STORMWATER MANAGEMENT PLAN

FOR

Siuslaw River Bridge Interpretive Wayside

FLORENCE, OR

December 14, 2011

Prepared For:

CITY OF FLORENCE

250 HWY 101

Florence, Oregon 97439

Branch Engineering, Inc.

310 5th Street

Springfield, OR 97477

Phone (541) 746-0637

Fax (541) 746-0389

Branch Engineering, Inc.

PROJECT # 11-001B

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. Introduction

The Siuslaw River Bridge is a recognized historic and cultural icon, important to the city of Florence. The bridge is listed on the *National Register of Historic Places* and is one of many historic depression area bridges built along the Oregon Coast designed by Conde McCullough. In the vicinity, a cannery and ferry operated prior to bridge construction. This type of historical information is not adequately conveyed to the community or to the travelers of the Pacific Coast Scenic Byway. The interpretive wayside project will create a scenic overlook park and a parking area. Figure 1 shows the vicinity of the project.

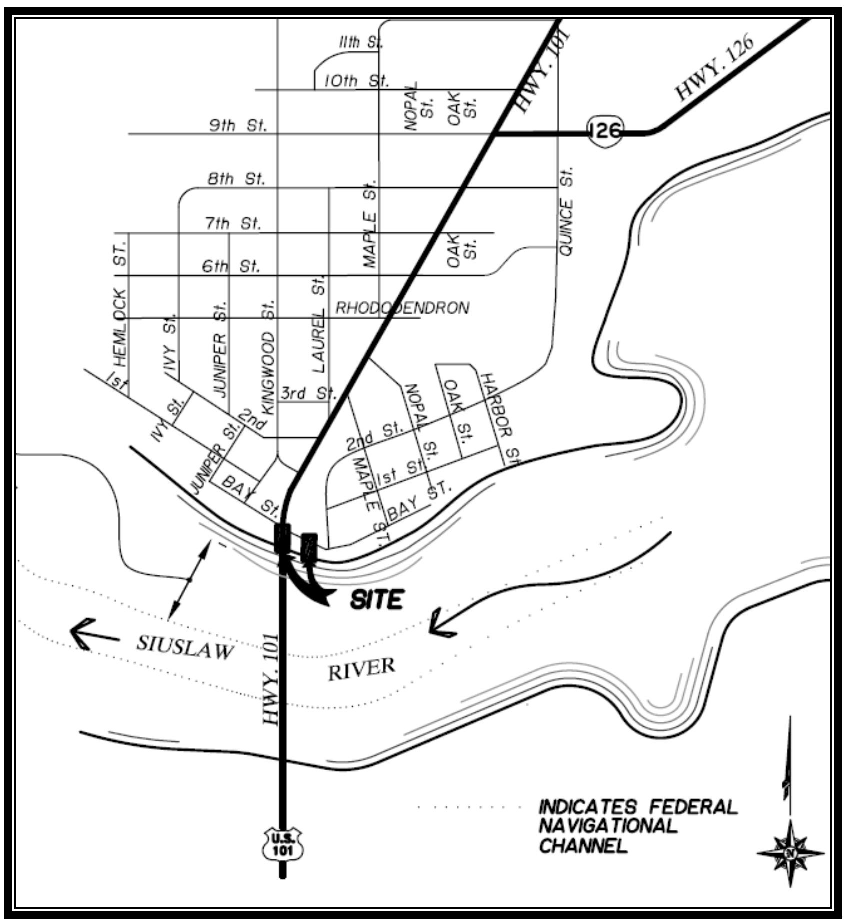


Figure 1: Vicinity Map

The project involves the construction of a wayside that includes interpretive signage and a stormwater demonstration project. The west portion involves building a parking area overlook and interpretive signs underneath the northern end of the Siuslaw Bridge. The east portion of the interpretive wayside includes stormwater improvements on undeveloped city owned property approximately 120 feet east of the bridge. The East project site will widen the existing sidewalk on Bay Street and extend a concrete pathway to an observation deck and also to an overlook for viewing the wetland enhancements, the proposed stormwater treatment facility, the estuary and the Siuslaw River Bridge. The north end of the Siuslaw River Bridge is shown in Figure 2 below.

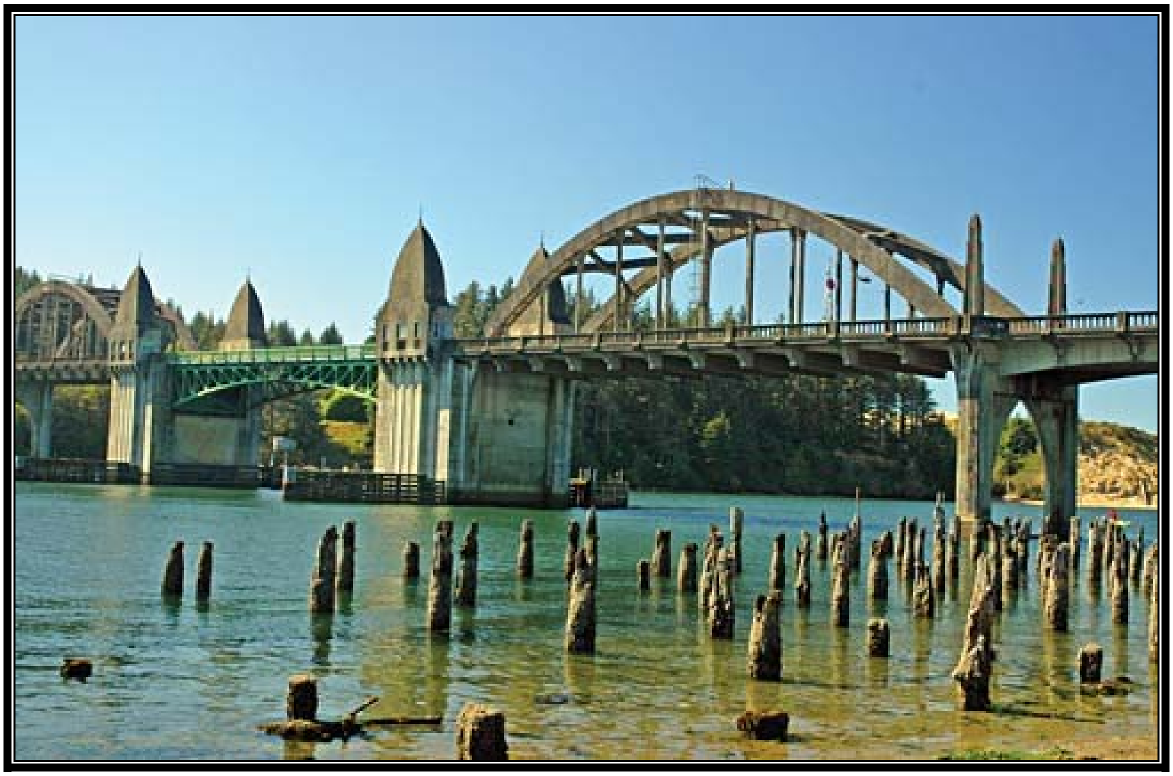


Figure 2: Siuslaw River Bridge

2. Site Characteristics & Existing Conditions

2.1 TOPOGRAPHY

Wayside West currently consists of loose alluvial sand between the bridge footings that slope gently towards the river. Approximately one-third of the proposed parking area lies below the Highest Measured Tide elevation. Wetlands are present outside the project on the west site.

Wayside East currently has an outfall structure near the center of the site that drains in a ditch south to a wetlands area adjacent to the river. The proposed improvements to this site will include grading adjustments to treat stormwater before releasing into the wetlands and the Siuslaw River.

2.2 SOILS

Most of the soil is native sand. Some mixed concrete and rock rubble are also located on site. Metal refuse is partially buried at Wayside East. Site soils consist of Waldport Urban Land Complex 0-12% slope, type 133C, according to the Lane County Soil Survey. Additional Soil data and an NRCS Soil map can be found in Appendix C.

2.3 GROUNDWATER

Soil type "Waldport Urban Land Complex" is not a hydric soil and not susceptible to high seasonal groundwater. The City of Florence Stormwater Design Manual does not identify this soil as requiring groundwater mitigation measures.

The site is located in a designated sole source aquifer so all stormwater generated by this project will be treated before infiltrating into the soil or discharged into the Siuslaw River.

2.4 RECEIVING WATER BODY

The receiving water body is the Siuslaw River. The river is a listed 303 (d) water quality limited water body for temperature only. It supports anadromous salmonids including threatened Coho Salmon.

The two subject sites fall into areas of potential flooding from the 100 year and 500 year flood zones. Since there will be no occupancy related to the development of these sites, no additional analysis necessary. A FEMA permit will be obtained, if necessary, for working in the floodplain. Appendix E includes FEMA flood maps.

2.5 ZONING

Wayside East zoned as Old Town District/ Zone A, and the west portion is in ODOT Right of Way.

2.6 EXISTING DRAINAGE

Wayside West is underneath the highway, where most of the rainfall is intercepted by the bridge and drained to scuppers. The scuppers are located mid bent on the bridge and drain aerially onto the site. Nearly all of this rainfall is infiltrated into the ground below the scuppers. Little precipitation reaches directly underneath the bridge. Any runoff that may occur would sheet flow directly into the Siuslaw River. An existing 15" outfall is located on this site. The pipe primarily drains the Highway 101 Right of Way. The outfall will not be altered with this development.

Wayside East is primarily wetlands and the Siuslaw River. Existing runoff sheet flows into the Siuslaw River. However, the site also conveys offsite drainage from an outfall structure that drains the neighboring Bay Street. Two catch basins pick up approximately 180 feet of Bay Street and about 15,000 square feet of total area. This drainage basin is primarily impervious surfaces such as streets, sidewalks, and buildings. The runoff from the Bay Street Basin discharges to Wayside East and travels to the river via a short ditch. Figure STM 1 shows the modeled drainage basins and Figure STM 2 shows existing drainage conditions for the site. Table 1 below is a brief summary of the basin areas.

Table 1: Existing Drainage Basin Description, Label and Size

Label	Description	Size (SF)	Assumed CN
B1a	Wayside East	4,515	85
B1b	Bay Street north of Wayside East	10,093	98
B1c	Roof Drainage north of Bay Street	5,340	98
B2	Southeast area of Wayside East	1,244	85
B3	Wayside West Overlook, underneath Siuslaw Bridge	6,018	80

3. PROJECT DESCRIPTION AND PROPOSED STORMWATER SYSTEM

3.1 PROJECT DESCRIPTION

Wayside West Overlook:
The west project site includes an asphalt paved parking area, approximately 70' x 60'. The parking area provides seven standard spaces, and one van accessible space. There is an accessible sidewalk from the public sidewalk to the interpretive signs and walkway which are elevated from the existing shoreline by a short retaining wall. A Stormfilter Catch Basin will be installed in the western area of the parking facility. Copies of the plans are included in Appendix A.

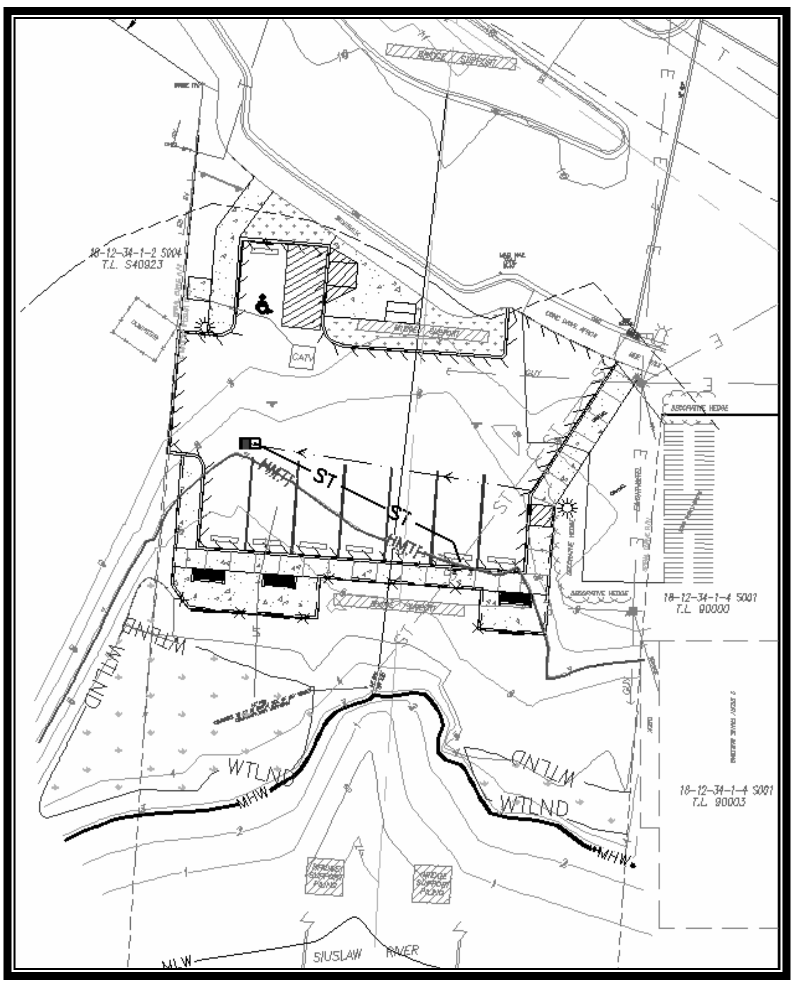


Figure 3: Proposed Siuslaw Interpretive Site & Wayside West

Wayside East:
Construction of the east project site will include the replacement of two older catch basins and a 6" storm pipe on Bay Street with new double-chambered water quality curb inlets and an 8" storm pipe. To the south of Bay Street a new stormwater treatment facility is proposed as well as a pedestrian path with interpretive signs that will highlight the ecological value of wetlands and native plants in treating stormwater. Figure 4 shows the layout of the new site.

