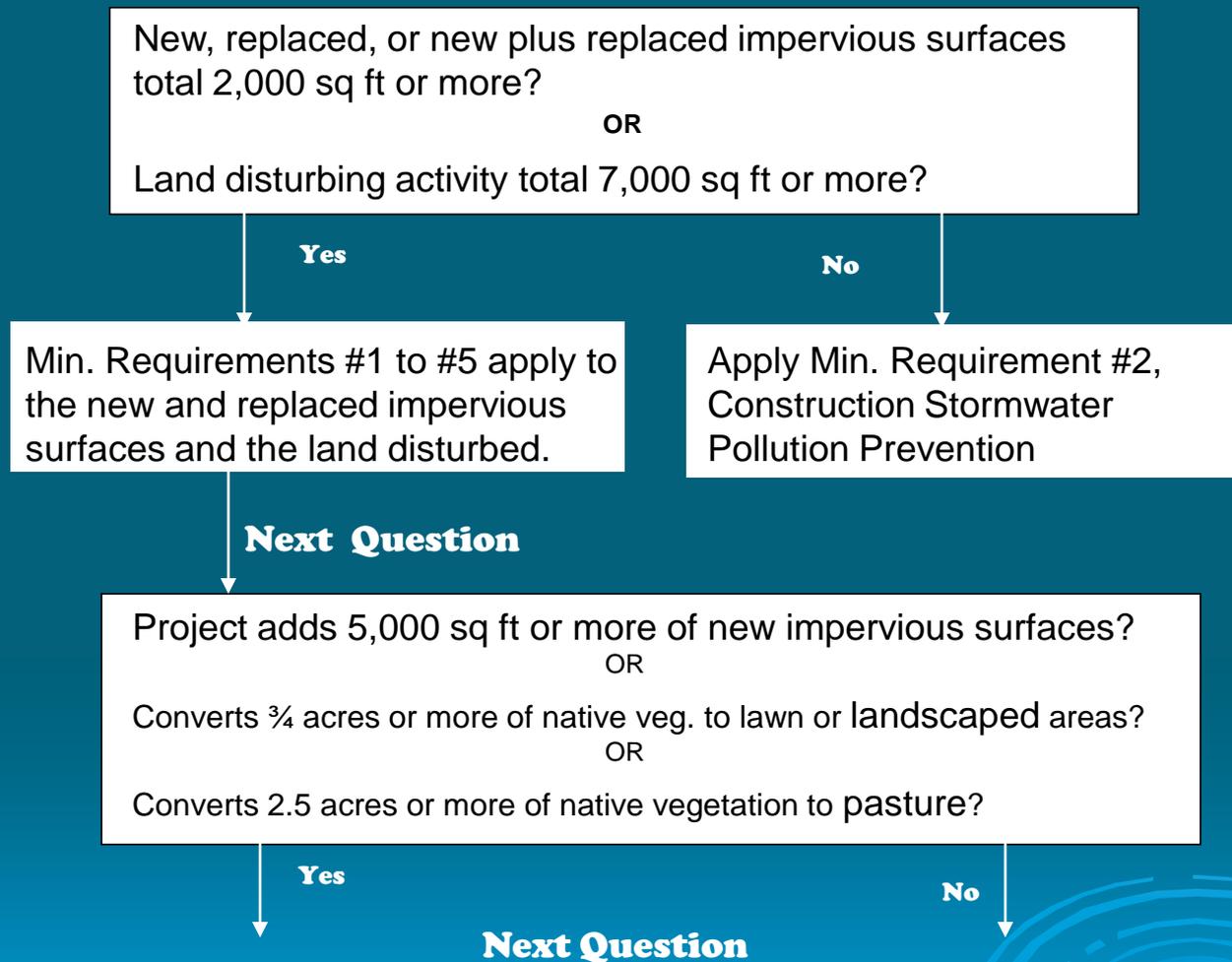


Figure 3.3 Permit Appendix 1
Figure 2.3, Vol. I

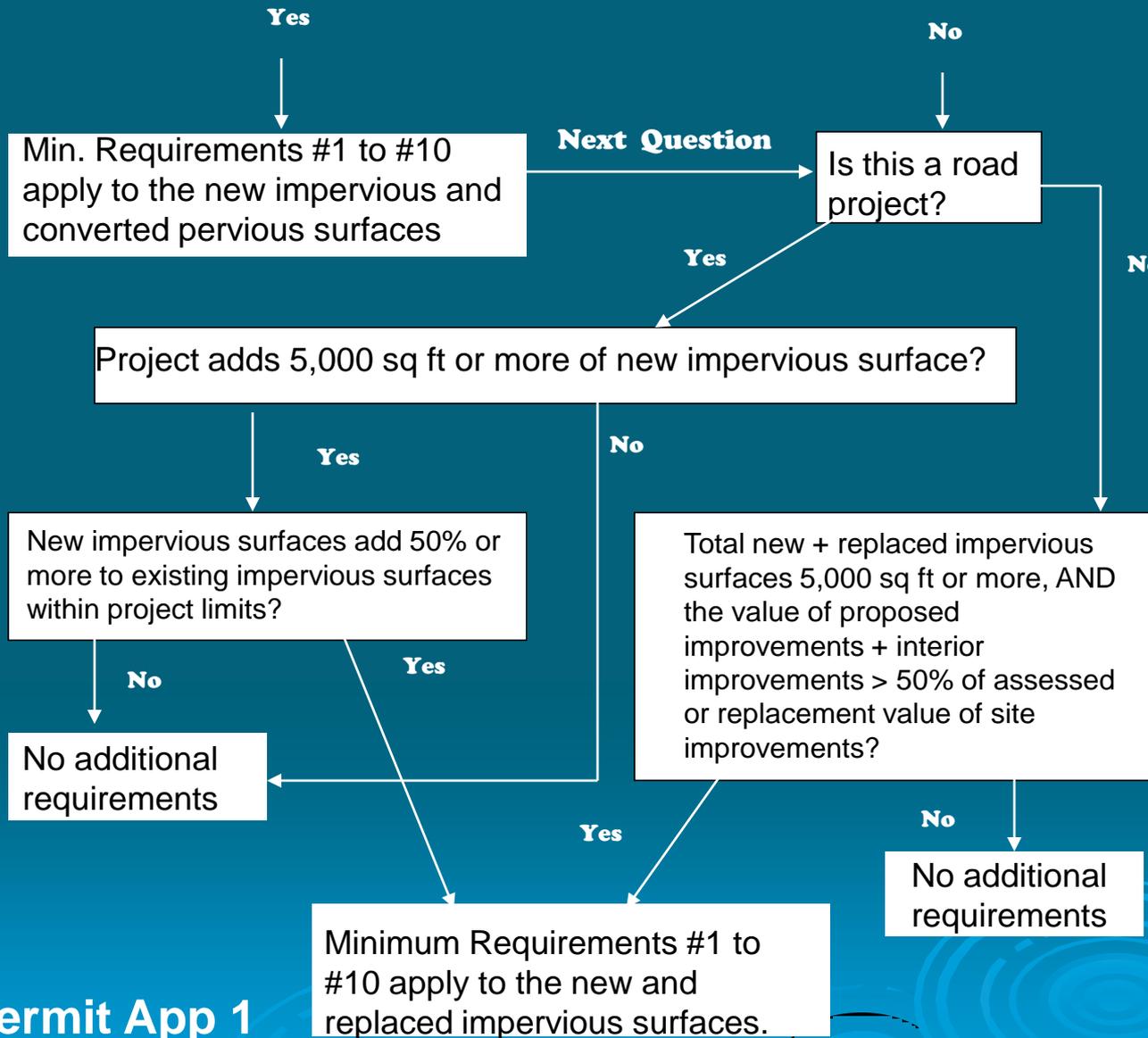


Figure 3.3 Permit App 1
Figure 2.3, Vol. I

MR 3 Source Control

A number of source control facilities described in Vol. IV of the Manual apply to this project site:

- Project is a commercial redevelopment with underground stormwater piping.*
- No open ditches on the project.*
- Landscaping along the boundary of the property will be installed to completely surround the site except where driveways are located.*

All Applicable operational source control BMPs as described in Vol. IV, Section 2.1 will be performed on this site.



