TERRADYN CONSULTANTS, LLC

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Portland, ME 04101

115 CONGRESS BELFAST HOUSING

115 CONGRESS STREET, BELFAST, MAINE

STORMWATER MANAGEMENT REPORT

PREPARED FOR:

DEVELOPERS COLLABORATIVE
100 COMMERCIAL STREET, SUITE 414
PORTLAND, MAINE 04101

PREPARED BY:

TERRADYN CONSULTANTS LLC
565 CONGRESS STREET, SUITE 201
PORTLAND, MAINE 04101

JANUARY 20, 2020

Introduction

Terradyn Consultants has been retained by Developers Collaborative to prepare civil-site plans and permit applications for the development of a 48-unit housing project, including 36 affordable housing units, located at 115 Congress Street in Belfast, Maine.

The project requires Site Plan approval from the Belfast Planning Board and a Stormwater Permit from the Maine Department of Environmental Protection. The existing site includes approximately 2.88 acres of impervious area, which will be reduced to approximately 1.51 acres of impervious area in the proposed condition, which is a reduction of approximately 1.37 acres of impervious area. This report analyzes the effect that the proposed project is expected to have on the downstream properties and waterways.

Existing Project Site

The site contains approximately 2.88 acres of compact gravel and pavement. Buildings associated with the former public works facility have been removed. The site appears to have been filled to create the public works facility. The majority of the site is impervious. The western portion of the site is made up of emergent wetlands that extend off site to the northwest and southwest.

The center of the site is highest in elevation and a fill slope along the western property line extends down to the emergent wetland. The eastern portion of the site generally slopes east towards Congress Street and the western portion of the site generally slopes west towards the wetlands. The majority of the stormwater runoff from the site is tributary to the wetland complex west of the project site. The wetland complex drains in a southernly direction and ultimately outlets into Belfast Bay.

The Natural Resource Conservation Commission (NRCS) identifies onsite soils as Peru Fine Sandy Loam (HSG C/D) and Brayton Fine Sandy Loam (HSG D).

A “Zone A” 100-year Flood Hazard Area associated with the wetland is located on the western edge of the site. No Base Flood Elevation has been established for the Flood Hazard Area. No development is proposed within the mapped flood hazard area.

Congress Street has approximately 22 feet of pavement width, minimal gravel shoulders and a roadside ditch adjacent to the project site. Public water and sewer mains are located within Congress Street. Overhead power and telecommunications utilities are located on poles on the east side of Congress Street.

The following existing conditions figures are provided in Exhibit 1:

Figure 1	USGS Topographic Map
Figure 2	Aerial Photograph
Figure 3	NRCS Medium Intensity Soil Survey
Figure 4	Flood Insurance Rate Map

Proposed Project

The proposed development includes removal of the existing packed gravel and paved areas on site, and the construction of four two-story buildings and one three-story building, featuring 48 apartments. 36 of the apartments within four of the buildings will be affordable housing. The project layout was designed around a large shared space central to the site. Lawn areas common to all residents will provide opportunities for residents to gather outdoors. The site development will also include a paved driveway and parking spaces, new utilities, and stormwater management features.

The buildings will face the central lawn common area. Building A is on the westerly side of the site and will include 12 market rate apartments. Buildings B and C are on the northerly side of the site, and Buildings D and E are on the southerly side of the site, all of which will include affordable housing. The buildings will feature sloped roofs and each unit will have a private back patio. A community room is located in building C. The common lawn area and parking is located between the buildings in the center of the site. The parking lot extends northwesterly around the back of Building A and contains parking for 72 vehicles. A new driveway will be constructed from Congress Street to access the parking.

The development will be served by the Belfast Water District's (BWD) public water system and the City of Belfast public sewer system. No on-site water extraction or subsurface wastewater disposal is proposed.

The project will result in 1.51 acres of impervious area, a net decrease of 1.37 acres from the existing condition. Overall, runoff patterns will remain similar to the existing condition. The site will continue to slope from the center to both the east and the west, with the majority of the site draining to the emergent wetland complex to the west.

Four structural best management practices (BMPs) have been designed to collect, store and treat runoff from on-site impervious areas prior to discharging it to the wetland and stream.

Runoff from a portion of the paved parking lot will be directed to a new underdrained soil filter located west of Building D. Runoff from another portion of the paved parking lot will be directed to a new underdrained soil filter located north of Building A. Runoff from walkways and lawn areas at the center of the site will be directed to two rain gardens located in the central lawn area.

Applicable Design Standards

Maine Department of Environmental Protection:

The project will disturb more than one acre of land area and requires a stormwater permit pursuant to the Stormwater Management Law 38 M.R.S §420-D. However, the project is a redevelopment project per the MDEP Chapter 500 Section 4.C(2)(d) that results in a decrease of impervious area. Redevelopment calculations were completed per Chapter 500 requirements and result in a negative ranked impact change, which means that 0% of the developed area requires stormwater treatment. The project must meet the following standards of Chapter 500:

Basic Standards: Erosion and Sedimentation Control Standards (Appendix A): These standards include the implementation of measures to prevent unreasonable erosion of soil or sediment beyond the project site or into a protected natural resource as define in 38 M.R.S. §480-B.

This standard will be met through the implementation of an Erosion & Sedimentation Control Plan specifically designed for the project. The plan includes limiting the amount of denuded area on the site, rapidly stabilizing disturbed areas and the implementation of a perimeter controls such as silt fence or erosion control mix berms at the downslope limits of disturbance. The plan was developed in accordance with Chapter 500 Appendix A and the *Maine Erosion and Sediment Control Best Management Practices (BMPs) Manual for Designers and Engineers*, dated October 2016.

The Erosion & Sedimentation Control Plan is presented on the following project drawings for convenient reference during construction.

C-4.0 Grading, Drainage & Erosion Control Plan
C-6.2 Erosion Control Notes & Details

Local:
In addition to the requirements of Chapter 500, the project must also meet the following standards of the City of Belfast Site Plan Review Criteria (Chapter 90 §90-42) and Environmental Standards (Chapter 102 §102-1124).

Soil Erosion and Sediment Control: Similar to the requirements of Chapter 500 (Appendix A), This standard requires developments to not cause unreasonable soil erosion or a reduction in the land's capacity to hold water so that a dangerous or unhealthy condition results.

This standard is met with the Erosion & Sedimentation Control Plan described above.