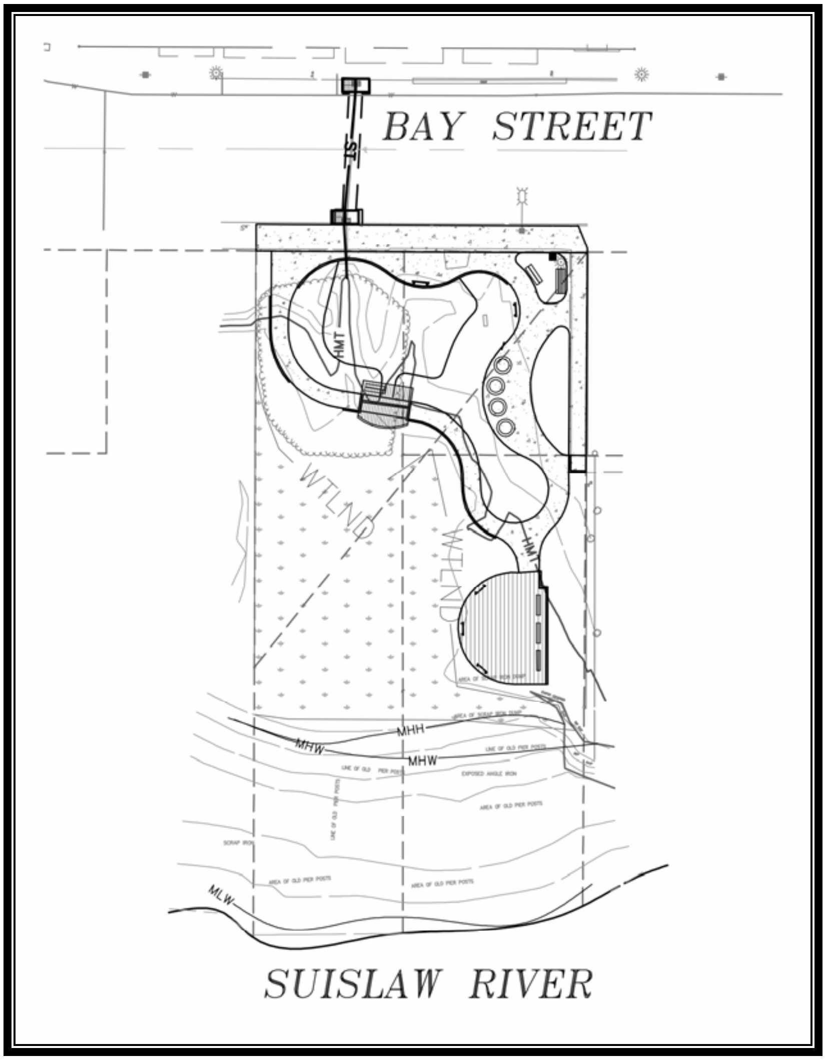


Figure 4: Proposed Siuslaw Interpretive Wayside: East Wayside

3.2 EXPECTED POLLUTANTS

Wayside West is expected to generate a low to moderate amount of car related pollutants oil, metals, sediment, etc. The primary pollutants expected are oil/grease, sediment, and metals. Wayside East should create very minor amounts of pollution since it is only pedestrian related improvements.

3.3 EXISTING STORMWATER RUNOFF

Existing stormwater runoff is primarily from Bay Street pavements and sidewalks. Table 1 shows the existing basin's peak runoff flows and volumes. Figure STM1 shows basin boundaries and STM2 shows existing site drainage patterns. Runoff rates were determined using HydroCAD 9.1 modeling software. This program was used utilizing the Santa Barbara Unit Hydrograph hydraulic modeling method. The results of this analysis are included in Appendix B. A standard SCS Type 1A 24-hour storm distribution with related rainfall depths per City of Florence Stormwater Design Manual dated November 2010 was used for the analysis. Table 2.2 displays the existing peak flows and the runoff volume discharged during the various storm events.

Table 2: Existing Stormwater Flows and Volumes

Basin ID	WQ Event		2-Year Event		10-Year Event		25-Year Event	
	Peak Flow (cfs)	Volume (acre-feet)	Peak Flow (cfs)	Volume (acre-feet)	Peak Flow (cfs)	Volume (acre-feet)	Peak Flow (cfs)	Volume (acre-feet)
B1a	0	0.001	0.05	0.017	0.08	0.025	0.09	0.03
B1b	0.04	0.012	0.19	0.062	0.25	0.082	0.28	0.093
B1c	0.02	0.006	0.10	0.033	0.13	0.043	0.15	0.049
B2	0	0	0.01	0.005	0.02	0.007	0.03	0.008
B3	0	0	0.05	0.018	0.08	0.028	0.10	0.034
Total	**0.06**	**0.019**	**0.4**	**0.135**	**0.56**	**0.185**	**0.65**	**0.214**

3.4 CONSTRUCTION EROSION CONTROL

Erosion control will be included for this project with silt fence barriers to prevent sediment from entering the Siuslaw River. The erosion control will be in compliance with ODOT standards and consistent with the Portland erosion control manual. Erosion control drawings are included with the preliminary Construction Drawings in Appendix A.

3.5 PROPOSED WATER QUALITY TREATMENT

Runoff rates were determined using HydroCAD 9.1 modeling software. This program was used utilizing the Santa Barbara Unit Hydrograph hydraulic modeling method. The results of this analysis are included in Appendix B.

Wayside West:
The west parking facility will create 5,300 ft^2 of impervious surfaces and will have a peak runoff 0.02 CFS for the water quality storm. To remove the

primary pollutants generated by the parking area, a Stormfilter® catch basin filter with two ZPG (zeolite, perlite, granulated activated carbon) media cartridges will be installed. This system is listed and approved by the Washington Department of Ecology, in compliance with the Florence Stormwater Design Manual. The Stormfilter catch basin will settle out particulates and retain oil and grease runoff from the pavement. Due to limited elevation difference between river and parking lot a low head Stormfilter Cartridge will be necessary. These cartridges are rated at 0.011 cfs each so the site will require a two cartridge system that will have a total capacity of 0.022 cfs. All runoff from newly created impervious area will be treated and discharged to the existing 15" storm pipe that runs through the site. This system will also and capture and treat a portion of the Highway 101 runoff that will drain onto the new parking area. Due to topography and site constraints, vegetated stormwater treatment is not feasible. The Stormfilter is an approved manufactured treatment process per City of Florence Stormwater Design Manual when site limitations necessitate manufactured treatment technology.

Wayside East:
The existing catch basins on Bay Street that will be replaced that collect stormwater from a basin area of approximately 15,000 ft^2. This stormwater will route through a new 8" pipe just under Bay Street to the proposed rain garden to be treated and infiltrated. The water quality stormwater runoff from Basins 1b and 1c on Bay Street of 0.04 CFS only fills the rain garden up 0.01'. The new walkway will primarily drain to the rain garden for treatment but approximately 1250 square feet, or about 10% of total site area, will drain to a filter strip. This filter strip does not meet all city design standards due to limited space and constraints with wetland areas. It is requested that this small area be exempted from full requirements as allowed in 3.4.4 of the Florence Design Manual for up to 30% of pedestrian impervious surfaces.

3.6 FLOW CONTROL

The stormwater runoff from the development of these two sites will be equal to or less than the pre-developed site from the 2 year storm through the 25 year storm event. The detention at the rain garden at Wayside East will compensate for the small increase at Wayside West. Flow control was modeled in the HydroCAD software using SBUH method. See Appendix B for Results.

Wayside West:
The west parking area will have a peak runoff of 0.17 CFS during the 25 year storm. The existing peak 25 year flow for this basin is 0.10 CFS. It is important to note that the parking area is underneath Highway 101, so modeling is very conservative and peak runoff flows calculated in the

HydroCAD model will actually be less for Wayside West. Assuming there is no highway above the west site, Table 3 shows the runoff flow and volumes for the post developed site.

Wayside East:
The development of the east site will add a small amount of additional impervious area through the construction of the pedestrian walkway. The walkway will drain primarily to the rain garden for detention. A small area will drain to a filter strip. See Drainage Plan in Appendix A. Currently the stormwater entering the catch basins on Bay Street flows directly into the river. The construction of the new stormwater facility will retain runoff and minimize peak flows into the Siuslaw River. These results can be seen by the comparisons in Table 4.

Table 3: Post Developed Stormwater Runoff

Basin ID	Basin Area (sq ft)	Weighted CN Value	WQ Event		2-Year Event		10-Year Event		25-Year Event	
			Peak Flow (cfs)	Volume (acre-feet)	Peak Flow (cfs)	Volume (acre-feet)	Peak Flow (cfs)	Volume (acre-feet)	Peak Flow (cfs)	Volume (acre-feet)
B1a	4,515	92	0.01	0.002	0.07	0.022	0.1	0.031	0.11	0.036
B1b	10,093	98	0.04	0.012	0.19	0.062	0.25	0.082	0.28	0.093
B1c	5,340	98	0.02	0.006	0.10	0.033	0.13	0.043	0.15	0.049
B2	1,244	91	0	0.001	0.02	0.006	0.03	0.008	0.03	0.01
B3	6,018	96	0.02	0.006	0.11	0.035	0.14	0.046	0.16	0.053

For the HydroCAD analysis the volume of the available storage in the rain garden was multiplied by 0.75 for a factor of safety. The weir design was set to limit overflow to the wetlands area and the river to the south. A square-notch weir at elevation 7.7' would allow the rain garden to fill up with 0.7 feet of stormwater before overflowing into the wetlands. The Rain garden was assumed to have a constant infiltration rate of 4 in/hr. The width of the weir was set to be 4 feet wide to avoid clogging from debris. A detail of the weir and foot bridge is located in the construction drawings in Appendix A.

Conclusions/Summary:
The conservative safety factor set to the available storage was applied to account for any minor adjustments to the layout that may arise. The comparison analysis shows a decrease in runoff during the 25 year storm from 0.65 CFS , (0.09+0.28+0.15+0.03+0.10 , Table 4), to 0.61 CFS (Table 4 & Appendix B). This decrease in flow may be even greater if the safety factor is removed or if the overhead bridge is taken into consideration. The development of these two sites will reduce flows into the Siuslaw River.

Table 4: Comparison of Pre and Post Developed Conditions.

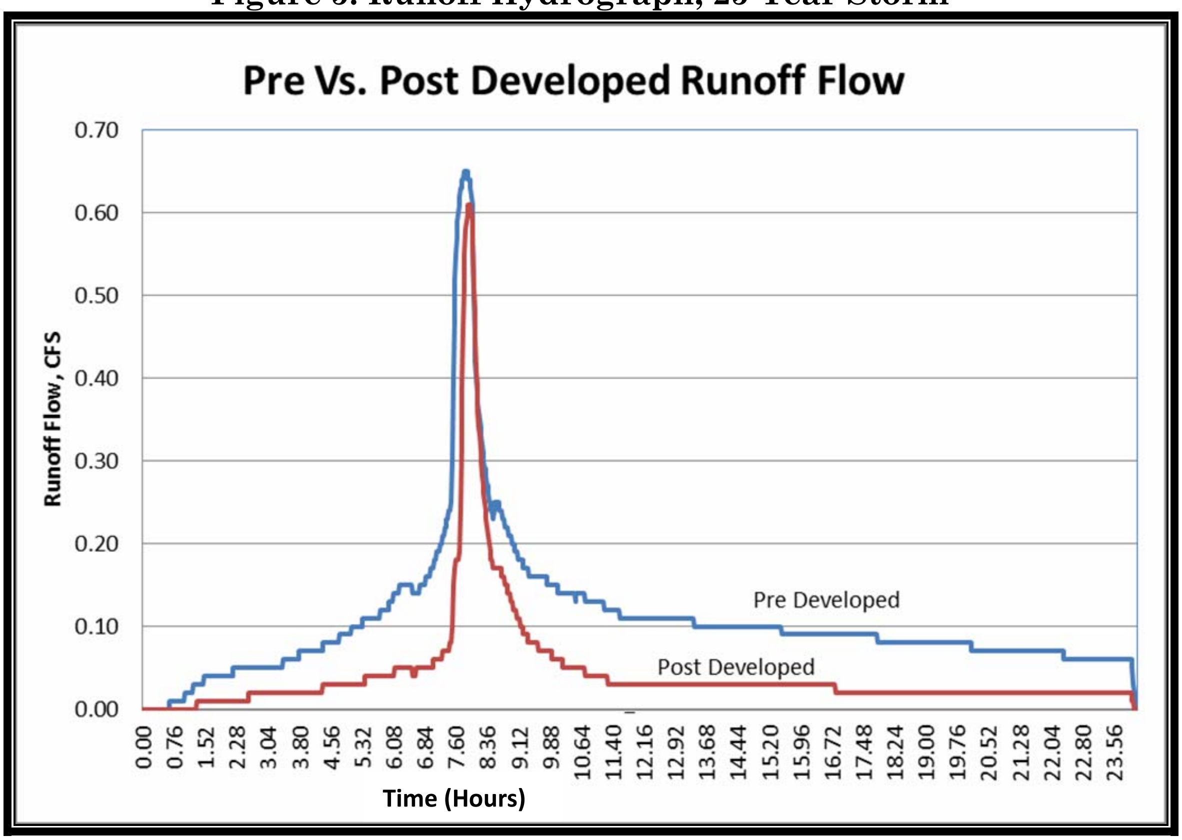
Basin ID	WQ Event		2-Year Event		10-Year Event		25-Year Event	
	PRE DEVELOPED	POST DEVELOPED	PRE DEVELOPED	POST DEVELOPED	PRE DEVELOPED	POST DEVELOPED	PRE DEVELOPED	POST DEVELOPED
B1a	0	0.01	0.05	0.07	0.08	0.1	0.09	0.11
B1b	0.04	0.04	0.19	0.19	0.25	0.25	0.28	0.28
B1c	0.02	0.02	0.10	0.10	0.13	0.13	0.15	0.15
B2	0	0	0.01	0.02	0.02	0.03	0.03	0.03
B3	0	0.02	0.05	0.11	0.08	0.14	0.10	0.16
*Total Discharge	**0.06**	**0.02**	**0.4**	**0.13**	**0.56**	**0.48**	**0.65**	**0.61**

*Total Discharged from all basins into the Siuslaw River.