MR 3 Source Control

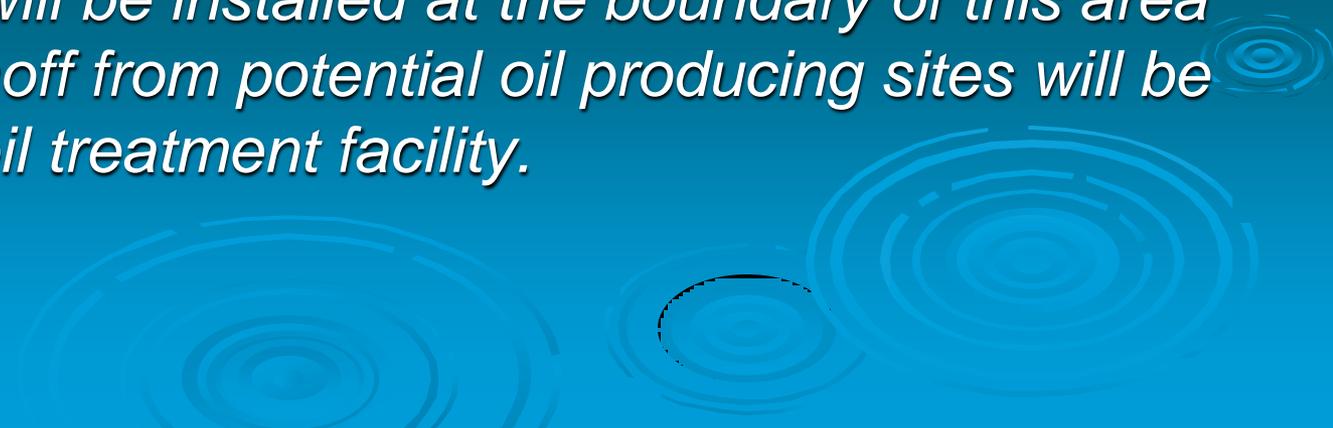
The following Source Control BMPs will be applied to this project:

- BMPs for Fueling at Dedicated Stations*
- BMPs for Landscaping and Lawn/Vegetation Management*
- BMPs for Loading and Unloading Areas for Liquid or Solid Material*
- BMPs for Maintenance and Repair of Vehicles and Equipment*
- BMPs for Maintenance of Stormwater Drainage and Treatment Systems*
- BMPs for Parking and Storage of Vehicles and Equipment*
- BMPs for Roof/Building Drains at Manufacturing and Commercial Buildings*
- BMPs for Spills of Oil and Hazardous Substances*
- BMPs for Storage of Liquid, Food Waste, or Dangerous Waste Containers*