Control of Stormwater Runoff: This standard requires surface water to be minimized and detained on-site, if possible, in order to prevent flooding downstream. The city's technical standards (Chapter 98) require that peak discharge for the developed site shall not exceed that of the undeveloped site for the 2 and 25-year storm events. The Environmental Standards (§102-1124) also require that stormwater infrastructure is designed for the 50-year design storm.

This standard is met through temporary storage and controlled release of runoff on the project site in the proposed Underdrained Soil Filters and Rain Gardens. More information on the control of peak flows is provided below.

Re-Development Project

The proposed project includes the removal of existing packed gravel and paved surfaces previously utilized as part of the City of Belfast Public Works facility, and redeveloping the site with buildings, parking, landscaped areas, and stormwater management features. This redevelopment results in the removal of approximately 1.37 acres of existing impervious area. The requirements for treatment of a redevelopment project are scaled based on the pollutant

discharge that, if the stormwater was untreated, would result from the re-development project. Maine DEP Chapter 500 Section 4.C(2)(d) outlines the required treatment calculations to determine the level of treatment required. These calculations are provided in Exhibit 2, and result in a negative ranked impact change, which means 0% of the developed area must be treated per Table 3: Treatment Levels for Redevelopment Projects from Chapter 500. A redevelopment plan showing the impact ratings is provided in Exhibit 3.

Stormwater BMPs

Proposed stormwater BMPs were designed in accordance with the Maine Department of Environmental Protection Stormwater Best Management Practices Manual. Information on each BMP is provided below and calculations are included in Exhibit 4. The following stormwater treatment measures were implemented on the site to treat stormwater runoff from a 2" storm event:

Underdrained Soil Filter #1

Underdrained Soil Filter #1 (UDSF) will be constructed in order to temporarily store and treat runoff from a portion the proposed parking lot. UDSF #1 will be located west of Building D. Portions of the parking lot will drain to two catch basins that direct stormwater to a riprap sediment forebay for pretreatment. Runoff from smaller storm events will filter through a soil media before being collected in the underdrain system and discharge to the ground surface.

- Treatment area: 20,754 square feet
- Water Quality Volume = 1" x impervious area + 0.4" x landscaped area
- Filter Surface Area =1.5% tributary landscaped area + 3.8% tributary impervious area
- Spillway designed to pass the 50 year storm event
- UDSF #1 drains in 27 hours with 2.5" orifice at underdrain outlet

Underdrained Soil Filter #2

UDSF #2 will be constructed in order to temporarily store and treat runoff from a portion the proposed parking lot. UDSF #2 will be located north of Building A. Portions of the parking lot will drain overland to a riprap sediment forebay for pretreatment. Runoff from smaller storm events will filter through a soil media before being collected in the underdrain system and discharge to the ground surface.

- Treatment area: 19,072 square feet
- Water Quality Volume = 1" x impervious area + 0.4" x landscaped area
- Filter Surface Area =2% tributary landscaped area + 5% tributary impervious area
- Spillway designed to pass the 50 year storm event
- UDSF #2 drains in 25 hours with 2.5" orifice at underdrain outlet

Rain Garden #1

Rain garden #1 will be constructed on the eastern side of the central lawn adjacent to the natural play area in order to temporarily store and treat runoff from the proposed lawn and pathways in the central area of the site. Rain garden #1 does not have underdrain, nor is it designed for infiltration. It will act as a shallow detention basin that allows stormwater to pass slowly over a small berm to discharge.

Rain Garden #2

Rain garden #2 will be constructed in order to temporarily store and treat runoff from the proposed lawn and pathways in the central area of the site. Rain garden #2 will be located on the western side of the central lawn area adjacent to Building A. Rain garden #2 is designed with underdrain that will outlet to the wetland complex on the western side of the project site.

Stormwater Quantity Control

A hydrologic analysis of pre-development and post-development conditions was conducted based upon the methodology contained in the USDA Soil Conservation Service's Technical Releases No. 22 and 55 (SCS TR-20 and TR-55).

Two study points were selected as the points of analysis for this project. Study Point 1 is located on the eastern side of the site where stormwater enters the Congress Street stormwater network (ditches and CB). Study Point 2 is located in the wetlands on the western side of the site where stormwater leaves the property.. The entire 2-acre project site drains directly to this Study Point. The total area tributary to the Study Point is approximately 112 acres.

For Waldo County, Maine a 24-hour SCS Type III storm distribution was used for the analysis using the following storm frequencies and rainfall amounts, per Maine DEP Chapter 500:

Storm Event	**24-Hour Rainfall**
2–Year Storm	2.9 inches
25–Year Storm	5.2 inches
50–Year Storm	6.1 inches

Land use, cover, delineation of watershed subcatchments, hydraulic flow paths, and hydrologic soil group (HSG) types were obtained using the following data:

1. Belfast, Maine USGS 7.5 minute quadrangle map.
2. NRCS Medium Intensity Soils Survey.
3. Lidar topography with 2-foot contour intervals, made available by the State of Maine office of GIS.
4. Plan of Topographic Site Survey prepared by Paul H. Ruopp Jr., PLS Land Surveying and Mapping of Monmouth, ME.
5. Wetland delineation completed by Mark Hampton Associates, Inc. of Portland, ME.
6. Field reconnaissance by Terradyn Consultants.

Runoff curve numbers, time of concentration, and travel time data were established based on methods outlined in the USDA TR-55 manual.

Culverts were included in the models as ponds with culvert outlets.

A minimum time of concentration of 5 minutes, and a maximum sheet flow distance of 150 linear feet was used in the models.

Pre-Development Conditions

The pre-development HydroCAD model includes four (4) subcatchments draining to the two (2) Study Points.

A Pre-Development Watershed Map, showing sub-watershed boundaries, time of concentration flow paths, ponds, and reaches is provided in Exhibit 5. The Pre-development HydroCAD model is attached in Exhibit 6.

Existing condition peak rates of runoff at the Study Points are as follows:

Pre-Development Peak Rates of Runoff (cfs)			
	2-Year	**25-Year**	**50-Year**
SP1	3.7	7.3	8.7
SP2	5.7	11.7	14.1

The pre-development peak rates of runoff are a baseline used for comparison to the post-development condition.

Post-Development Conditions

The post-development condition includes the proposed development of the project site. Five post-development subcatchments on the project site were delineated in order to model the proposed improvements, including the underdrained soil filter and roof dripline filter. The off-site subcatchments remain unchanged from the pre-development model.

A Post-development Watershed Map showing sub-watershed boundaries, time of concentration flow paths, ponds, and reaches is provided in Exhibit 5. The Post-development HydroCAD model is attached in Exhibit 7.