Note that the Total Discharges for the Post Developed condition are less than the sum of the flows because of the detention volume and infiltration dispersion in the rain garden

The graph below displays the total of the Pre Vs. Post Developed discharges into the Siuslaw River.

Figure 5: Runoff Hydrograph, 25-Year Storm



3.7 100 Year Flood

Both sites will be inundated by the 100 year Flood and an overflow elevation of the stormwater facilities isn't relevant. The facilities proposed will be resistant to damage from inundation events.

4. OPERATIONS AND MAINTENANCE PLAN

4.1 RESPONSIBILITY

The facilities will be maintained by the City of Florence. Prior to contstruction, the City will likely sign a maintenance agreement with ODOT for all maintenance required for the Wayside West parking area underneath Highway 101.

4.2 DESCRIPTION

The west project site will include a Stormfilter Catch Basin for treatment of the parking area. Contech Stormwater Solutions, the maker of the Stormfilter products have specific guidelines for the operation and maintenance of their Stormfilter Catch Basins which can be found in Appendix D.

The east project site will include a new rain garden stormwater treatment facility. According to City of Florence Stormwater Management Manual, “Rain gardens are landscaped reservoirs used to collect, filter, and/or infiltrate stormwater runoff, allowing pollutants to settle and filter out as the water percolates through the planter soil before infiltrating into the ground below or being piped to its downstream destination.” Maintenance for this facility will be done in accordance with Florence Stormwater Design Manual

4.3 INSPECTION/MAINTENANCE SCHEDULE

For the first two years the rain garden and filter strip shall be inspected and maintained quarterly and within 48 hours after each major storm event which shall be defined as the water quality event in any 24 hour period for the City of Florence. City of Florence shall keep a log, recording all inspection dates, observations, and maintenance activities. Appendix D has example logs for the inspection of the stormwater facilities. For the quarterly inspections of the rain garden and filter strip, city crews shall confirm the facility is in working order and that vegetation is in adequate form.

The Stormfilter shall be inspected and maintained in accordance with the manufacturers recommendations. Generally the manufacturer recommends annual maintenance and inspection after all major storm events. The filter media will need to be regularly replaced to maintain effectiveness. A 2 year replacement is the basic renewal schedule recommended but may need to be done more often based on field observation.

4.4 INSPECTION/MAINTENANCE PROCEDURES

Rain Garden

- Vegetation or roots from large shrubs and trees that limit access or interfere with rain garden operations shall be prevented.
- Fallen leaves and debris from deciduous plant foliage shall be raked and removed biannually.
- Nuisance and prohibited vegetation of all species shall be removed biannually. Invasive vegetation shall be removed and replaced.
- Dead vegetation shall be removed to maintain less than 10% of area coverage or when planter function is impaired. Vegetation shall be replaced within 3 months or immediately if the season is appropriate in order to maintain cover density and control erosion where soils are exposed.
- The rain garden shall infiltrate within 48 hours after a storm event. If water continues to pond after that time, sources of possible clogging shall be identified and corrected. If necessary, the top layers shall be tilled and amended with compost; if this is not sufficient, they shall be removed and replaced with new freely draining growing medium.
- Inlets and outlets shall be inspected quarterly and after any large rain event.
- Any trash or debris that collects in the planter and may inhibit planter function shall be removed quarterly.

Catch Basins, Trench Drains, and Piped Storm System

- Sediment shall be removed biannually.
- Debris shall be removed from inlets and outlets quarterly.
- Quarterly inspection for clogging shall be performed.

Stormfilter treatment Catch basin

- Remove sediment annually
- Replace cartridge media on recommended 2 year interval or more often based on inspection
- Refer to Appendix D for detailed manufacturer maintenance requirements

APPENDIX

A

Site Plan and Basin Drawings

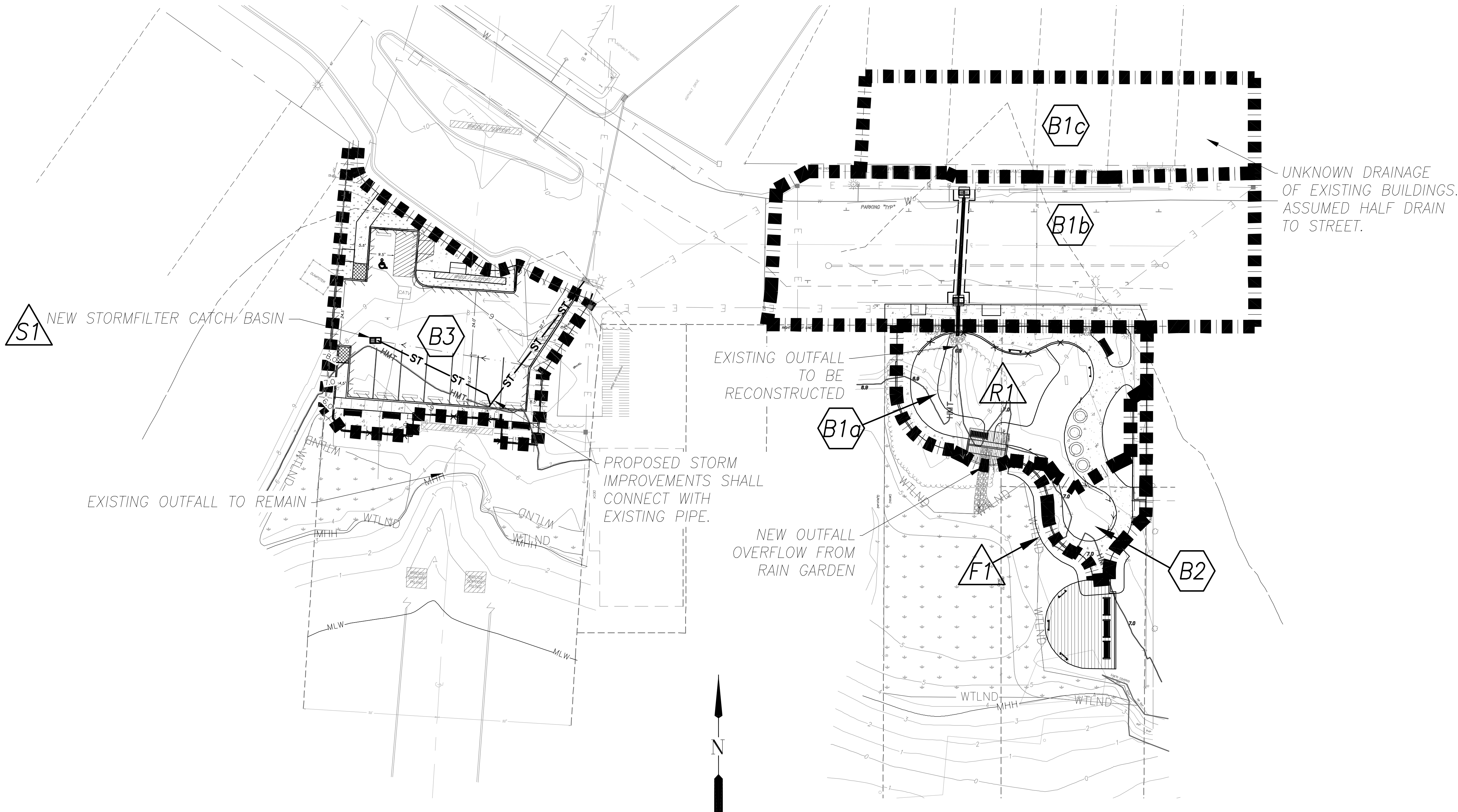
Site Basin Maps
11x17 Set of Plans

LEGEND

- PROPOSED BASIN LINE
- BASIN ID
- TREATMENT FACILITY

Drainage Basin Summary

Label (SF)	Description CN	Size CN	Existing	Future
B1a	Wayside East	4,515	85	92
B1b	Bay Street north of Wayside East	10,093	98	98
B1c	Existing Building Runoff north of Bay Street	5,340	98	98
B2	Southeast area of Wayside East	1,244	85	91
B3	Wayside West Overlook, underneath Siuslaw Bridge	6,018	80	96



GRAPHIC SCALE
20 0 10 20 40
(IN FEET)

Stormwater Treatment Facilities

Label	Description	Size SF
R1	Rain Garden	1,130
F1	Filter Strip	280
S1	Stormfilter Catch Basin	N/A

TAX MAP 18-12-34-1-4, TAX LOT 101, 107, & 700

PROJECT TITLE:
SIUSLAW RIVER BRIDGE INTERPRETIVE SITE
CITY OF FLORENCE, P.O. BOX 340
FLORENCE, OR 97439

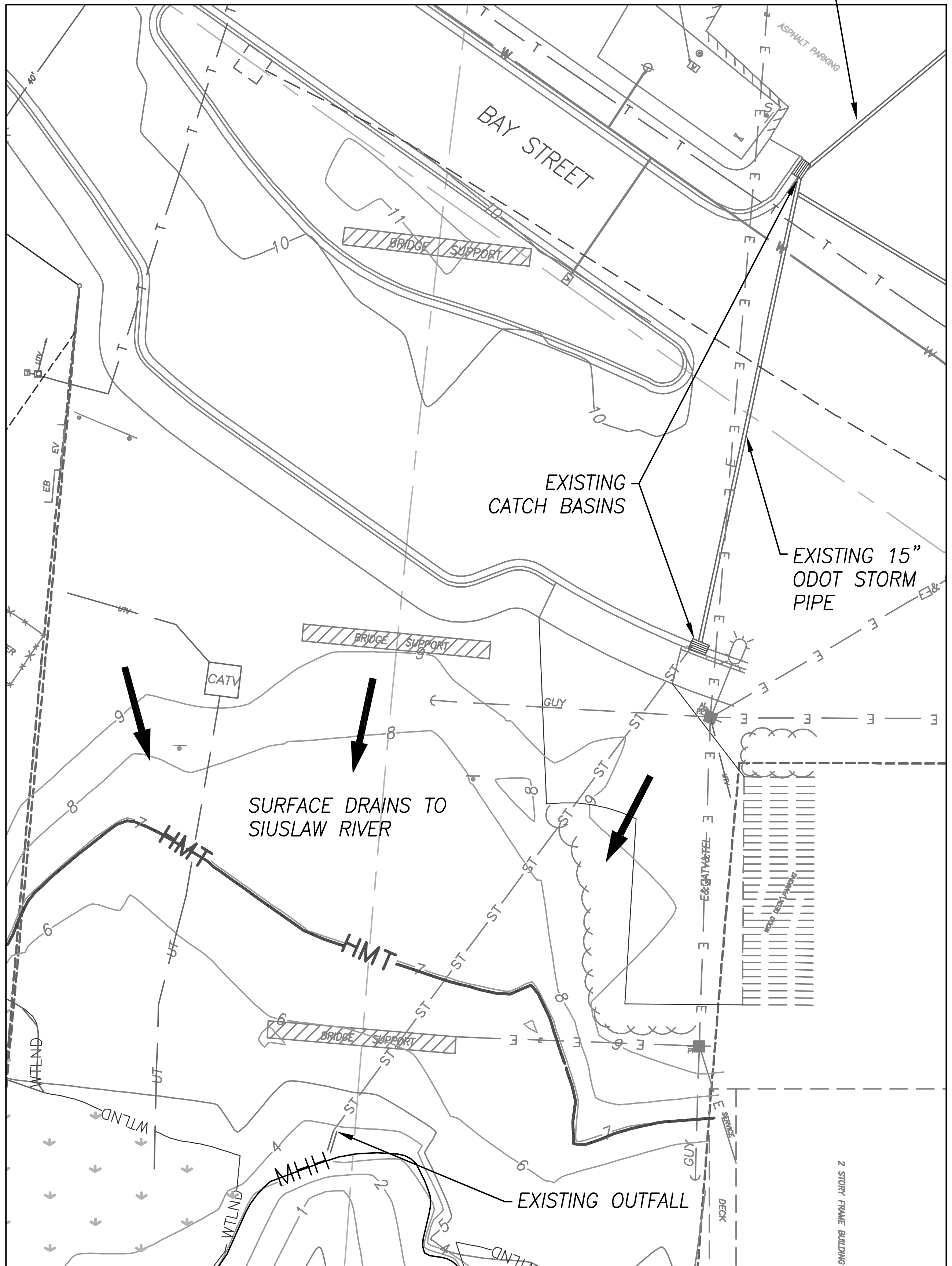
DESCRIPTION:
STORM SYSTEM MAP 1
PROPOSED BASIN DELINEATION

Branch Engineering, Inc.
Headquarters
310 Fifth Street
Springfield, Oregon 97477
(541) 746-0637
Salem/Keizer Office
4310 Cherry Avenue N.E.
Salem, Oregon 97303
(503) 779-2577
www.BranchEngineering.com
Civil • Structures • Transportation • Geotechnical • Surveying