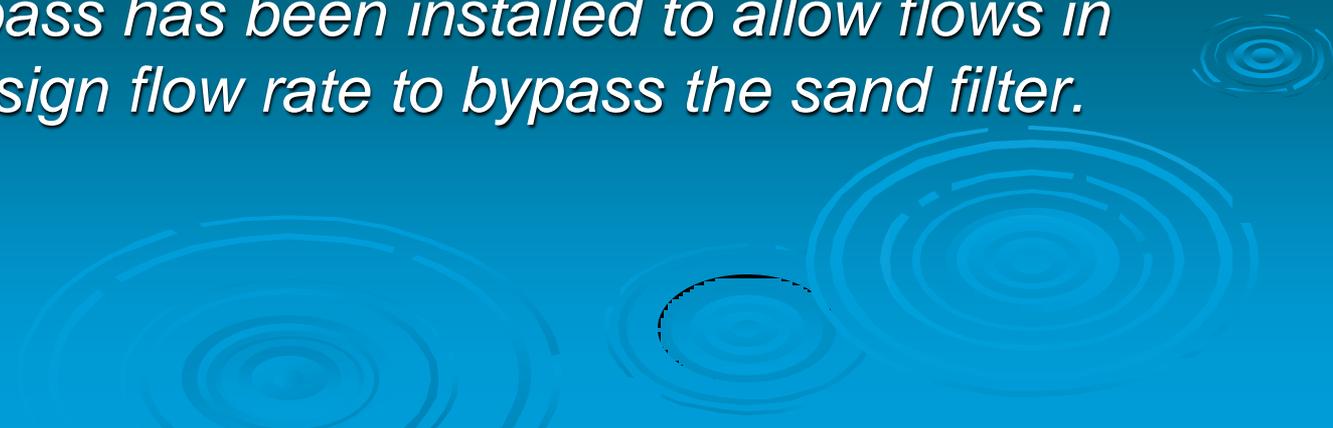
MR 3 Source Control

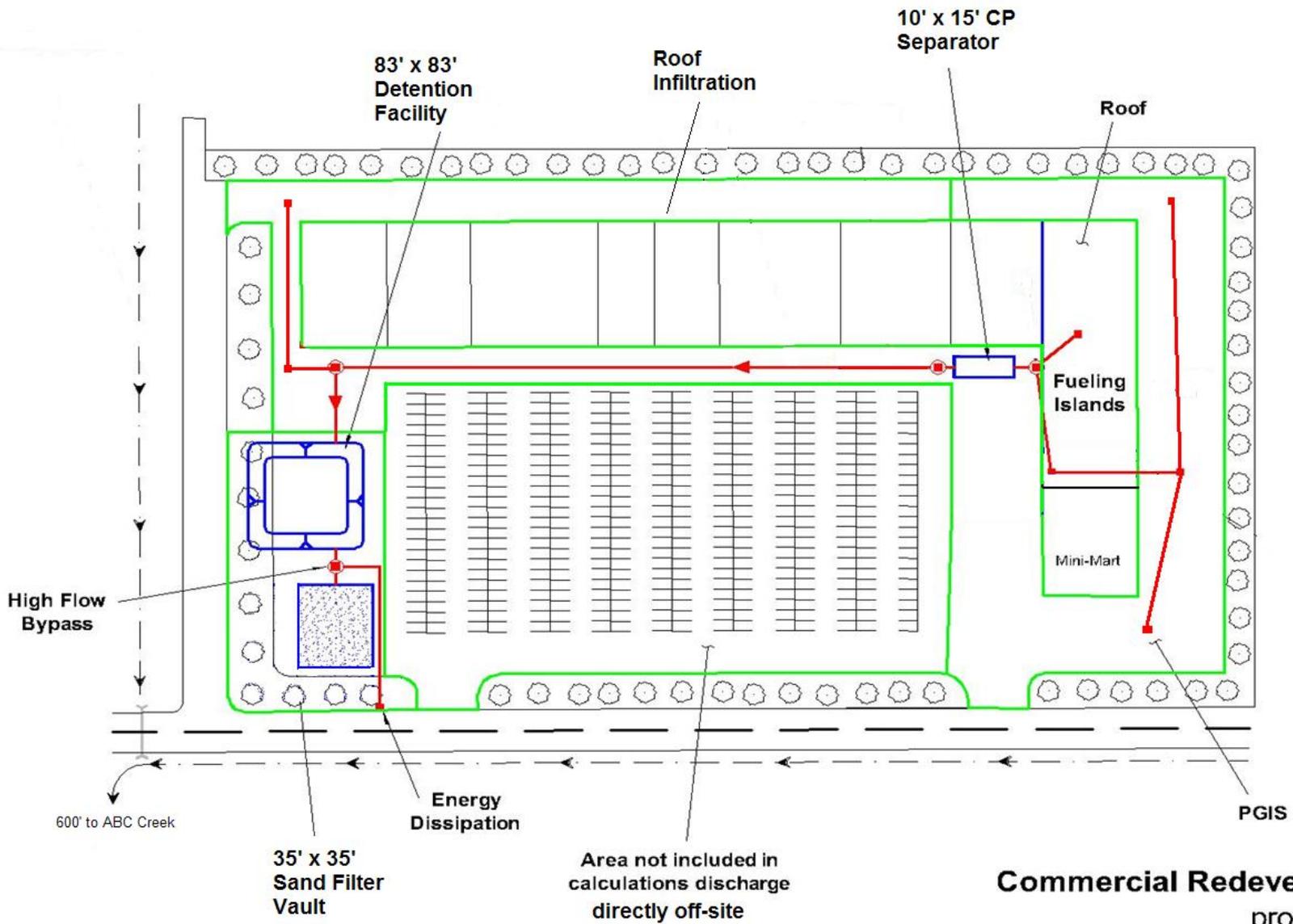
- Source Control BMPs Vol. IV Chapter 2
- Applies to Commercial/Industrial projects
- Confirm all applicable Operational Source Controls (Section 2.1) are included in project