Post-development peak rates of runoff at the Study Point are as follows:

Post-Development Peak Rates of Runoff (cfs)			
	2-Year	**25-Year**	**50-Year**
SP1	1.6	4.8	5.9
SP2	1.8	4.5	5.5

Stormwater Analysis

The results of the pre-development and post-development models were analyzed at the defined Study Points. The direct comparison of the pre-development and post-development conditions at the Study Points is as follows:

Peak Runoff Flow Rates Comparison		
Storm Event	**Pre-Development (cfs)**	**Post-Development (cfs)**
Study Point 1		
2-Year	3.7	1.6
25-Year	7.3	4.8
50-Year	11.7	5.9
Study Point 2		
2-Year	5.7	1.8
25-Year	11.7	4.5
50-Year	14.1	5.5

The peak rates of runoff are expected to decrease or remain the same for the three design storm events at the two study points.

Inspection & Maintenance Plan

Stormwater management and treatment measures require regular inspection and maintenance to maintain their effectiveness. The project Inspection & Maintenance Plan is included in Exhibit 8.

Conclusions

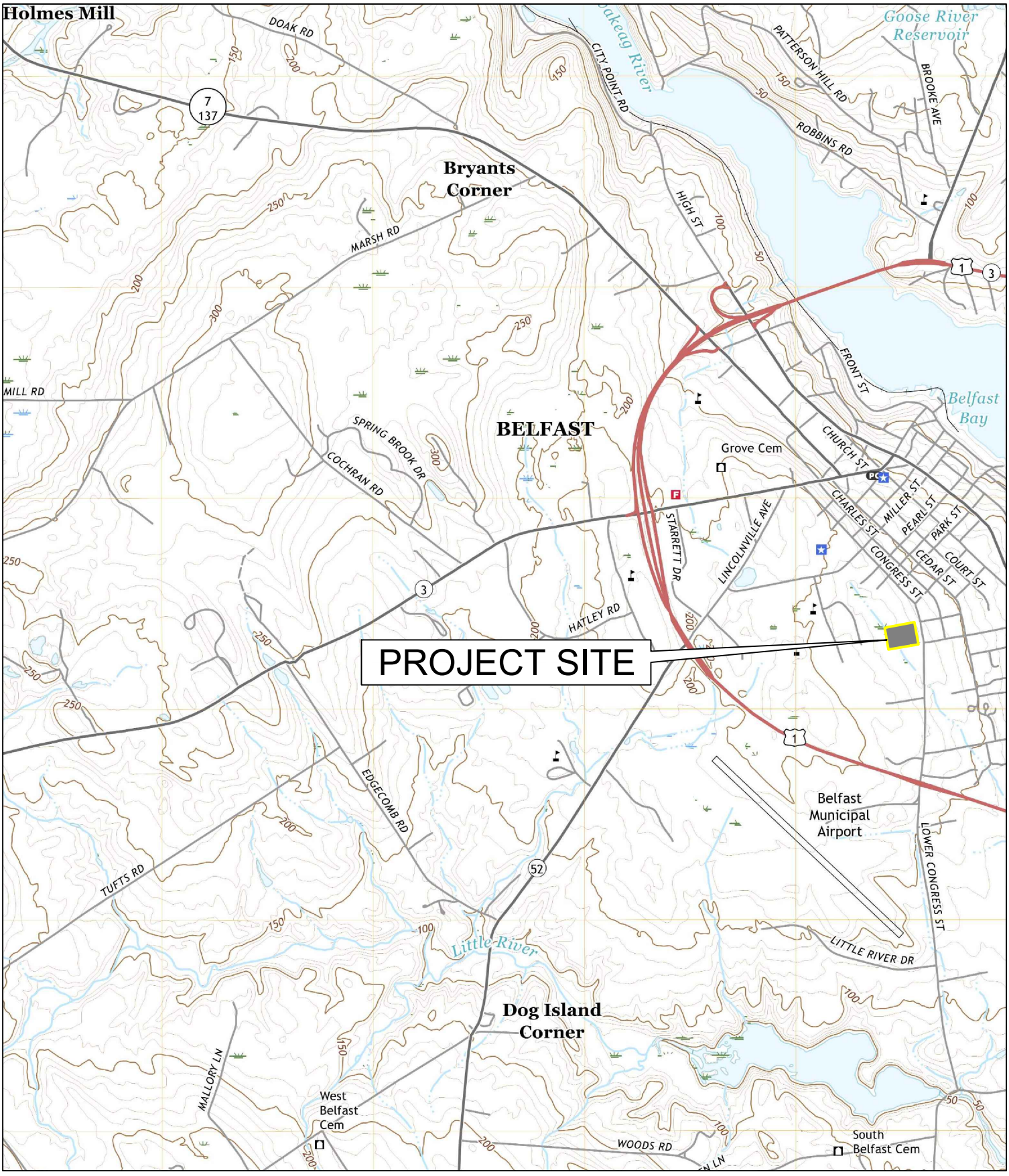
The proposed project will result in the reduction of 1.37 acres of impervious area through the redevelopment of the former Belfast Public Works site. Runoff patterns will remain similar to existing conditions. Redevelopment calculations indicate that no stormwater treatment is required for this project by DEP Chapter 500. However, stormwater BMPs will be constructed to provide water quality (below DEP standards) and quantity control in order to protect downstream properties and waterbodies from the effects of the redevelopment. The project meets the applicable Basic Standards of Chapter 500 and the City of Belfast requirements, and is expected to have no detrimental effect on downstream properties.