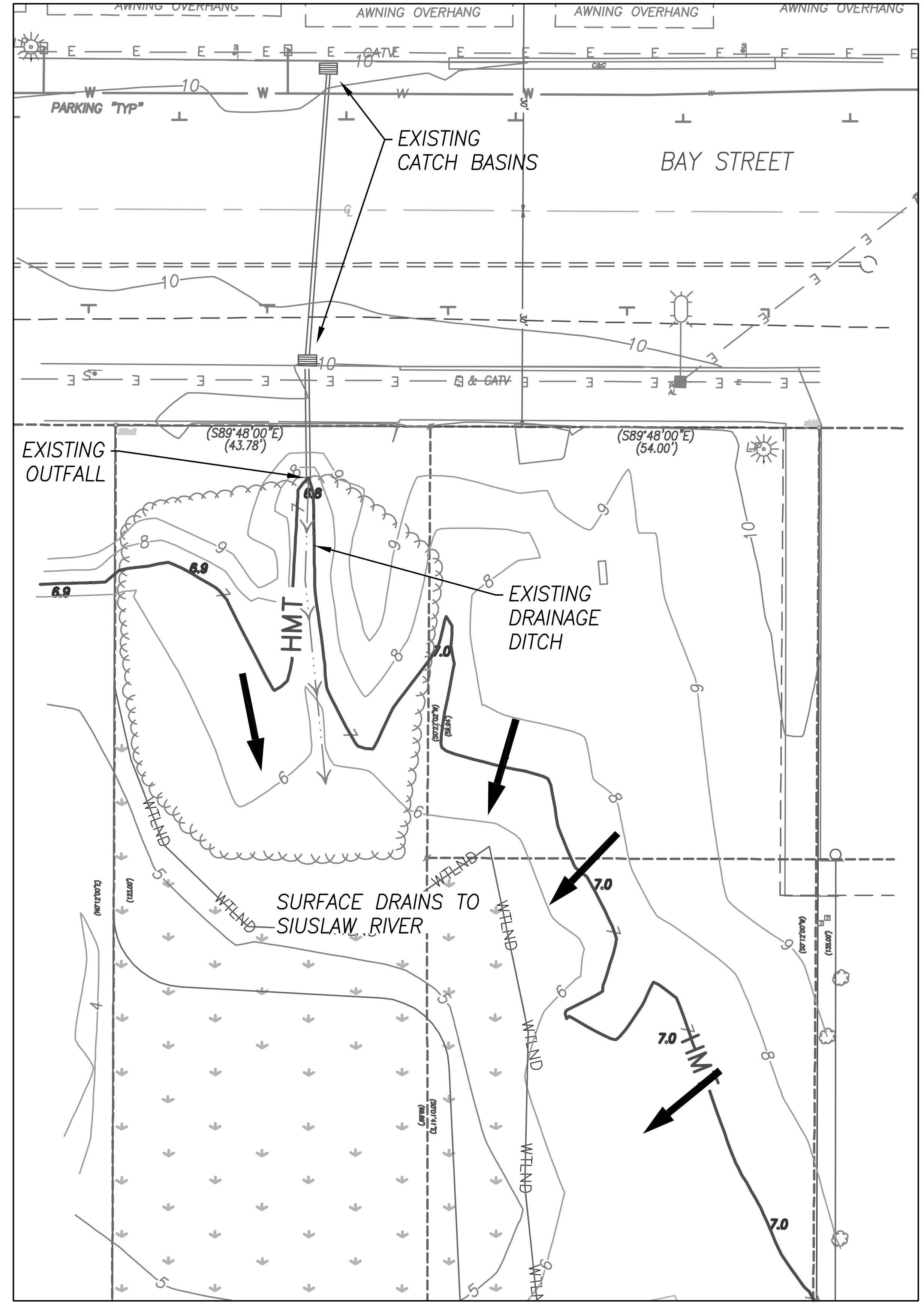
DATE	NOV. 23, 2011
SCALE	1'' = 40'
DRAWN BY	NP
DESIGNER	CCI
CHECKED BY	DG
PROJECT NUMBER	11-01B

STM 1

WAYSIDE WEST OVERLOOK EXISTING CONDITIONS



WAYSIDE EAST EXISTING CONDITIONS



N

GRAPHIC SCALE
10 0 5 10 20
(IN FEET)

TAX MAP 18-12-34-1-4, TAX LOT 101, 107, & 700

PROJECT TITLE:
SIUSLAW RIVER BRIDGE INTERPRETIVE SITE
CITY OF FLORENCE, P.O. BOX 340
FLORENCE, OR 97439

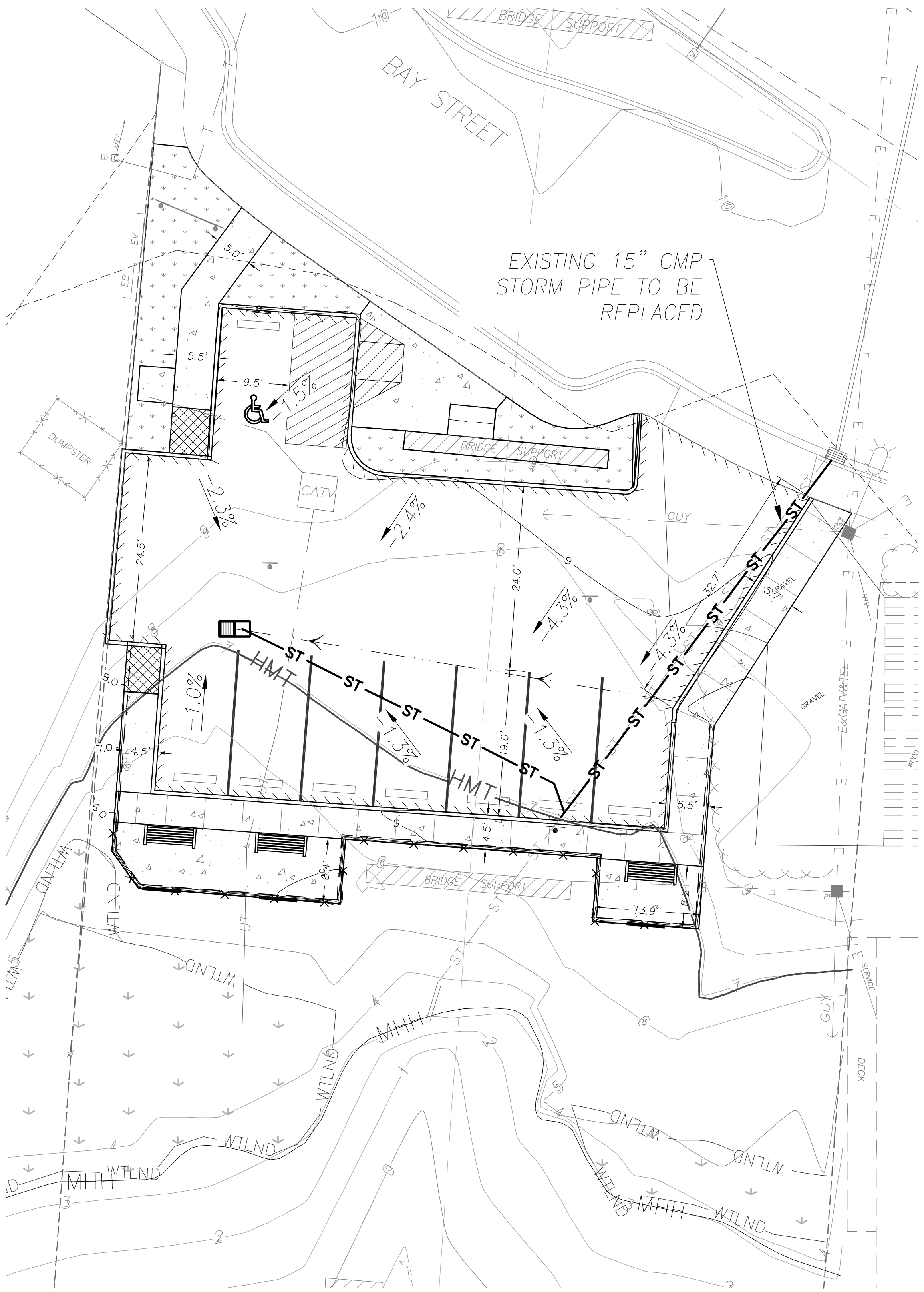
DESCRIPTION:
STORM SYSTEM MAP 2
EXISTING CONDITIONS

Branch Engineering, Inc.
Headquarters
310 Fifth Street
Springfield, Oregon 97477
(541) 746-0637
Salem/Keizer Office
4310 Cherry Avenue N.E.
Salem, Oregon 97303
(503) 779-2577
www.BranchEngineering.com
Civil • Structures • Transportation • Geotechnical • Surveying

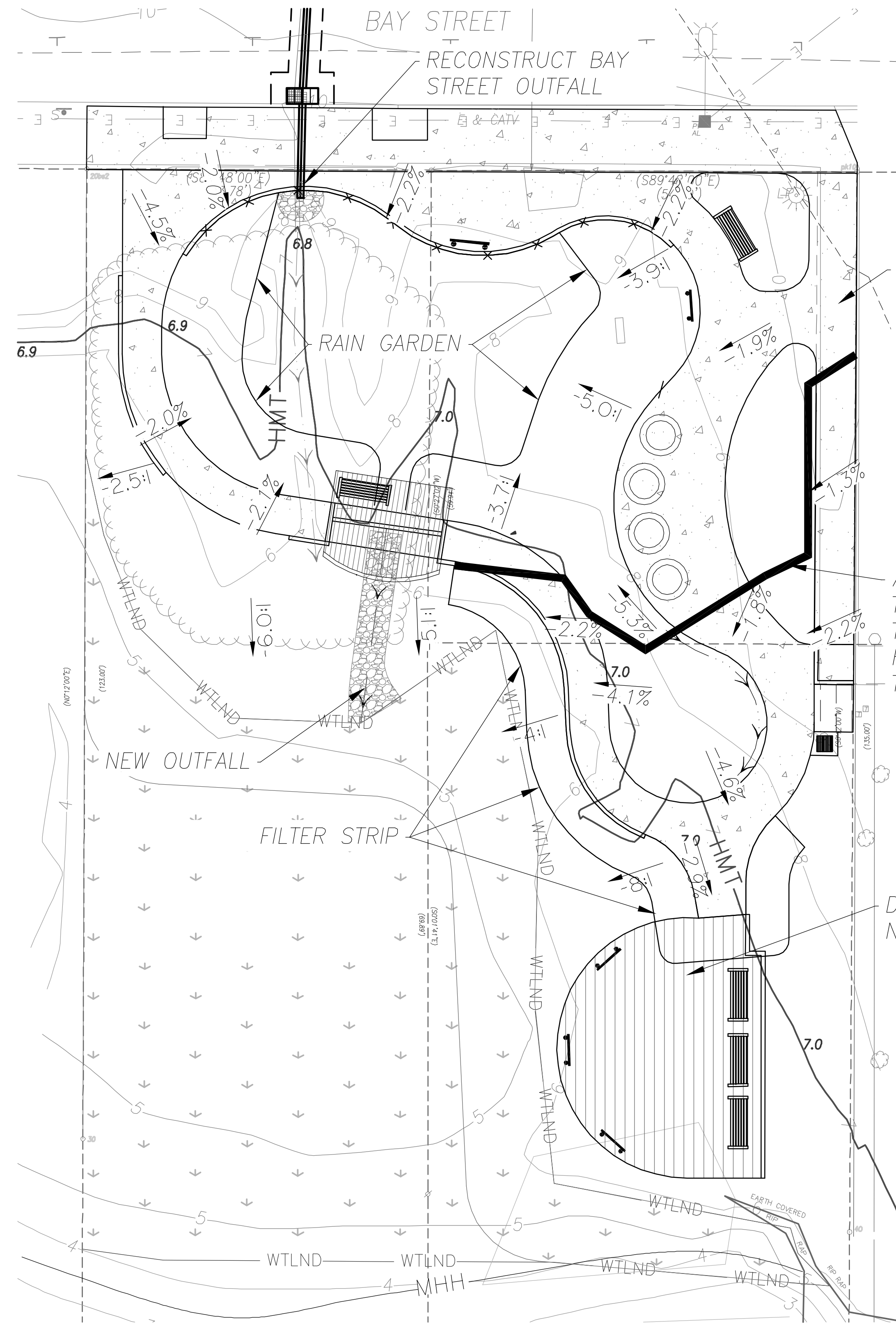
DATE	NOV. 23, 2011
SCALE	1" = 20'
DRAWN BY	NP
DESIGNER	CCI
CHECKED BY	DG
PROJECT NUMBER	11-01B

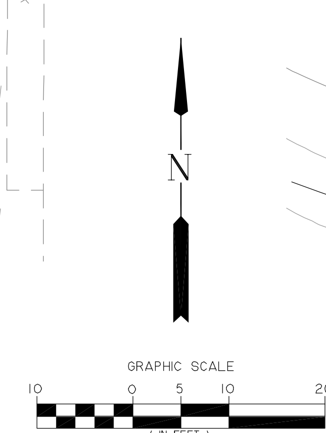
STM 2

WAYSIDE WEST OVERLOOK PROPOSED CONDITIONS



WAYSIDE EAST PROPOSED CONDITIONS





TAX MAP 18-12-34-1-4, TAX LOT 101, 107, & 700

PROJECT TITLE:
SIUSLAW RIVER BRIDGE INTERPRETIVE SITE
CITY OF FLORENCE, P.O. BOX 340
FLORENCE, OR 97439

DESCRIPTION:
STORM SYSTEM MAP 3
PROPOSED DRAINAGE PLAN

Branch Engineering, Inc.