MR 6 Runoff Treatment (1/7)

- *This project meets the third level Threshold for MR6.*
 - *There is more than 5,000 sq ft of Effective PGIS surface in a TDA.*
 - *There are two locations where runoff treatment will be applied on the project site.*
 - *Oil control applies on all runoff from the gas station area.*
 - *A small berm will be installed at the boundary of this area to ensure all runoff from potential oil producing sites will be directed to the oil treatment facility.*
- 

MR 6 Runoff Treatment (2/7)

- Additional water quality treatment for the effluent from the oil treatment facility and remainder of site is provided by a sand filter installed immediately downstream of the detention facility (discussed in the next section).*
 - The sand filter has been designed to treat the full 2-year discharge from the detention pond.*
 - A high-flow bypass has been installed to allow flows in excess of the design flow rate to bypass the sand filter.*
- 
- The background of the slide features several concentric, light blue circular ripples that resemble water droplets hitting a surface, scattered across the lower half of the page.



**Commercial Redevelopment
provements**

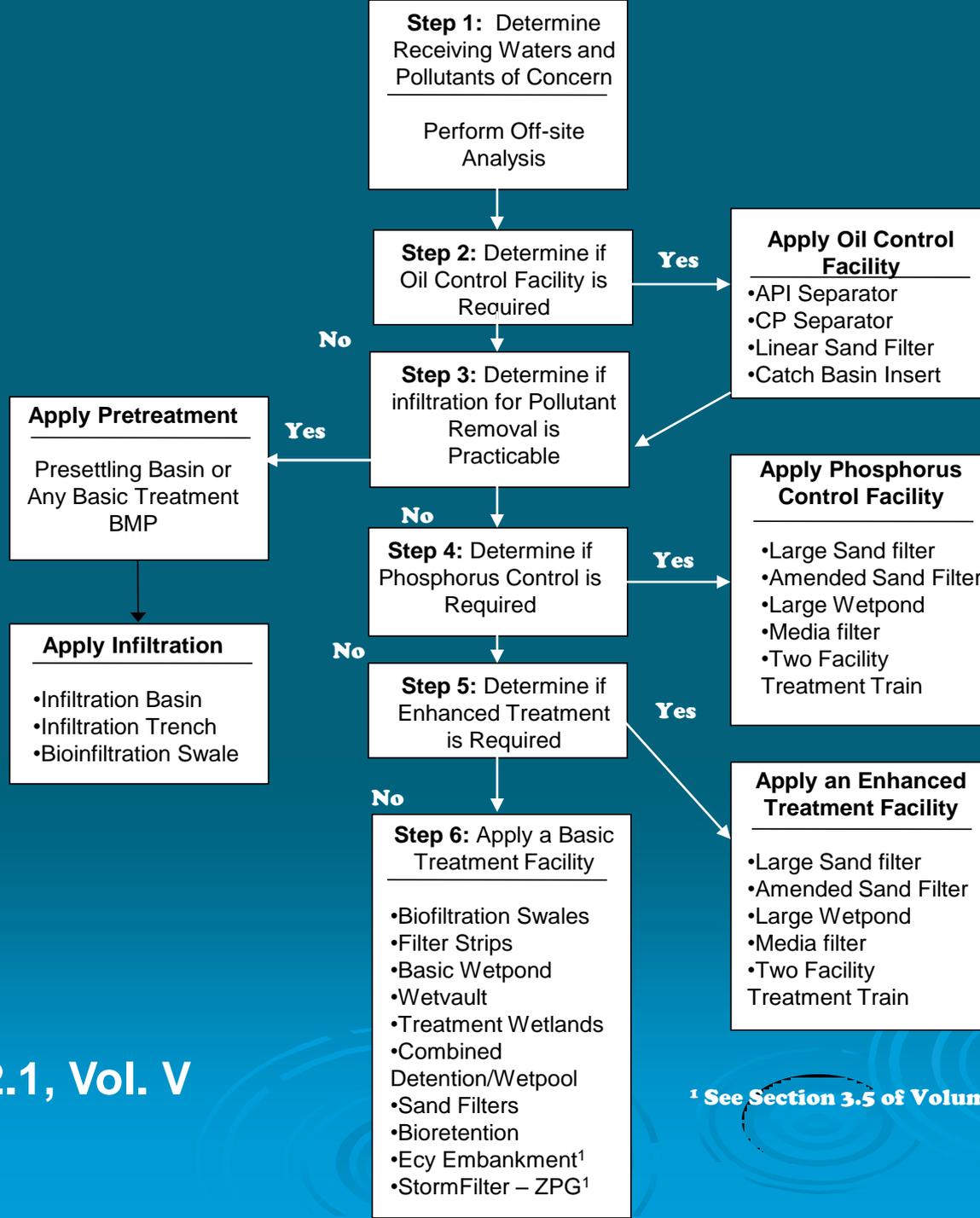


Figure 2.1, Vol. V

¹ See Section 3.5 of Volume V for more information

MR 6 Runoff Treatment (5/7)

| Item | Value |
|------------------------------|---|
| Type of Treatment | Coalescing Plate Separator |
| Area controlled by Separator | 1.2 acres (1.0 PGIS around Fueling islands, 0.2 acre under islands) |
| No. of Bays | 2 |
| Length and width | 15' x 10' |
| Side slopes | Vertical |
| Effective Depth | 4 feet |
| Simulation Results | |
| Design Flow Rate | 0.205 cfs |

MR 6 Runoff Treatment (6/7)

| Item | Value |
|--|--|
| Type of Treatment | Sand Filter Vault, Immediately Downstream of Detention |
| Length to Width Ratio | 1:1 |
| Length and width | 35' x 35' |
| Side slopes | Vertical |
| Effective Depth | 3 feet |
| Riser Height and Diameter | 2 feet tall and with 24" diameter Riser |
| Simulation Results | |
| Area Draining to Facility | 2.5 acres |
| Design Flow Rate (Full 2-year discharge) | 0.095 cfs |
| Volume to Pond | 322.62 ac-ft |
| Volume filtered | 310.10 ac-ft |
| Percent filtered | 96.12% |

MR 6 WWHM Output (7/7)