List of Exhibits

1 – Existing Conditions Figures
2 – Redevelopment Calculations
3 – Redevelopment Plan
4 – BMP Design Calculations
5 – Watershed Maps
6 – Pre-Development HydroCAD Model
7 – Post-Development HydroCAD Model
8 – Inspection & Maintenance Plan

Exhibit 1

Existing Conditions Figures



USGS MAP	TERRADYN CONSULTANTS, LLC	PROJECT NO. 2033	FIGURE 1
PROJECT: MULTI-FAMILY HOUSING 115 CONGRESS STREET, BELFAST, MAINE	PINELAND 41 CAMPUS DRIVE, SUITE 101 NEW GLOUCESTER, ME 04260	DATE 8/26/2020	N
PREPARED FOR: DEVELOPERS COLLABORATIVE 100 COMMERCIAL STREET, SUITE 414 PORTLAND, MAINE 04101	PORTLAND 565 CONGRESS STREET, SUITE 201 PORTLAND, ME 04101	SCALE 1"=2,000'	
	207.926.5111 • info@terradynconsultants.com • www.terradynconsultants.com		

AERIAL PHOTO

PROJECT:
MULTI-FAMILY HOUSING
115 CONGRESS STREET, BELFAST, MAINE

PREPARED FOR:
DEVELOPERS COLLABORATIVE
100 COMMERCIAL STREET, SUITE 414
PORTLAND, MAINE 04101

TERRADYN CONSULTANTS, LLC

PINELAND
41 CAMPUS DRIVE, SUITE 101
NEW GLOUCESTER, ME 04260

PORTLAND
565 CONGRESS STREET, SUITE 201
PORTLAND, ME 04101

207.926.5111 • info@terradynconsultants.com • www.terradynconsultants.com

PROJECT NO.
2033

DATE
8/26/2020

SCALE
1"=100'

FIGURE 2

N

SOILS LEGEND	
SYMBOL	NAME
PaB	PERU FINE SANDY LOAM
BtB	BRAYTON FINE SANDY LOAM
BvB	BRAYTON FINE SANDY LOAM

MEDIUM INTENSITY SOIL SURVEY

PROJECT:
MULTI-FAMILY HOUSING
115 CONGRESS STREET, BELFAST, MAINE

PREPARED FOR:
DEVELOPERS COLLABORATIVE
100 COMMERCIAL STREET, SUITE 414
PORTLAND, MAINE 04101

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PORTLAND
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PORTLAND, ME 04101

207.926.5111 • info@terradynconsultants.com • www.terradynconsultants.com

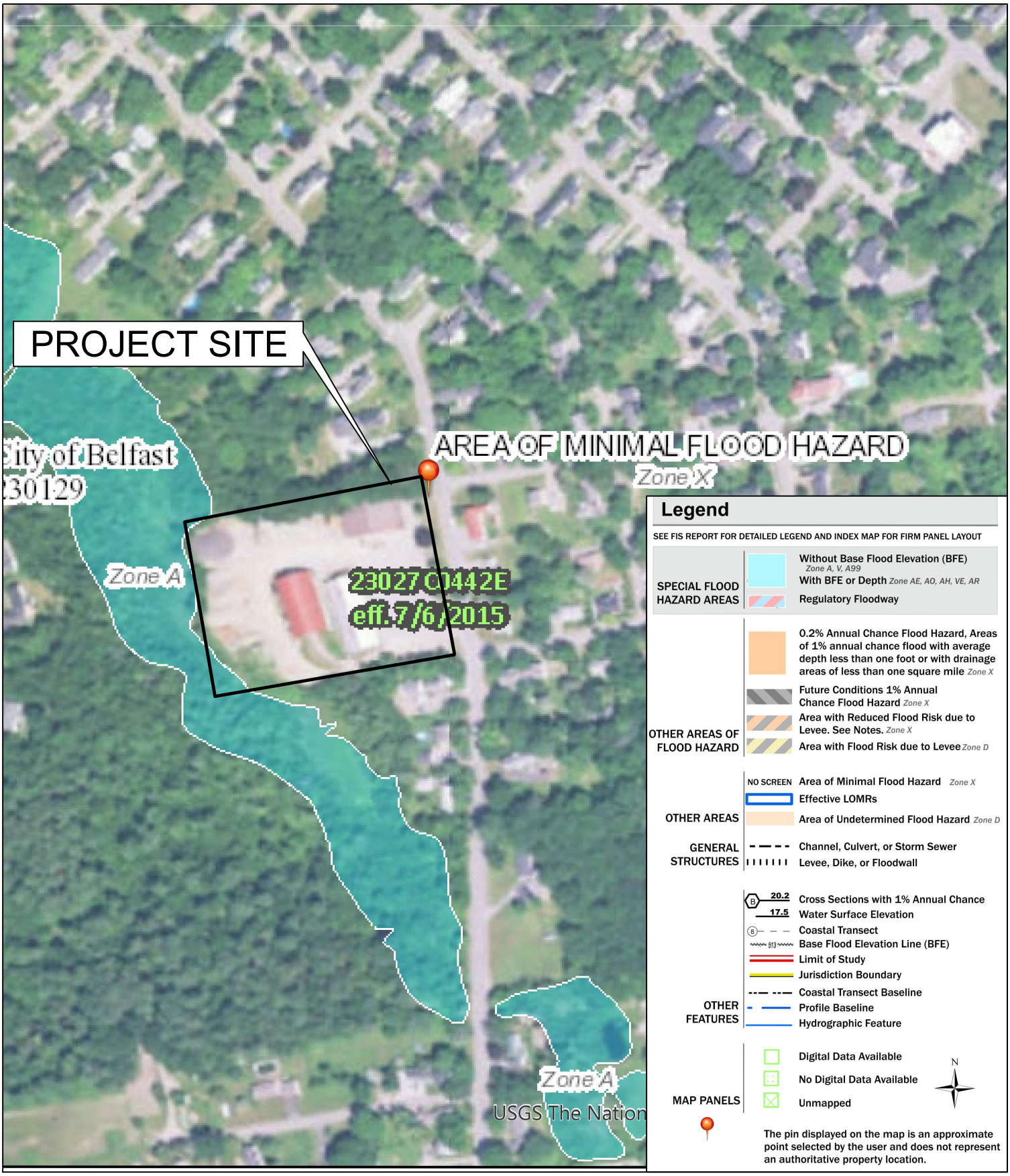
PROJECT NO.
2033

DATE
12/30/2020

SCALE
1"=100'

FIGURE 3

N



FLOOD INSURANCE RATE MAP

PROJECT:
MULTI-FAMILY HOUSING
115 CONGRESS STREET, BELFAST, MAINE

PREPARED FOR:
DEVELOPERS COLLABORATIVE
100 COMMERCIAL STREET, SUITE 414
PORTLAND, MAINE 04101

TERRADYN CONSULTANTS, LLC

PINELAND
41 CAMPUS DRIVE, SUITE 101
NEW GLOUCESTER, ME 04260

PORTLAND
565 CONGRESS STREET, SUITE 201
PORTLAND, ME 04101

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PROJECT NO.
2033

DATE
12/30/2020

SCALE
1"=250'

FIGURE 4

N

Exhibit 2

Redevelopment Calculations

Redevelopment Treatment Calculations
Per Chapter 500 Section 4.C(2)(d)