Headquarters
310 Fifth Street
Springfield, Oregon 97477
(541) 746-0637

Salem/Keizer Office
4310 Cherry Avenue N.E.
Salem, Oregon 97303
(503) 779-2577

www.BranchEngineering.com
Civil • Structures • Transportation • Geotechnical • Surveying

DATE	NOV. 23, 2011
SCALE	1" = 20'
DRAWN BY	NP
DESIGNER	CCI
CHECKED BY	DG
PROJECT NUMBER	11-01B

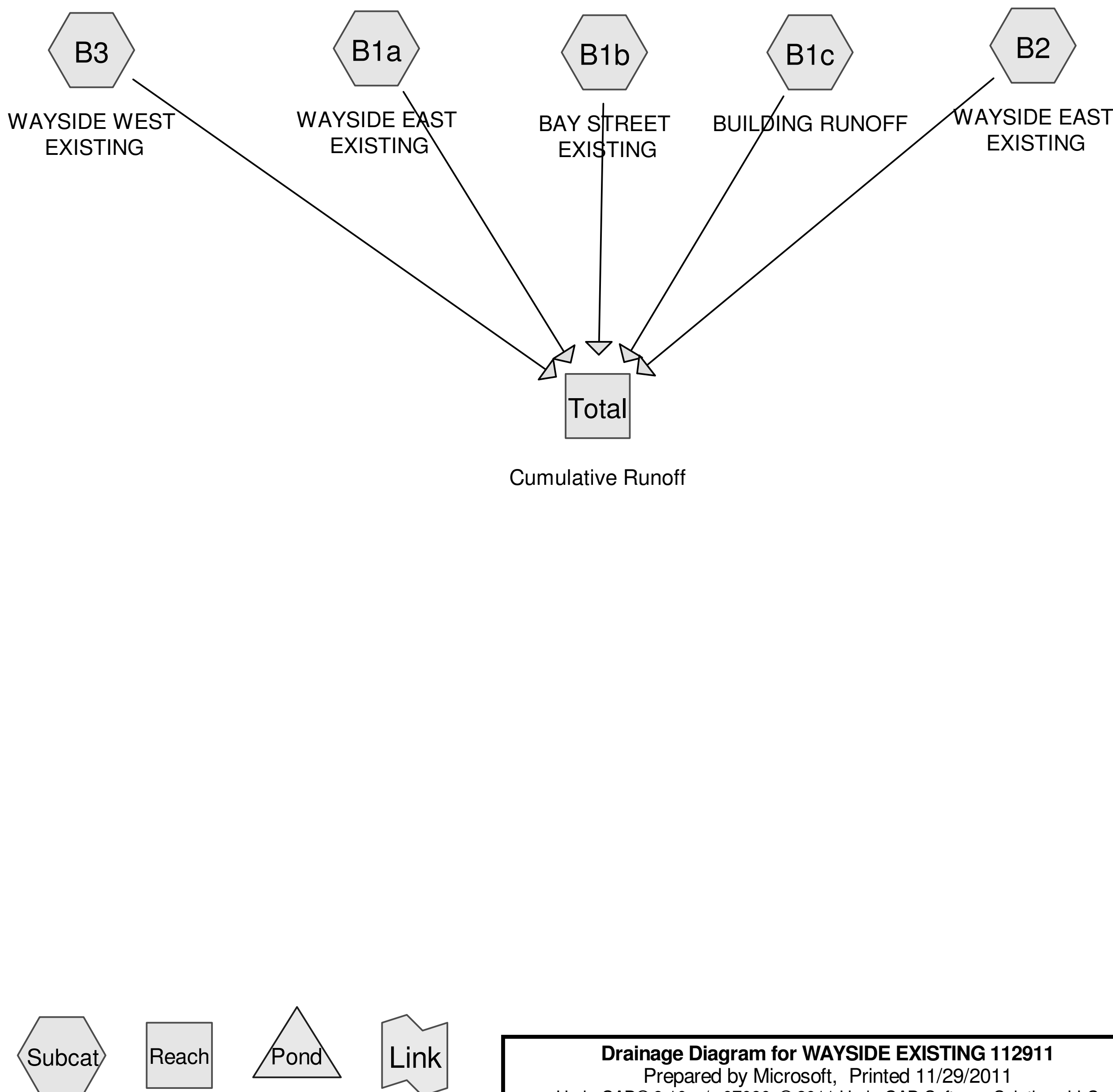
STM 3

APPENDIX

B

HydroCAD Analysis

Existing Conditions Analysis
Proposed Conditions Analysis



Drainage Diagram for WAYSIDE EXISTING 112911
Prepared by Microsoft, Printed 11/29/2011
HydroCAD® 9.10 s/n 07090 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment B1a: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.05 cfs @ 7.88 hrs, Volume= 0.017 af, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	4,514	85	Existing Landscape
	4,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.19 cfs @ 7.83 hrs, Volume= 0.062 af, Depth= 3.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

Area (sf)	CN	Description
10,093	98	Paved parking, HSG B
10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.10 cfs @ 7.81 hrs, Volume= 0.033 af, Depth= 3.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.01 cfs @ 7.88 hrs, Volume= 0.005 af, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	1,244	85	EXISTING LANDSCAPE
	1,244		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST EXISTING

Runoff = 0.05 cfs @ 7.92 hrs, Volume= 0.018 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	6,018	80	EXISTING LANDSCAPE
	6,018		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	75	0.0100	0.97		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 56.72% Impervious, Inflow Depth = 2.60" for 2 yr event
Inflow = 0.41 cfs @ 7.85 hrs, Volume= 0.136 af
Outflow = 0.41 cfs @ 7.86 hrs, Volume= 0.136 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.52 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 1.1 min

Peak Storage= 13 cf @ 7.86 hrs
Average Depth at Peak Storage= 0.08'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'

Summary for Subcatchment B1a: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.08 cfs @ 7.86 hrs, Volume= 0.025 af, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	4,514	85	Existing Landscape
	4,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.25 cfs @ 7.83 hrs, Volume= 0.082 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

Area (sf)	CN	Description
10,093	98	Paved parking, HSG B
10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.13 cfs @ 7.81 hrs, Volume= 0.043 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.02 cfs @ 7.86 hrs, Volume= 0.007 af, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	1,244	85	EXISTING LANDSCAPE
	1,244		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST EXISTING

Runoff = 0.08 cfs @ 7.89 hrs, Volume= 0.028 af, Depth= 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	6,018	80	EXISTING LANDSCAPE
	6,018		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	75	0.0100	0.97		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 56.72% Impervious, Inflow Depth = 3.56" for 10 yr event
Inflow = 0.56 cfs @ 7.84 hrs, Volume= 0.185 af
Outflow = 0.56 cfs @ 7.85 hrs, Volume= 0.185 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.70 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.86 fps, Avg. Travel Time= 1.0 min

Peak Storage= 17 cf @ 7.85 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'

Summary for Subcatchment B1a: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.09 cfs @ 7.85 hrs, Volume= 0.030 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	4,514	85	Existing Landscape
	4,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.28 cfs @ 7.83 hrs, Volume= 0.093 af, Depth= 4.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

Area (sf)	CN	Description
10,093	98	Paved parking, HSG B
10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.15 cfs @ 7.81 hrs, Volume= 0.049 af, Depth= 4.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.03 cfs @ 7.85 hrs, Volume= 0.008 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	1,244	85	EXISTING LANDSCAPE
	1,244		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST EXISTING

Runoff = 0.10 cfs @ 7.88 hrs, Volume= 0.034 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	6,018	80	EXISTING LANDSCAPE
	6,018		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	75	0.0100	0.97		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 56.72% Impervious, Inflow Depth = 4.11" for 25 yr event
Inflow = 0.65 cfs @ 7.84 hrs, Volume= 0.214 af
Outflow = 0.65 cfs @ 7.85 hrs, Volume= 0.214 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.80 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 0.9 min

Peak Storage= 18 cf @ 7.85 hrs
Average Depth at Peak Storage= 0.11'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'

Summary for Subcatchment B1a: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.00 cfs @ 17.40 hrs, Volume= 0.001 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	4,514	85	Existing Landscape
	4,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.04 cfs @ 7.87 hrs, Volume= 0.012 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

Area (sf)	CN	Description
10,093	98	Paved parking, HSG B
10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.02 cfs @ 7.85 hrs, Volume= 0.006 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST EXISTING

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.00 cfs @ 17.40 hrs, Volume= 0.000 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	1,244	85	EXISTING LANDSCAPE
	1,244		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, LANDSCAPE SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST EXISTING

Runoff = 0.00 cfs @ 20.56 hrs, Volume= 0.000 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	6,018	80	EXISTING LANDSCAPE
	6,018		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	75	0.0100	0.97		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

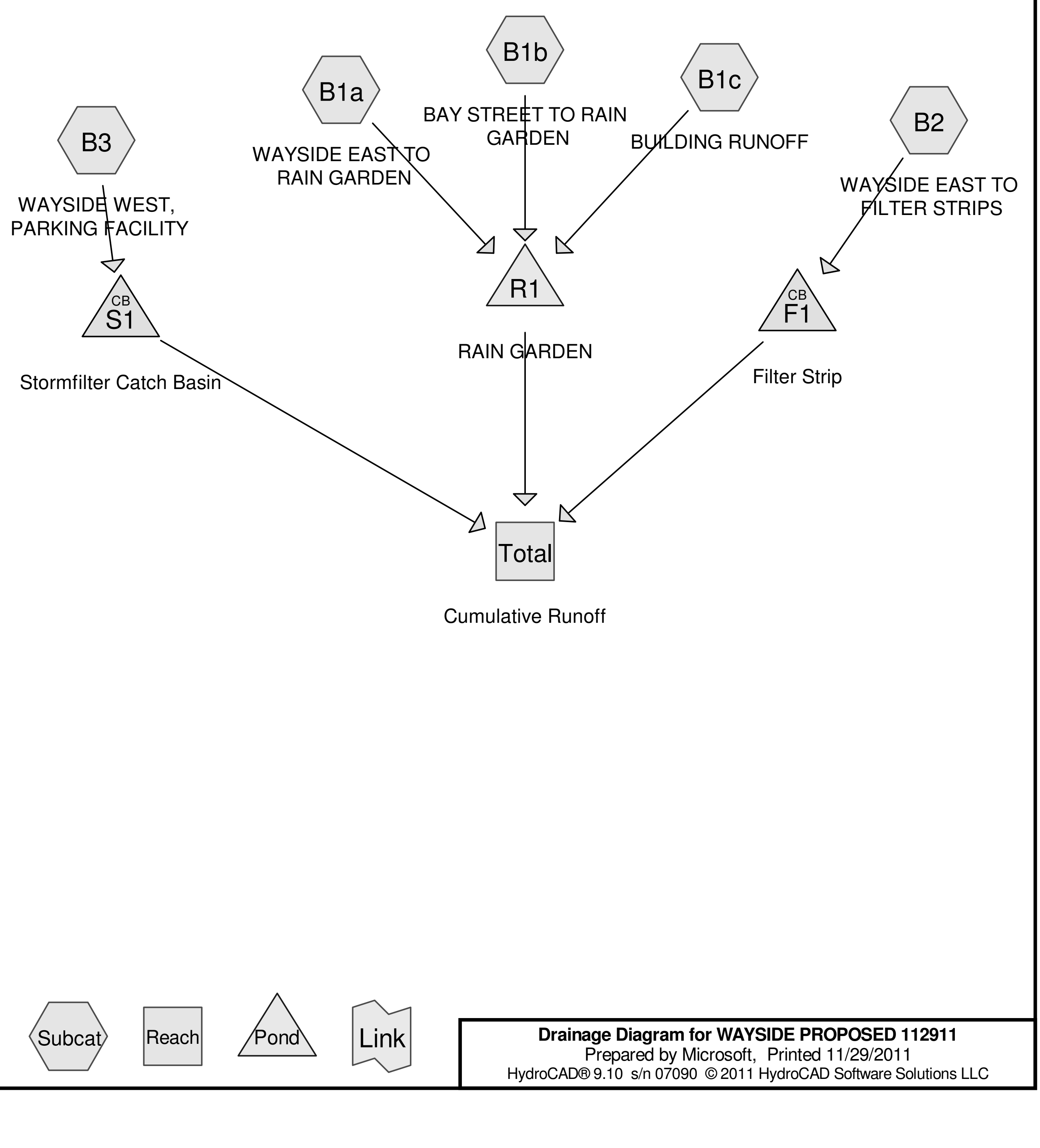
Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 56.72% Impervious, Inflow Depth = 0.39" for WQ event
Inflow = 0.06 cfs @ 7.86 hrs, Volume= 0.020 af
Outflow = 0.06 cfs @ 7.87 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.75 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 1.4 min

Peak Storage= 4 cf @ 7.87 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'



Drainage Diagram for WAYSIDE PROPOSED 112911
Prepared by Microsoft, Printed 11/29/2011
HydroCAD® 9.10 s/n 07090 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment B1a: WAYSIDE EAST TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.07 cfs @ 7.83 hrs, Volume= 0.022 af, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	1,130	100	Pond Area
*	1,707	80	Landscape
*	1,677	98	PEDESTRIAN WALKWAY
	4,514	92	Weighted Average
	1,707		37.82% Pervious Area
	2,807		62.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.19 cfs @ 7.83 hrs, Volume= 0.062 af, Depth= 3.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	10,093	98	BAY STREET
	10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.10 cfs @ 7.81 hrs, Volume= 0.033 af, Depth= 3.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST TO FILTER STRIPS

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.02 cfs @ 7.84 hrs, Volume= 0.006 af, Depth= 2.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	455	80	Landscape
*	789	98	PEDESTRIAN WALKWAY
	1,244	91	Weighted Average
	455		36.58% Pervious Area
	789		63.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST, PARKING FACILITY

Runoff = 0.11 cfs @ 7.81 hrs, Volume= 0.035 af, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=3.46"

	Area (sf)	CN	Description
*	3,742	98	Parking Area
*	1,602	98	Sidwalk
*	674	80	Landscape
	6,018	96	Weighted Average
	674		11.20% Pervious Area
	5,344		88.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	70	0.0100	0.96		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 89.58% Impervious, Inflow Depth = 0.80" for 2 yr event
Inflow = 0.13 cfs @ 7.81 hrs, Volume= 0.042 af
Outflow = 0.13 cfs @ 7.82 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.98 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 1.3 min

Peak Storage= 6 cf @ 7.82 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'

‡

Summary for Pond F1: Filter Strip

Inflow Area =	0.029 ac, 63.42% Impervious, Inflow Depth = 2.50"	for 2 yr event	
Inflow =	0.02 cfs @ 7.84 hrs, Volume=	0.006 af	
Outflow =	0.02 cfs @ 7.84 hrs, Volume=	0.006 af, Atten= 0%, Lag= 0.0 min	
Primary =	0.02 cfs @ 7.84 hrs, Volume=	0.006 af	

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 8.50' @ 7.84 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8.50'	**80.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.01 cfs @ 7.84 hrs HW=8.50' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.08 fps)

Summary for Pond R1: RAIN GARDEN

Inflow Area =	0.458 ac, 91.44% Impervious, Inflow Depth = 3.08"	for 2 yr event	
Inflow =	0.36 cfs @ 7.83 hrs, Volume=	0.118 af	
Outflow =	0.13 cfs @ 8.71 hrs, Volume=	0.118 af, Atten= 65%, Lag= 53.0 min	
Discarded =	0.10 cfs @ 8.71 hrs, Volume=	0.117 af	
Primary =	0.03 cfs @ 8.71 hrs, Volume=	0.001 af	

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs

Peak Elev= 7.71' @ 8.71 hrs Surf.Area= 1,109 sf Storage= 699 cf

Plug-Flow detention time= 41.3 min calculated for 0.118 af (100% of inflow)
Center-of-Mass det. time= 41.2 min (713.4 - 672.2)