WWHM3 Redev treat

File Edit View Zoom Help

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

ELEMENTS

Move Elements

X: 40

Y: 42

Sand Filter 1 Mitigated

Facility Name: Sand Filter 1

Outlet 1: 0 Outlet 2: 0 Outlet 3: 0

Downstream Connections

Facility Type: Sand Filter

Precipitation Applied to Facility

Evaporation Applied to Facility

Facility Bottom Elevation (ft): 0

Facility Dimensions

Bottom Length: 35

Bottom Width: 35

Effective Depth: 3

Left Side Slope: 0

Bottom Side Slope: 0

Right Side Slope: 0

Top Side Slope: 0

Infiltration: YES

Hydraulic Conductivity(in/hr): 1

Filter material depth(ft): 1.5

Total Volume Filtered(acre-ft): 310.097

Total Volume Through Riser(acre-ft): 12.525

Total Volume (acre-ft): 322.621

Percent Filtered: 96.12

Outlet Structure

Riser Height (ft): 3

Riser Diameter(in): 24

Riser Type: Notched

Notch Type: Rectangular

Notch Height (ft): 2

Notch Width (ft): 1

| Orifice Number | Diameter (In) | Height (Ft) | QMax (cfs) |
|----------------|---------------|-------------|------------|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 |

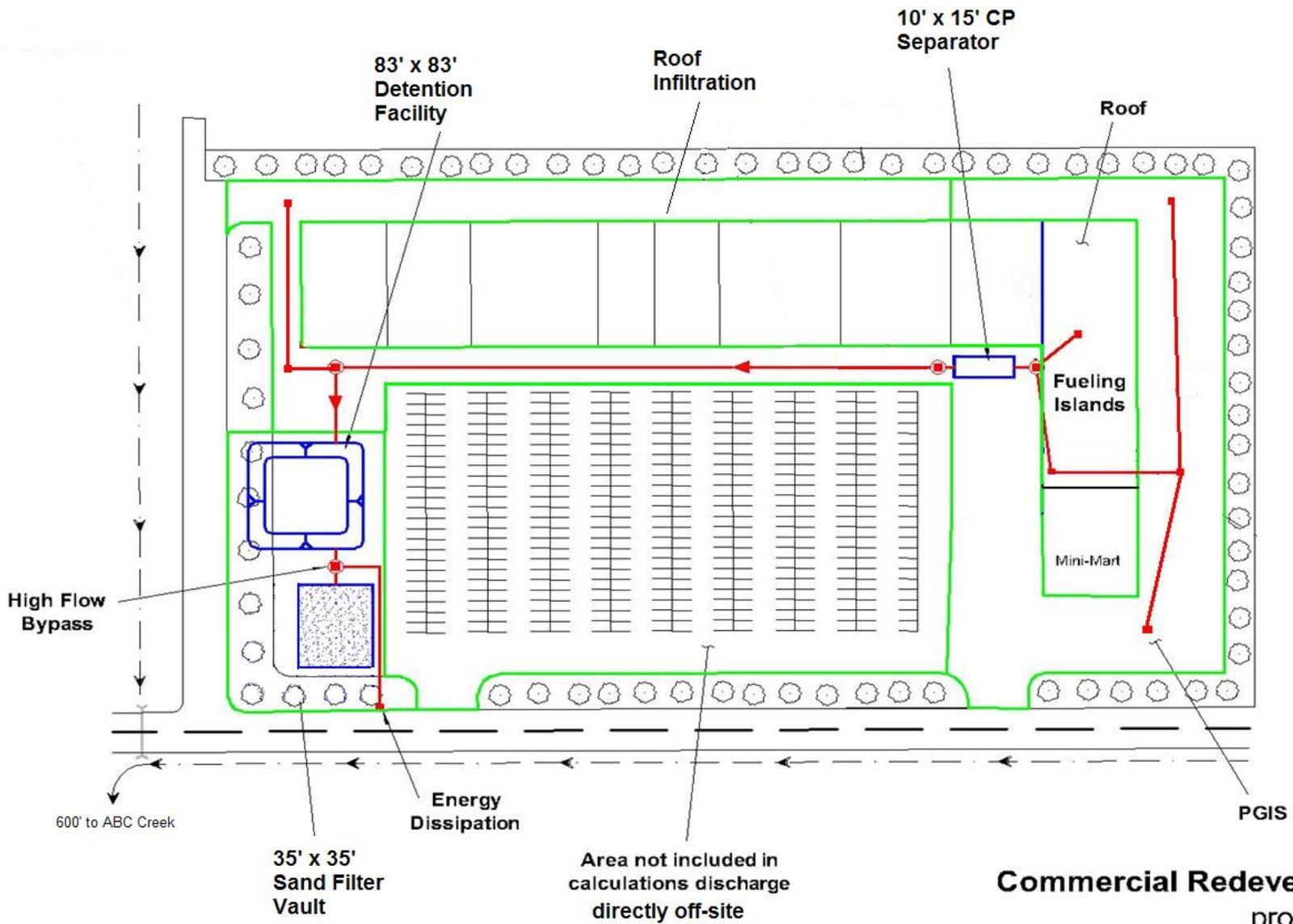
Filter Storage Volume at Riser Head: .085