		EXISTING CONDITION			PROPOSED CONDITION		
Land Use	**Pollutant Ranking**	**Existing Area (s.f.)**	**Existing Area (acre)**	**Existing Impact Rating**	**Proposed Area (s.f.)**	**Proposed Area (acre)**	**Proposed Impact Rating**
Roads where idling may occur; High Use Parking Lots	5	-	-	-		-	-
Other Roads; Medium Use Parking Lots	4		-	-	28,421	0.7	2.6
Other Parking Lots & Driveways; Flat Asphalt Rooftops; Roofs on an industrial facility	3	125,559	2.9	8.6	-	-	-
Other Rooftops; Bikeways; Grassed areas mowed more than twice per year; Walkways/foot traffic only pavement	2	15,158	0.3	0.7	87,049	2.0	4.0
Non-Grass Landscaped Areas; Stormwater treatment/storage systems (except buffers)	1	-	-	-	4,843	0.1	0.1
Forest; Meadow mowed no more than twice per year	0	43,085	1.0	-	63,489	1.5	-
Total Impact Rating (TIR):	-			9.3			6.7
Ranked Impact (TIR/TRA)				2.21			1.59

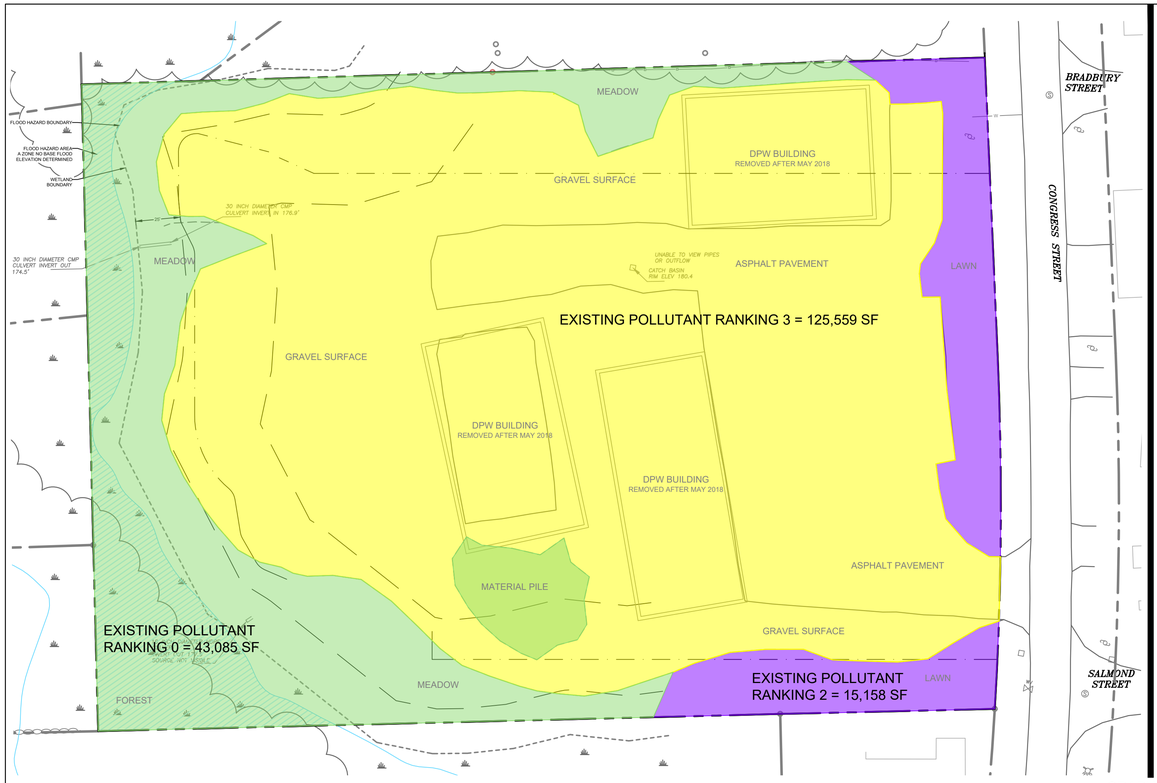
	s.f.	acres
Total Redevelopment Area (TRA):	183,802	4.22

Ranked Impact Change Due to Redevelopment:	(0.62)	< 0.0

Percentage of Developed Area that Must Be Treated (From Chapter 500, Table 3)	0%

Exhibit 3

Redevelopment Plan

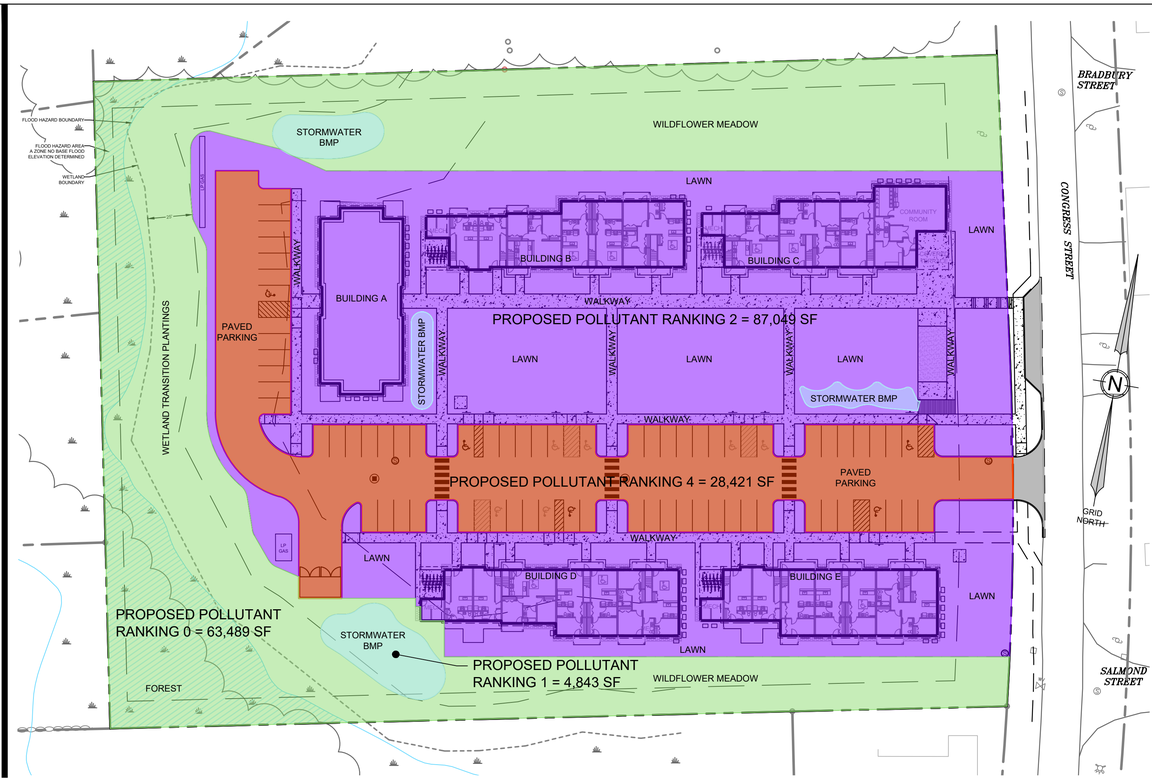


EXISTING CONDITIONS WITH EXISTING POLLUTANT RANKINGS

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch =40 ft.