Volume	Invert	Avail.Storage	Storage Description
#1	7.00'	2,430 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.75

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	1,134	0	0
7.50	1,370	626	626
8.00	1,624	749	1,375
8.50	1,843	867	2,241
9.00	2,154	999	3,241

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Primary	7.70'	**90.0 deg x 4.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** C= 2.50

Discarded OutFlow Max=0.10 cfs @ 8.71 hrs HW=7.71' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.02 cfs @ 8.71 hrs HW=7.71' (Free Discharge)
↑**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.02 cfs @ 0.38 fps)

Summary for Pond S1: Stormfilter Catch Basin

Inflow Area =	0.138 ac,	88.80% Impervious,	Inflow Depth =	3.01"	for 2 yr event
Inflow =	0.11 cfs @	7.81 hrs,	Volume=	0.035 af	
Outflow =	0.11 cfs @	7.81 hrs,	Volume=	0.035 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.11 cfs @	7.81 hrs,	Volume=	0.035 af	

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 5.50' @ 7.81 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	5.30'	**6.0" Round Culvert** L= 49.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 5.30' / 4.81' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior

Primary OutFlow Max=0.11 cfs @ 7.81 hrs HW=5.50' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.11 cfs @ 1.51 fps)

Summary for Subcatchment B1a: WAYSIDE EAST TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.10 cfs @ 7.82 hrs, Volume= 0.031 af, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	1,130	100	Pond Area
*	1,707	80	Landscape
*	1,677	98	PEDESTRIAN WALKWAY
	4,514	92	Weighted Average
	1,707		37.82% Pervious Area
	2,807		62.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.25 cfs @ 7.83 hrs, Volume= 0.082 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	10,093	98	BAY STREET
	10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.13 cfs @ 7.81 hrs, Volume= 0.043 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST TO FILTER STRIPS

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.03 cfs @ 7.82 hrs, Volume= 0.008 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	455	80	Landscape
*	789	98	PEDESTRIAN WALKWAY
	1,244	91	Weighted Average
	455		36.58% Pervious Area
	789		63.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST, PARKING FACILITY

Runoff = 0.14 cfs @ 7.80 hrs, Volume= 0.046 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=4.48"

	Area (sf)	CN	Description
*	3,742	98	Parking Area
*	1,602	98	Sidwalk
*	674	80	Landscape
	6,018	96	Weighted Average
	674		11.20% Pervious Area
	5,344		88.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	70	0.0100	0.96		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 89.58% Impervious, Inflow Depth = 1.33" for 10 yr event
Inflow = 0.48 cfs @ 8.00 hrs, Volume= 0.069 af
Outflow = 0.48 cfs @ 8.00 hrs, Volume= 0.069 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.62 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 1.3 min

Peak Storage= 15 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.09'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'

Summary for Pond F1: Filter Strip

Inflow Area =	0.029 ac, 63.42% Impervious, Inflow Depth = 3.48"	for 10 yr event	
Inflow =	0.03 cfs @	7.82 hrs, Volume=	0.008 af
Outflow =	0.03 cfs @	7.82 hrs, Volume=	0.008 af, Atten= 0%, Lag= 0.0 min
Primary =	0.03 cfs @	7.82 hrs, Volume=	0.008 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 8.50' @ 7.82 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8.50'	**80.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.01 cfs @ 7.82 hrs HW=8.50' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.09 fps)

Summary for Pond R1: RAIN GARDEN

Inflow Area =	0.458 ac, 91.44% Impervious, Inflow Depth = 4.09"	for 10 yr event	
Inflow =	0.48 cfs @	7.82 hrs, Volume=	0.156 af
Outflow =	0.43 cfs @	8.01 hrs, Volume=	0.156 af, Atten= 9%, Lag= 11.0 min
Discarded =	0.11 cfs @	8.01 hrs, Volume=	0.142 af
Primary =	0.33 cfs @	8.01 hrs, Volume=	0.015 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs

Peak Elev= 7.79' @ 8.01 hrs Surf.Area= 1,137 sf Storage= 780 cf

Plug-Flow detention time= 48.1 min calculated for 0.156 af (100% of inflow)
Center-of-Mass det. time= 48.1 min (712.8 - 664.7)

Volume	Invert	Avail.Storage	Storage Description
#1	7.00'	2,430 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.75

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	1,134	0	0
7.50	1,370	626	626
8.00	1,624	749	1,375
8.50	1,843	867	2,241
9.00	2,154	999	3,241

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Primary	7.70'	**90.0 deg x 4.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** C= 2.50

Discarded OutFlow Max=0.11 cfs @ 8.01 hrs HW=7.79' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.33 cfs @ 8.01 hrs HW=7.79' (Free Discharge)
↑**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.33 cfs @ 0.92 fps)

Summary for Pond S1: Stormfilter Catch Basin

Inflow Area = 0.138 ac, 88.80% Impervious, Inflow Depth = 4.02" for 10 yr event
Inflow = 0.14 cfs @ 7.80 hrs, Volume= 0.046 af
Outflow = 0.14 cfs @ 7.80 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min
Primary = 0.14 cfs @ 7.80 hrs, Volume= 0.046 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 5.53' @ 7.80 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	5.30'	**6.0" Round Culvert** L= 49.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 5.30' / 4.81' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior

Primary OutFlow Max=0.14 cfs @ 7.80 hrs HW=5.53' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.14 cfs @ 1.63 fps)

Summary for Subcatchment B1a: WAYSIDE EAST TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.11 cfs @ 7.81 hrs, Volume= 0.036 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	1,130	100	Pond Area
*	1,707	80	Landscape
*	1,677	98	PEDESTRIAN WALKWAY
	4,514	92	Weighted Average
	1,707		37.82% Pervious Area
	2,807		62.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.28 cfs @ 7.83 hrs, Volume= 0.093 af, Depth= 4.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	10,093	98	BAY STREET
	10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.15 cfs @ 7.81 hrs, Volume= 0.049 af, Depth= 4.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST TO FILTER STRIPS

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.03 cfs @ 7.82 hrs, Volume= 0.010 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	455	80	Landscape
*	789	98	PEDESTRIAN WALKWAY
	1,244	91	Weighted Average
	455		36.58% Pervious Area
	789		63.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST, PARKING FACILITY

Runoff = 0.16 cfs @ 7.80 hrs, Volume= 0.053 af, Depth= 4.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=5.06"

	Area (sf)	CN	Description
*	3,742	98	Parking Area
*	1,602	98	Sidwalk
*	674	80	Landscape
	6,018	96	Weighted Average
	674		11.20% Pervious Area
	5,344		88.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	70	0.0100	0.96		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 89.58% Impervious, Inflow Depth = 1.67" for 25 yr event
Inflow = 0.61 cfs @ 7.92 hrs, Volume= 0.087 af
Outflow = 0.61 cfs @ 7.92 hrs, Volume= 0.087 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.76 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 1.2 min

Peak Storage= 17 cf @ 7.92 hrs
Average Depth at Peak Storage= 0.11'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'

‡

Summary for Pond F1: Filter Strip

Inflow Area = 0.029 ac, 63.42% Impervious, Inflow Depth = 4.04" for 25 yr event
Inflow = 0.03 cfs @ 7.82 hrs, Volume= 0.010 af
Outflow = 0.03 cfs @ 7.82 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min
Primary = 0.03 cfs @ 7.82 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 8.50' @ 7.82 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8.50'	**80.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.01 cfs @ 7.82 hrs HW=8.50' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.10 fps)

Summary for Pond R1: RAIN GARDEN

Inflow Area = 0.458 ac, 91.44% Impervious, Inflow Depth = 4.67" for 25 yr event
Inflow = 0.54 cfs @ 7.82 hrs, Volume= 0.178 af
Outflow = 0.53 cfs @ 7.93 hrs, Volume= 0.178 af, Atten= 3%, Lag= 6.7 min
Discarded = 0.11 cfs @ 7.93 hrs, Volume= 0.154 af
Primary = 0.42 cfs @ 7.93 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs

Peak Elev= 7.80' @ 7.93 hrs Surf.Area= 1,143 sf Storage= 799 cf

Plug-Flow detention time= 52.2 min calculated for 0.178 af (100% of inflow)
Center-of-Mass det. time= 52.2 min (713.8 - 661.5)

Volume	Invert	Avail.Storage	Storage Description
#1	7.00'	2,430 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.75

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	1,134	0	0
7.50	1,370	626	626
8.00	1,624	749	1,375
8.50	1,843	867	2,241
9.00	2,154	999	3,241

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Primary	7.70'	**90.0 deg x 4.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** C= 2.50

Discarded OutFlow Max=0.11 cfs @ 7.93 hrs HW=7.80' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.42 cfs @ 7.93 hrs HW=7.80' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.42 cfs @ 1.00 fps)

Summary for Pond S1: Stormfilter Catch Basin

Inflow Area = 0.138 ac, 88.80% Impervious, Inflow Depth = 4.59" for 25 yr event
Inflow = 0.16 cfs @ 7.80 hrs, Volume= 0.053 af
Outflow = 0.16 cfs @ 7.80 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.0 min
Primary = 0.16 cfs @ 7.80 hrs, Volume= 0.053 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 5.55' @ 7.80 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	5.30'	**6.0" Round Culvert** L= 49.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 5.30' / 4.81' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior

Primary OutFlow Max=0.16 cfs @ 7.80 hrs HW=5.55' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.16 cfs @ 1.69 fps)

Summary for Subcatchment B1a: WAYSIDE EAST TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.01 cfs @ 7.97 hrs, Volume= 0.002 af, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	1,130	100	Pond Area
*	1,707	80	Landscape
*	1,677	98	PEDESTRIAN WALKWAY
	4,514	92	Weighted Average
	1,707		37.82% Pervious Area
	2,807		62.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1b: BAY STREET TO RAIN GARDEN

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.04 cfs @ 7.87 hrs, Volume= 0.012 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	10,093	98	BAY STREET
	10,093		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	200	0.0050	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B1c: BUILDING RUNOFF

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.02 cfs @ 7.85 hrs, Volume= 0.006 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	5,340	98	BUILDING RUNOFF
	5,340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	40	0.0050	0.65		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"
1.2	105	0.0050	1.44		**Shallow Concentrated Flow, Gutter Flow** Paved Kv= 20.3 fps
2.2	145	Total			

Summary for Subcatchment B2: WAYSIDE EAST TO FILTER STRIPS

This subcatchment reproduces the runoff calculation from Sample Job #1 in the TR-20 manual.

Since TR-20 has no CN or Tc calculation procedures, these values have been entered directly, rather than using HydroCAD's built-in CN lookup table and Tc calculation procedures.

The resulting peak flow of 2176cfs is approximately 4% higher than the published TR-20 value of 2097cfs. This difference occurs at small Tc values due to the additional detail provided by the polynomial-based rainfall distributions used in HydroCAD.

If a more exact TR-20 match is desired, an optional "Type II 24-hr Tabular" rainfall definition is available, which produces a peak runoff of 2099cfs, just 0.1% higher than TR-20.

Runoff = 0.00 cfs @ 7.99 hrs, Volume= 0.001 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	455	80	Landscape
*	789	98	PEDESTRIAN WALKWAY
	1,244	91	Weighted Average
	455		36.58% Pervious Area
	789		63.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.90		**Sheet Flow, ROADWAY** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Subcatchment B3: WAYSIDE WEST, PARKING FACILITY

Runoff = 0.02 cfs @ 7.88 hrs, Volume= 0.006 af, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=0.83"

	Area (sf)	CN	Description
*	3,742	98	Parking Area
*	1,602	98	Sidwalk
*	674	80	Landscape
	6,018	96	Weighted Average
	674		11.20% Pervious Area
	5,344		88.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	70	0.0100	0.96		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.12"

Summary for Reach Total: Cumulative Runoff

Inflow Area = 0.625 ac, 89.58% Impervious, Inflow Depth = 0.12" for WQ event
Inflow = 0.02 cfs @ 7.89 hrs, Volume= 0.006 af
Outflow = 0.02 cfs @ 7.91 hrs, Volume= 0.006 af, Atten= 0%, Lag= 1.4 min

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.61 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 1.4 min

Peak Storage= 1 cf @ 7.91 hrs
Average Depth at Peak Storage= 0.01'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 166.11 cfs

3.00' x 2.00' deep channel, n= 0.025 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 4.00', Outlet Invert= 3.00'

‡

Summary for Pond F1: Filter Strip

Inflow Area =	0.029 ac, 63.42% Impervious,	Inflow Depth = 0.25"	for WQ event
Inflow =	0.00 cfs @ 7.99 hrs,	Volume=	0.001 af
Outflow =	0.00 cfs @ 7.99 hrs,	Volume=	0.001 af, Atten= 0%, Lag= 0.0 min
Primary =	0.00 cfs @ 7.99 hrs,	Volume=	0.001 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 8.50' @ 7.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8.50'	**80.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 7.99 hrs HW=8.50' (Free Discharge)
↑—1=Broad-Crested Rectangular Weir (Weir Controls 0.00 cfs @ 0.02 fps)

Summary for Pond R1: RAIN GARDEN

Inflow Area =	0.458 ac, 91.44% Impervious,	Inflow Depth = 0.55"	for WQ event
Inflow =	0.06 cfs @ 7.88 hrs,	Volume=	0.021 af
Outflow =	0.06 cfs @ 7.94 hrs,	Volume=	0.021 af, Atten= 1%, Lag= 3.7 min
Discarded =	0.06 cfs @ 7.94 hrs,	Volume=	0.021 af
Primary =	0.00 cfs @ 0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs

Peak Elev= 7.02' @ 7.94 hrs Surf.Area= 856 sf Storage= 14 cf

Plug-Flow detention time= 3.6 min calculated for 0.021 af (100% of inflow)
Center-of-Mass det. time= 3.6 min (740.1 - 736.5)

Volume	Invert	Avail.Storage	Storage Description
#1	7.00'	2,430 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.75