Pond Increment: 0.10

Show Pond Table: Open Table

MR 7 Flow Control (1/4)

- *The third level Threshold for MR 7 is met on this project.*
- *There is more than 10,000 sq ft of Effective Impervious surface in the TDA.*
- *Flow control is being installed upstream of the treatment system.*
- *All runoff that enters the collection system will pass through a detention pond located in the SW corner of the project site.*
- *Information on the areas used in the mitigated analysis in WWHM are included in Table 1.*



MR 7 Flow Control (3/4)

| Item | Value |
|--|--------------------------|
| Type of Pond | Trapezoidal |
| Length to Width Ratio | 3:1 |
| Side slopes (H:V) | 3:1 |
| Depth of Pond | 4 feet |
| Type of Discharge Structure | 18" Riser with 1 orifice |
| Riser Height | 3 feet |
| Resulting Pond | |
| Bottom Length | 83 feet |
| Bottom Width | 83 feet |
| Size of Orifice and Maximum Discharge Rate | 1.43 inches, 0.107 cfs |
| Volume below Top of Riser | 0.590 Acre-ft |

MR 7 WWHM Output (4/4)

WWHM3 Redev treat

File Edit View Help

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

ELEMENTS

Move Elements

Save x,y Load x,y

X: 40 Y: 6

Trapezoidal Pond 1 Mitigated

Facility Name: Trapezoidal Pond 1

Downstream Connections: Outlet 1: Flow Splitter 1, Outlet 2: 0, Outlet 3: 0

Facility Type: Trapezoidal Pond

Precipitation Applied to Facility Auto Pond Quick Pond

Evaporation Applied to Facility

Facility Bottom Elevation (ft): 0

Facility Dimensions

Bottom Length (ft): 83

Bottom Width (ft): 83

Effective Depth (ft): 4

Left Side Slope (H/V): 3

Bottom Side Slope (H/V): 3

Right Side Slope (H/V): 3

Top Side Slope (H/V): 3

Facility Dimension Diagram

Infiltration: NO

Outlet Structure

Riser Height (ft): 3

Riser Diameter (in): 18

Riser Type: Notched

Notch Type: Rectangular

Notch Height (ft): 1.025

Notch Width (ft): 0.0800

| Orifice Number | Diameter (In) | Height (Ft) | QMax (cfs) |
|----------------|---------------|-------------|------------|
| 1 | 1.43 | 0 | 0.10741 |
| 2 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 |

Pond Volume at Riser Head (acre-ft): .590

Pond Increment: 0.10

Show Pond Table: Open Table

Use Tide Gate?: NO

Comments and Questions

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