PROPOSED CONDITIONS WITH PROPOSED POLLUTANT RANKINGS

LEGEND

POLLUTANT RANKING 0:		FOREST; MEADOW MOWED NO MORE THAN TWICE PER YEAR
POLLUTANT RANKING 1		NON-GRASS LANDSCAPED AREAS; STORMWATER TREATMENT/STORAGE SYSTEMS
POLLUTANT RANKING 2		OTHER ROOFTOPS; BIKEWAYS; GRASSED AREAS MOWED MORE THAN TWICE PER YEAR; WALKWAYS/FOOT TRAFFIC ONLY PAVEMENT
POLLUTANT RANKING 3		OTHER PARKING LOTS & DRIVEWAYS; FLAT ASPHALT ROOFTOPS; ROOFS ON AN INDUSTRIAL FACILITY
POLLUTANT RANKING 4		OTHER ROADS; MEDIUM USE PARKING LOTS

NOTES

1. THE DPW BUILDINGS SHOWN ON THE EXISTING CONDITIONS PLAN WERE REMOVED FROM THE SITE BETWEEN MAY 2018 AND MAY 2020.
2. EXISTING GRAVEL AND PAVED PARKING AREAS ARE CLASSIFIED AS "OTHER PARKING LOTS" BECAUSE THEY ARE CURRENTLY USED INFREQUENTLY.
3. PROPOSED PARKING IS CLASSIFIED AS "MEDIUM USE PARKING LOTS" BECAUSE IT IS A RESIDENTIAL DRIVEWAY AND PARKING TO BE USED BY RESIDENTS OF THE PROPOSED PROJECT AND THEIR VISITORS.
4. THE WILDFLOWER MEADOW IN THE PROPOSED CONDITIONS IS PART OF A RE-VEGETATION EFFORT ON THE SITE AND WILL BE MOWED LESS THAN 2 TIMES PER YEAR. ADDITIONALLY, WETLAND TRANSITION PLANTINGS ARE PROPOSED ALONG THE SLOPE FROM THE PARKING LOT DOWN TO THE WETLANDS ON THE WESTERN SIDE OF THE SITE.

TERRADYN CONSULTANTS, LLC

115 Congress Street Housing
115 Congress Street, Belfast, Maine

Redevelopment Treatment Calculations
Per Chapter 500 Section 4.C(2)(d)

		EXISTING CONDITION			PROPOSED CONDITION		
Land Use	**Pollutant Ranking**	**Existing Area (s.f.)**	**Existing Area (acre)**	**Existing Impact Rating**	**Proposed Area (s.f.)**	**Proposed Area (acre)**	**Proposed Impact Rating**
Roads where idling may occur; High Use Parking Lots	5	-	-	-		-	-
Other Roads; Medium Use Parking Lots	4		-	-	28,421	0.7	2.6
Other Parking Lots & Driveways; Flat Asphalt Rooftops; Roofs on an industrial facility	3	125,559	2.9	8.6	-	-	-
Other Rooftops; Bikeways; Grassed areas mowed more than twice per year; Walkways/foot traffic only pavement	2	15,158	0.3	0.7	87,049	2.0	4.0
Non-Grass Landscaped Areas; Stormwater treatment/storage systems (except buffers)	1	-	-	-	4,843	0.1	0.1
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Total Impact Rating (TIR):	-			9.3			6.7
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	s.f.	acres
Total Redevelopment Area (TRA):	183,802	4.22

Ranked Impact Change Due to Redevelopment:	(0.62)	< 0.0

Percentage of Developed Area that Must Be Treated (From Chapter 500, Table 3)	0%

STATE OF MAINE
ADRIENNE R. FINE
No. 14252
REGISTERED PROFESSIONAL ENGINEER

DATE: 01.08.21
P.E. ADRIENNE R. FINE

NO.	DATE	REVISIONS	APP'D BY
1	01.12.21	REVISED RE-DEVELOPMENT CALCULATIONS AND RESUBMITTED TO DEP	ARF

565 CONGRESS STREET
SUITE 301
PORTLAND, ME 04102

41 CAMPUS DRIVE
SUITE 101
NEW GLOUCESTER, ME 04260

OFFICE: (207) 926-5111 FAX: (207) 221-1317
www.terradynconsultants.com

TERRADYN CONSULTANTS, LLC

Civil Engineering | Land Planning | Stormwater Design | Environmental Permitting

PERMIT DRAWING
NOT FOR CONSTRUCTION

PROJECT: BELFAST HOUSING
115 CONGRESS STREET, BELFAST, MAINE

SHEET TITLE: RE-DEVELOPMENT PLAN

CLIENT: DEVELOPERS COLLABORATIVE
100 COMMERCIAL STREET, SUITE 414
PORTLAND, MAINE 04101

DATE:	12/2/2020
SCALE:	1"=40'
DESIGNED:	ARF
JOB NO:	2033
FILE:	2033-SW.DWG

SHEET WS-3

Exhibit 4

BMP Design Calculations

UDSF #: 1

Total Tributary Area:	20,754	SF	
Total Impervious Area:	15,614	SF	
Total Lawn Area:	5,140	SF	
Required Treatment Volume:	1,473	CF	1" x Imp. Area + 0.4" x LS Area
Miminum Filter Area:	884	SF	5% Imp. Area + 2% LS Area
Treatment deisnged to	97%	of DEP standards	

STAGE STORAGE

ELEVATION	AREA (SF)	INCREMENTAL VOLUME (CF)	TOTAL VOLUME (CF)	
177	670	0	0	<-- Surface of Filter
178	1,044	857	857	
178.5	1,253	574	**1431**	
179				<-- Outlet Elevation