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	1,134	0	0
7.50	1,370	626	626
8.00	1,624	749	1,375
8.50	1,843	867	2,241
9.00	2,154	999	3,241

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Primary	7.70'	**90.0 deg x 4.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** C= 2.50

Discarded OutFlow Max=0.08 cfs @ 7.94 hrs HW=7.02' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=7.00' (Free Discharge)
↑**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond S1: Stormfilter Catch Basin

Inflow Area = 0.138 ac, 88.80% Impervious, Inflow Depth = 0.48" for WQ event
Inflow = 0.02 cfs @ 7.88 hrs, Volume= 0.006 af
Outflow = 0.02 cfs @ 7.88 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min
Primary = 0.02 cfs @ 7.88 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 5.37' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	5.30'	**6.0" Round Culvert** L= 49.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 5.30' / 4.81' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior

Primary OutFlow Max=0.02 cfs @ 7.88 hrs HW=5.37' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.02 cfs @ 0.92 fps)

APPENDIX C

Soil Data and Lane County Soil Maps

Lane County Area, Oregon

133C—Waldport-Urban land complex, 0 to 12 percent slopes

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 60 to 100 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 165 to 250 days

Map Unit Composition

Waldport and similar soils: 50 percent
Urban land: 40 percent
Minor components: 5 percent

Description of Waldport

Setting

Landform: Dunes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sand of mixed origin

Properties and qualities

Slope: 0 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.8 inches)

Interpretive groups

Land capability (nonirrigated): 6e

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 3 inches: Moderately decomposed plant material
3 to 8 inches: Fine sand
8 to 60 inches: Fine sand

Description of Urban Land

Interpretive groups

Land capability (nonirrigated): 8

Minor Components

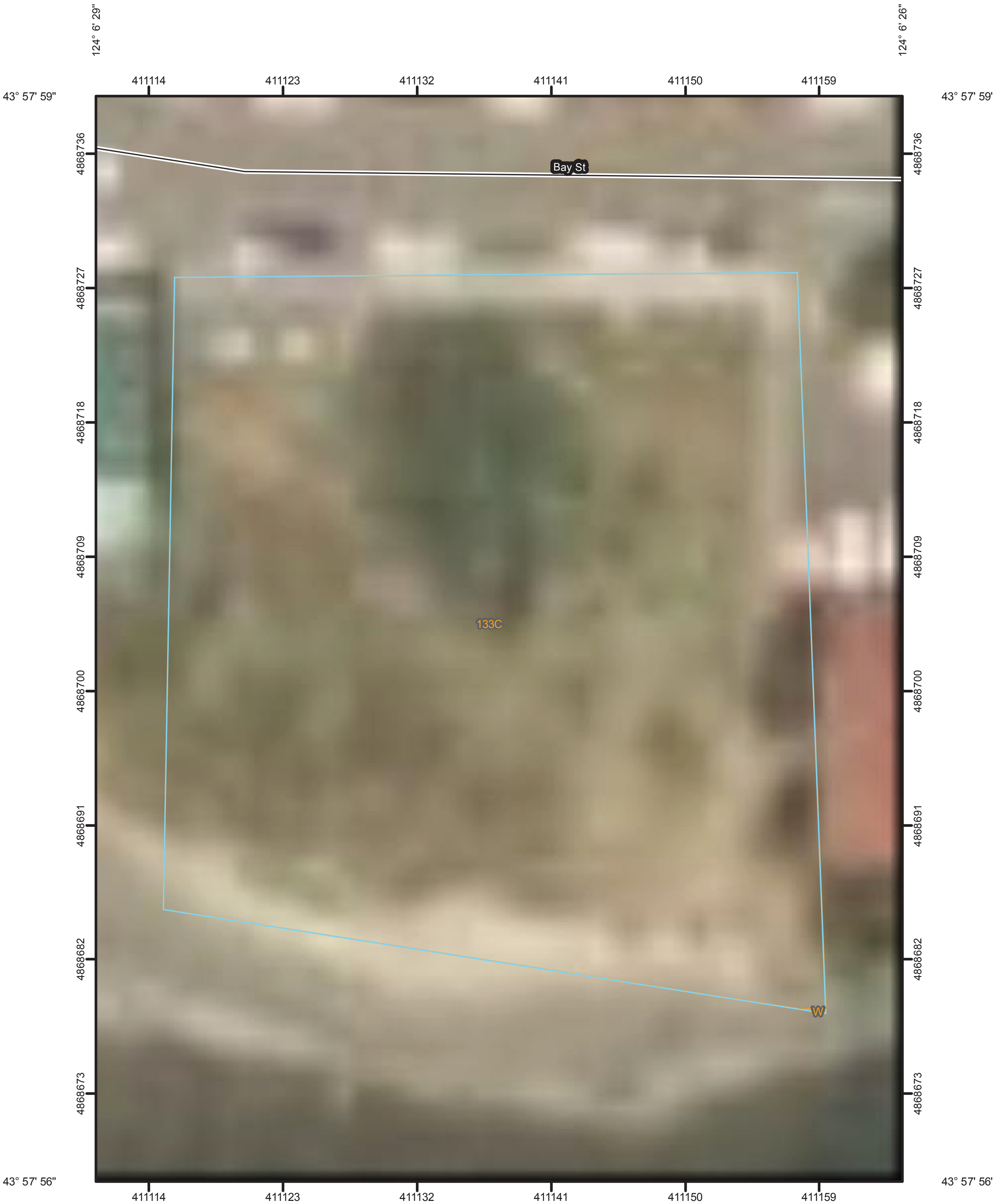
Yaquina

Percent of map unit: 5 percent

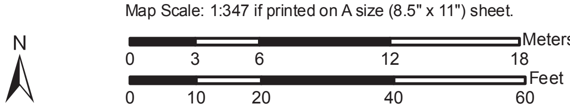
Landform: Marine terraces

Data Source Information

Soil Survey Area: Lane County Area, Oregon
Survey Area Data: Version 8, Feb 9, 2010



Map Scale: 1:347 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Special Point Features

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

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

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

MAP INFORMATION

Map Scale: 1:347 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

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

Soil Survey Area: Lane County Area, Oregon
Survey Area Data: Version 8, Feb 9, 2010

Date(s) aerial images were photographed: 7/17/2005

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

Map Unit Legend

Lane County Area, Oregon (OR637)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
133C	Waldport-Urban land complex, 0 to 12 percent slopes	0.5	100.0%
W	Water	0.0	0.0%
Totals for Area of Interest		**0.5**	**100.0%**

Map Scale: 1:301 if printed on A size (8.5" x 11") sheet.

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

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

MAP INFORMATION

Map Scale: 1:301 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

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

Soil Survey Area: Lane County Area, Oregon
Survey Area Data: Version 8, Feb 9, 2010

Date(s) aerial images were photographed: 7/17/2005

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

Map Unit Legend

Lane County Area, Oregon (OR637)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
133C	Waldport-Urban land complex, 0 to 12 percent slopes	0.4	94.2%
W	Water	0.0	5.8%
Totals for Area of Interest		**0.4**	**100.0%**

APPENDIX D

Operation and Maintenance Documents

CONTECH
CONSTRUCTION PRODUCTS INC.

StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are likely many effective maintenance options, we believe the following procedure is efficient and can be implemented using common equipment and existing maintenance protocols. A two step procedure is recommended as follows:

1. Inspection

Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

Cartridge replacement

Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

Maintenance Frequency

The primary factor controlling timing of maintenance of the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs.

Prior to the development of the maintenance database, the following maintenance frequencies should be followed:

Inspection

One time per year

After major storms

Maintenance

As needed, based on results of inspection (The average maintenance lifecycle is approximately 1-3 years)

Per Regulatory requirement

In the event of a chemical spill

Frequencies should be updated as required. The recommended initial frequency for inspection is one time per year. StormFilter units should be inspected after major storms.

Sediment removal and cartridge replacement on an as needed basis is recommended unless site conditions warrant.

Once an understanding of site characteristics has been established, maintenance may not be needed for one to three years, but inspection is warranted and recommended annually.

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.

3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water in the cartridge bay for more that 24 hours after end of rain event, maintenance is required.
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.
8. Calendar Lifecycle.
   a. If system has not been maintained for 3 years maintenance is required.

Assumptions

- No rainfall for 24 hours or more
- No upstream detention (at least not draining into StormFilter)
- Structure is online
- Outlet pipe is clear of obstruction
- Construction bypass is plugged

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from CONTECH Construction Products.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH Construction Products for suggested attachment devices.

Important: Note that cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and could be capped during the maintenance activity to prevent sediments from entering the underdrain manifold.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless CONTECH Construction Products performs the maintenance activities and damage is not related to discharges to the system.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. Enter the vault using appropriate confined space protocols.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood screws (3) hood and float.

D. At location under structure access, tip the cartridge on its side.

Important: Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

D. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

E. Set the empty, used cartridge aside or load onto the hauling truck.

F. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
    a. Replace any damaged connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH Construction Products.

Related Maintenance Activities -

Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

CONTECH CONSTRUCTION PRODUCTS INC.
800.338.1122
www.contech-cpi.com

Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our engineers.

CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

Inspection Report

Date: ______________________ Personnel: ______________________

Location: ______________________ System Size: ______________________

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: ______________________ Date: ____________

Sediment Depth on Vault Floor: ______________________

Structural Damage: ______________________

Estimated Flow from Drainage Pipes (if available): ______________________

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: ______________________

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: ______________________

☐ Minor Structural Repairs: ______________________

☐ Drainage Area Report ______________________

Excessive Oil Loading: Yes ☐ No ☐ Source: ______________________

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: ______________________

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: ______________________

Items Needing Further Work: ______________________

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

____

____

____

____

____

____

____

____

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: ______________________ Personnel: ______________________

Location: ______________________ System Size: ______________________

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: ______________________

____

____

System Observations

Months in Service:

Oil in Forebay: Yes ☐ No ☐

Sediment Depth in Forebay: ______________________

Sediment Depth on Vault Floor: ______________________

Structural Damage: ______________________

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: ______________________

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: ______________________

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: ______________________

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: ______________________

Replace Cartridges: Yes ☐ No ☐ Details: ______________________

Sediment Removed: Yes ☐ No ☐ Details: ______________________

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: ______________________

Residuals (debris, sediment) Disposal Methods: ______________________

Notes:

____

____

____

____

____

____

____

Operation and Maintenance

CatchBasin StormFilter™

Important: These guidelines should be used as a part of your site stormwater plan.

Overview

The CatchBasin StormFilter™ (CBSF) consists of a multi-chamber steel, concrete, or plastic catch basin unit that can contain up to four StormFilter cartridges. The steel CBSF is offered both as a standard and as a deep unit.

The CBSF is installed flush with the finished grade and is applicable for both constrained lot and retrofit applications. It can also be fitted with an inlet pipe for roof leaders or similar applications.

The CBSF unit treats peak water quality design flows up to 0.13 cfs, coupled with an internal weir overflow capacity of 1.0 cfs for the standard unit, and 1.8 cfs for the deep steel and concrete units. Plastic units have an internal weir overflow capacity of 0.5 cfs.

Design Operation

The CBSF is installed as the primary receiver of runoff, similar to a standard, grated catch basin. The steel and concrete CBSF units have an H-20 rated, traffic-bearing lid that allows the filter to be installed in parking lots, and for all practical purposes, takes up no land area. Plastic units can be used in landscaped areas and for other non-traffic-bearing applications.

The CBSF consists of a sumped inlet chamber and a cartridge chamber(s). Runoff enters the sumped inlet chamber either by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit vault. The inlet chamber is equipped with an internal baffle, which traps debris and floating oil and grease, and an overflow weir. While in the inlet chamber, heavier solids are allowed to settle into the deep sump, while lighter solids and soluble pollutants are directed under the baffle and into the cartridge chamber through a port between the baffle and the overflow weir. Once in the cartridge chamber, polluted water ponds and percolates horizontally through the media in the filter cartridges. Treated water collects in the cartridge's center tube from where it is directed by an under-drain manifold to the outlet pipe on the downstream side of the overflow weir and discharged.

When flows into the CBSF exceed the water quality design value, excess water spills over the overflow weir, bypassing the cartridge bay, and discharges to the outlet pipe.

Applications

The CBSF is particularly useful where small flows are being treated or for sites that are flat and have little available hydraulic head to spare. The unit is ideal for applications in which standard catch basins are to be used. Both water quality and catchment issues can be resolved with the use of the CBSF.

Retro-Fit

The retrofit market has many possible applications for the CBSF**.** The CBSF can be installed by replacing an existing catch basin without having to "chase the grade," thus reducing the high cost of re-piping the storm system.

Maintenance Guidelines

Maintenance procedures for typical catch basins can be applied to the CatchBasin StormFilter (CBSF). The filter cartridges contained in the CBSF are easily removed and replaced during maintenance activities according to the following guidelines.

1. Establish a safe working area as per typical catch basin service activity.
2. Remove steel grate and diamond plate cover (weight ≈ 100 lbs. each).
3. Turn cartridge(s) counter-clockwise to disconnect from pipe manifold.
4. Remove 4" center cap from cartridge and replace with lifting cap.
5. Remove cartridge(s) from catch basin by hand or with vactor truck boom.
6. Remove accumulated sediment via vactor truck (min. clearance 13" x 24").
7. Remove accumulated sediment from cartridge bay.
   (min. clearance 9.25" x 11")
8. Rinse interior of both bays and vactor remaining water and sediment.
9. Install fresh cartridge(s) threading clockwise to pipe manifold.
10. Replace cover and grate.
11. Return original cartridges to CONTECH Stormwater Solutions for cleaning and media disposal.

Media may be removed from the filter cartridges using the vactor truck before the cartridges are removed from the catch basin structure. Empty cartridges can be easily removed from the catch basin structure by hand. Empty cartridges should be reassembled and returned to CONTECH Stormwater Solutions, as appropriate.

Materials required include a lifting cap, vactor truck, and fresh filter cartridges. Contact CONTECH Stormwater Solutions for specifications and availability of the lifting cap. The vactor truck must be equipped with a hose capable of reaching areas of restricted clearance. The owner may refresh spent cartridges. Refreshed cartridges are also available from CONTECH Stormwater Solutions on an exchange basis. Contact the maintenance department of CONTECH Stormwater Solutions at (503) 240-3393 for more information.