Sediment Pretreatment

Sediment Load:	50	cf/acre of sanded area/year
Area to be sanded:	0.32	acres
Sediment Volume:	15.92	CF
Provided Volume:	25.50	CF

ELEVATION	AREA (SF)	INCREMENTAL VOLUME (CF)	TOTAL VOLUME (CF)
178	3	0	0
179	48	26	26

UDSF #: 2

Total Tributary Area:	19,072	SF	
Total Impervious Area:	10,477	SF	
Total Lawn Area:	8,595	SF	
Required Treatment Volume:	1,160	CF	1" x Imp. Area + 0.4" x LS Area
Miminum Filter Area:	696	SF	5% Imp. Area + 2% LS Area

STAGE STORAGE

ELEVATION	AREA (SF)	INCREMENTAL VOLUME (CF)	TOTAL VOLUME (CF)	
179.5	711	0	0	<-- Surface of Filter
180	901	403	403	
181	1,323	1112	**1515**	<-- Outlet Elevation

Sediment Pretreatment

Sediment Load: 50 cf/acre of sanded area/year
Area to be sanded: 0.32 acres
Sediment Volume: 15.92 CF
Provided Volume: 37.50 CF

ELEVATION	AREA (SF)	INCREMENTAL VOLUME (CF)	TOTAL VOLUME (CF)
181	25	0	0
181.5	125	38	38

Rain Garden #1

Total Tributary Area:	16,390	SF	
Total Impervious Area:	3,897	SF	
Total Lawn Area:	12,493	SF	
Required Treatment Volume:	741	CF	1" x Imp. Area + 0.4" x LS Area
Miminum Filter Area:	445	SF	5% Imp. Area + 2% LS Area

STAGE STORAGE

ELEVATION	AREA (SF)	INCREMENTAL VOLUME (CF)	TOTAL VOLUME (CF)	
178.5	465	0	0	<-- Surface of Filter
179	465	233	233	
180	875	670	**903**	<-- Outlet Elevation

Rain Garden #2

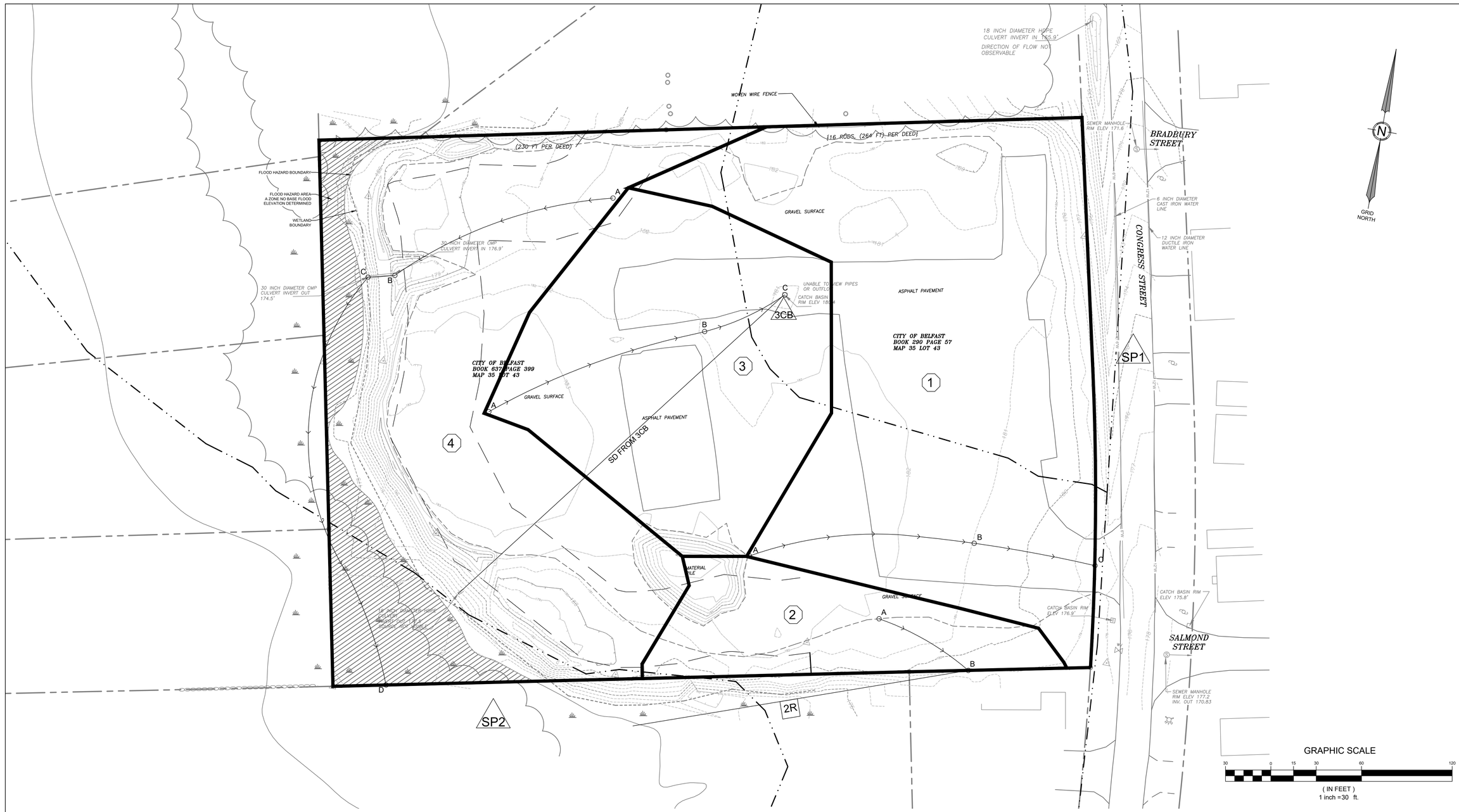
Total Tributary Area:	8,233	SF	
Total Impervious Area:	3,414	SF	
Total Lawn Area:	4,819	SF	
Required Treatment Volume:	445	CF	1" x Imp. Area + 0.4" x LS Area
Miminum Filter Area:	267	SF	5% Imp. Area + 2% LS Area

STAGE STORAGE

ELEVATION	AREA (SF)	INCREMENTAL VOLUME (CF)	TOTAL VOLUME (CF)	
181.8	286	0	0	<-- Surface of Filter
182.3	286	143	143	
183	627	320	**463**	<-- Outlet Elevation