Maintenance is estimated at 26 minutes of site time. For units with more than one cartridge, add approximately 5 minutes for each additional cartridge. Add travel time as required.

Mosquito Abatement

In certain areas of the United States, mosquito abatement is desirable to reduce the incidence of vectors.

In BMPs with standing water, which could provide mosquito breeding habitat, certain abatement measures can be taken.

1. Periodic observation of the standing water to determine if the facility is harboring mosquito larvae.
2. Regular catch basin maintenance
3. Use of larvicides containing *Bacillus thuringiensis israelensis* (BTI). BTI is a bacterium toxic to mosquito and black fly larvae.

In some cases, the presence of petroleum hydrocarbons may interrupt the mosquito growth cycle.

Using Larvicides in the CatchBasin StormFilter

Larvicides should be used according to manufacturer's recommendations.

Two widely available products are Mosquito Dunks and Summit B.t.i. Briquets. For more information, visit http://www.summitchemical.com/mos_ctrl/default.htm.

The larvicide must be in contact with the permanent pool. The larvicide should also be fastened to the CatchBasin StormFilter by string or wire to prevent displacement by high flows. A magnet can be used with a steel catch basin.

For more information on mosquito abatement in stormwater BMPs, refer to the following:
http://www.ucmrp.ucdavis.edu/publications/managingmosquitoesstormwater8125.pdf

CONTECH CONSTRUCTION PRODUCTS INC.

The Stormwater Management StormFilter®

Important: Inspection should be performed by a person who is familiar with the StormFilter treatment unit.

StormFilter Maintenance Guidelines

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site, and may be required in the event of a chemical spill or due to excessive sediment loading.

Maintenance Procedures

Although there are other effective maintenance options, CONTECH recommends the following two step procedure:

1. Inspection: Determine the need for maintenance.
2. Maintenance: Cartridge replacement and sediment removal.

Inspection and Maintenance Activity Timing

At least one scheduled inspection activity should take place per year with maintenance following as warranted.

First, inspection should be done before the winter season. During which, the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, maintenance should be performed during periods of dry weather.

In addition, you should check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation. It may be necessary to adjust the inspection/maintenance activity schedule depending on the actual operating conditions encountered by the system.

Generally, inspection activities can be conducted at any time, and maintenance should occur when flows into the system are unlikely.

Maintenance Activity Frequency

Maintenance is performed on an as needed basis, based on inspection. Average maintenance lifecycle is 1-3 years. The primary factor controlling timing of maintenance of the StormFilter is sediment loading. Until appropriate timeline is determined, use the following:

Inspection:

- One time per year
- After major storms

Maintenance:

- As needed
- Per regulatory requirement
- In the event of a chemical spill

Inspection Procedures

It is desirable to inspect during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH immediately.

To conduct an inspection:

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. Use the following as a general guide. (Other factors, such as regulatory requirements, may need to be considered)

1. Sediment loading on the vault floor. If >4" of accumulated sediment, then go to maintenance.
2. Sediment loading on top of the cartridge. If >1/4" of accumulation, then go to maintenance.
3. Submerged cartridges. If >4" of static water in the cartridge bay for more that 24 hrs after end of rain event, then go to maintenance.
4. Plugged media. If pore space between media granules is absent, then go to maintenance.
5. Bypass condition. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), then go to maintenance.
6. Hazardous material release. If hazardous material release (automotive fluids or other) is reported, then go to maintenance.
7. Pronounced scum line. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, then go to maintenance.
8. Calendar Lifecycle. If system has not been maintained for 3 years, then go to maintenance.

Assumptions:

No rainfall for 24 hours or more.

No upstream detention (at least not draining into StormFilter).

Structure is online. Outlet pipe is clear of obstruction. Construction bypass is plugged.

Maintenance

Depending on the configuration of the particular system, workers will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flow is occurring.

Replacement cartridges can be delivered to the site or customers facility. Contact CONTECH for more information.

Warning: In the case of a spill, the worker should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH immediately.

To conduct cartridge replacement and sediment removal:

1. If applicable, set up safety equipment to protect workers and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that workers enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH for suggested attachment devices.

> Important: Cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Do not damage the manifold connectors. They should remain installed in the manifold and can be capped during the maintenance activity to prevent sediments from entering the under drain manifold.

B. Remove the used cartridges (up to 250 lbs.) from the vault.

> Important: Avoid damaging the cartridges during removal and installation.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps A through C until all cartridges have been removed.

Method 2:

A. Enter the vault using appropriate confined space protocols.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood screws (3) hood and float.

D. At location under structure access, tip the cartridge on its side.

> Important: Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through E until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. Use vacuum truck for highest effectiveness.
9. Once the sediments are removed, assess the condition of the vault and the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
   a. Replace any damaged connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH.

Material Disposal

The accumulated sediment must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals. Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with applicable waste disposal regulations. Coordinate disposal of solids and liquids as part of your maintenance procedure. Contact the local public works department to inquire how they disposes of their street waste residuals.

800.338.1122
www.contech-cpi.com

Date:____________ Initials:___________
Work performed by:____
Work performed:____
____
Details:____
____

Date:____________ Initials:___________
Work performed by:____
Work performed:____
____
Details:____
____

Date:____________ Initials:___________
Work performed by:____
Work performed:____
____
Details:____
____

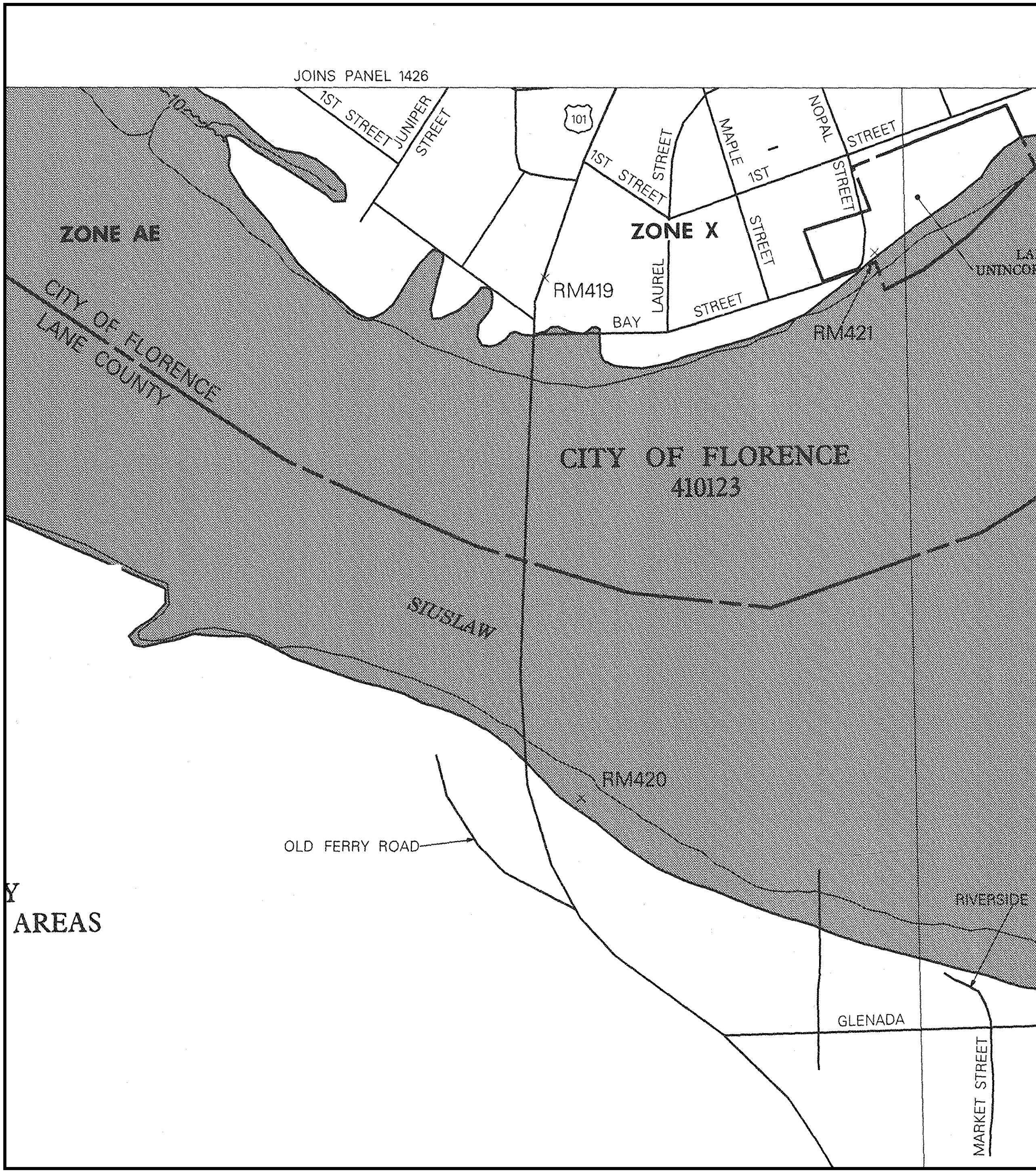
Date:____________ Initials:___________
Work performed by:____
Work performed:____
____
Details:____
____

Date:____________ Initials:___________
Work performed by:____
Work performed:____
____
Details:____
____

Date:____________ Initials:___________
Work performed by:____
Work performed:____
____
Details:____
____

APPENDIX E

FEMA Flood Maps



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

LANE COUNTY, OREGON AND INCORPORATED AREAS

PANEL 1428 OF 2975
(SEE MAP INDEX FOR PANELS NOT PRINTED)

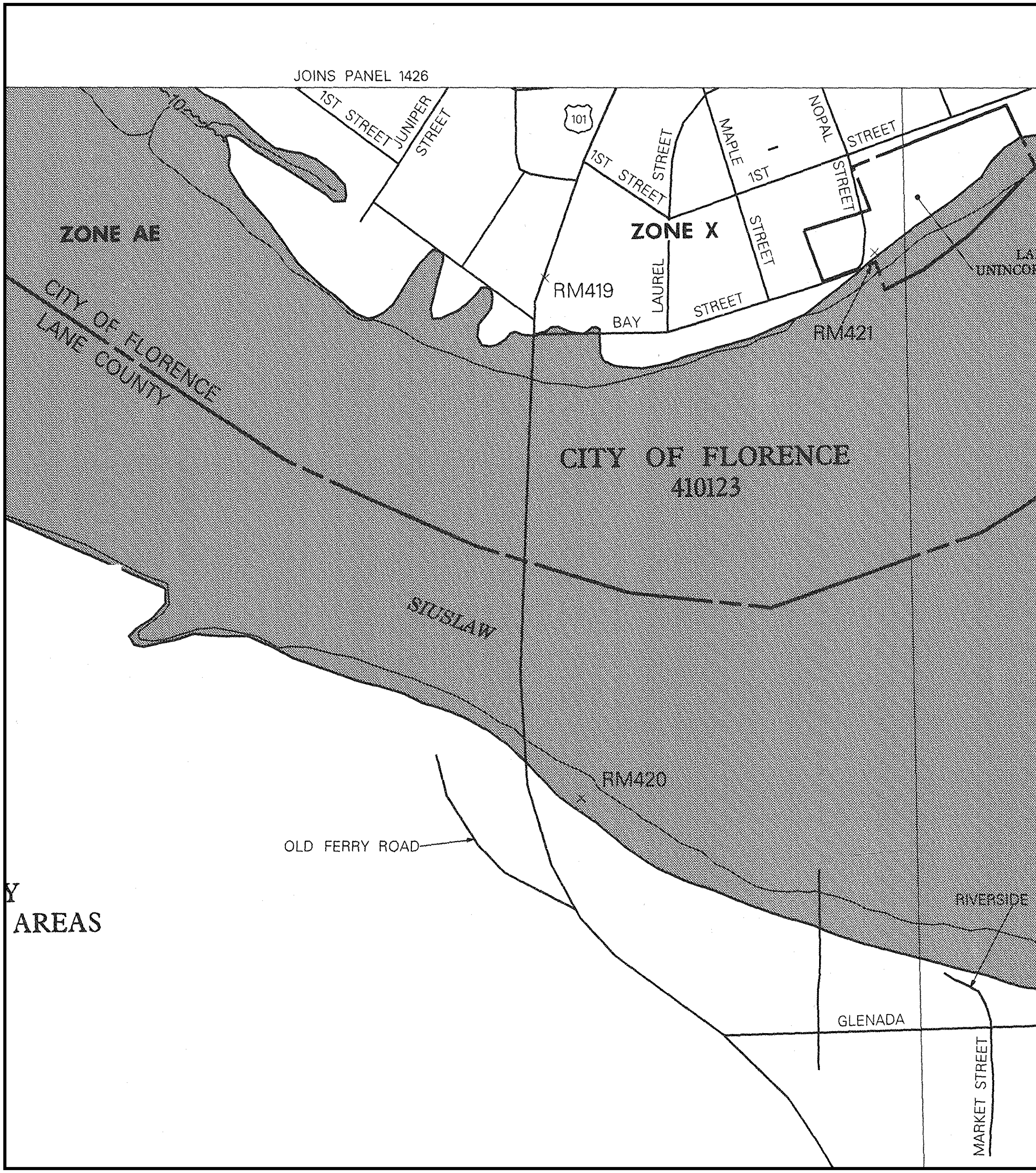
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DUNES CITY, CITY OF	410262	1428	F
FLORENCE, CITY OF	410123	1428	F
LANE COUNTY, UNINCORPORATED AREAS	415591	1428	F

MAP NUMBER
41039C1428 F

EFFECTIVE DATE:
JUNE 2, 1999

Federal Emergency Management Agency



APPROXIMATE SCALE IN FEET

500 0 500

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100–YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100–year flood by Federal flood protection system under construction ; no base flood elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500–year flood; areas of 100–year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100–year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500–year floodplain.

ZONE D Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

~~~513~~~ Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.

D — D Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone.
~~~