Exhibit 5

Watershed Maps



WATERSHED LEGEND

PREDEVELOPMENT

- WATERSHED BOUNDARY
- Tc FLOWPATH
- SOILS BOUNDARY
- 5 — SUBCATCHMENT
- 3 — POND
- 1 — REACH

PRE-DEVELOPMENT WATERSHEDS			
WATERSHED	AREA (SF)	CN	TC
1	65,437	93	5.0
2	14,683	87	5.7
3	37,589	98	5.0
4	66,093	88	6.0

STATE OF MAINE
ADRIENNE R. FINE
No. 14252
REGISTERED PROFESSIONAL ENGINEER

DATE: 01.19.21

P.E. ADRIENNE R. FINE

NO.	DATE	REVISIONS	APP'D BY

TERRADYN CONSULTANTS, LLC
41 CAMPUS DRIVE, SUITE 101, NEW GLOUCESTER, ME 04260
OFFICE: (207) 926-5111
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565 CONGRESS STREET, SUITE 410, PORTLAND, ME 04102
FAX: (207) 221-1317
Civil Engineering | Land Planning | Stormwater Design | Environmental Permitting

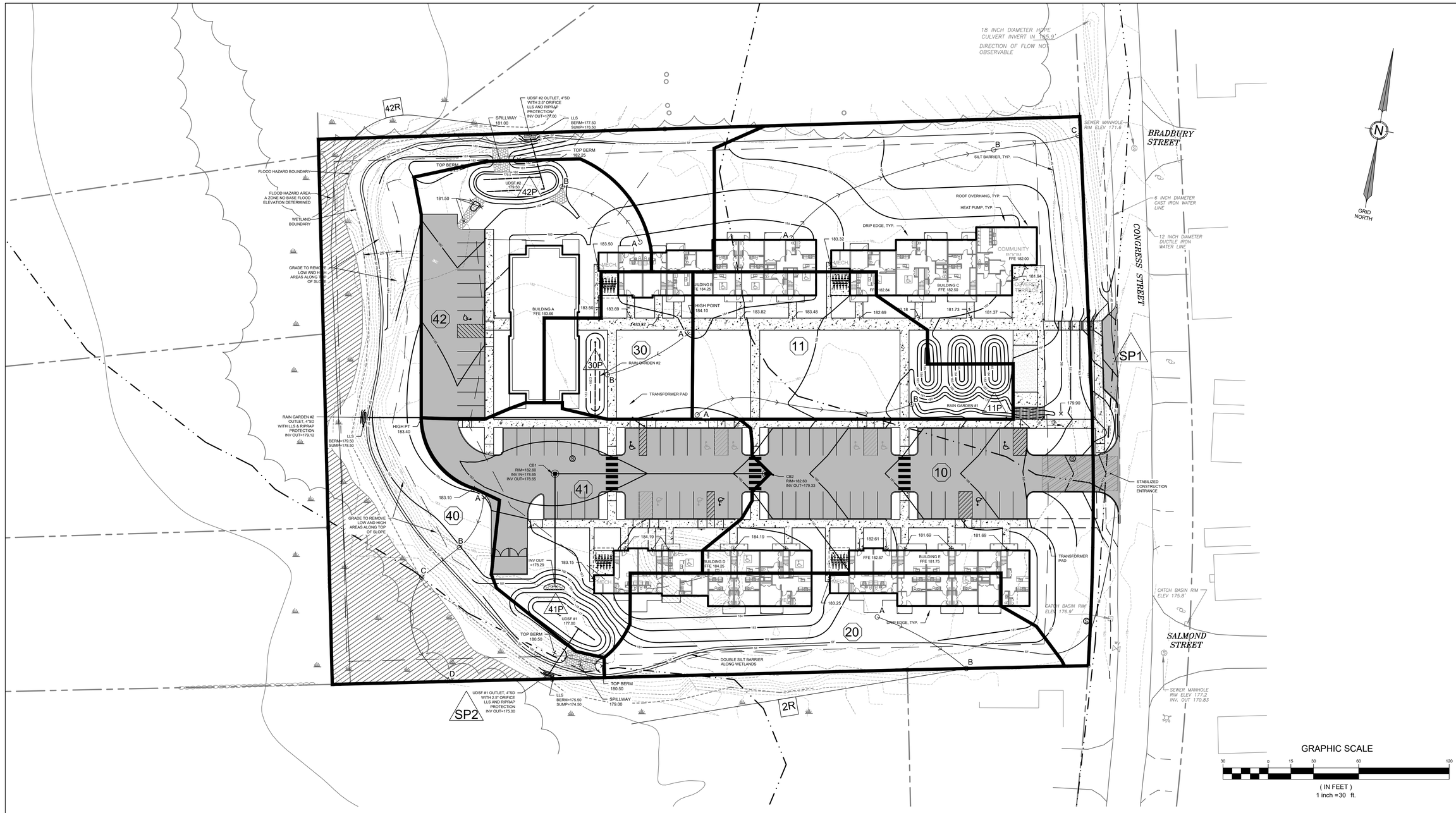
PERMIT DRAWING
NOT FOR CONSTRUCTION

PROJECT: BELFAST HOUSING
115 CONGRESS STREET, BELFAST, MAINE

SHEET TITLE: PRE-DEVELOPMENT WATERSHED MAP

CLIENT: DEVELOPERS COLLABORATIVE
100 COMMERCIAL STREET, SUITE 414
PORTLAND, MAINE 04101

DATE:	12/2/2020
SCALE:	1"=30'
DESIGNED:	ARF
JOB NO:	2033
FILE: 2033-SW.DWG	
SHEET	WS-1



WATERSHED LEGEND

POSTDEVELOPMENT

- WATERSHED BOUNDARY
- Tc FLOWPATH
- SOILS BOUNDARY
- 5 — SUBCATCHMENT
- 3 — POND
- 1 — REACH

PRE-DEVELOPMENT WATERSHEDS			
WATERSHED	AREA (SF)	CN	TC
10	59,959	84	19.1
11	16,390	84	19.6
20	17,600	85	5.7
30	8,233	87	10.0
40	40,155	77	7.2
41	22,407	93	5.0
42	19,072	90	8.7

Peak Runoff Flow Rates Comparison		
Storm Event	Pre-Development (cfs)	Post-Development (cfs)
Study Point 1		
2-Year	3.7	1.6
25-Year	7.3	4.8
50-Year	11.7	5.9
Study Point 2		
2-Year	5.7	1.8
25-Year	11.7	4.5
50-Year	14.1	5.5

STATE OF MAINE
ADRIENNE R. FINE
No. 14252
REGISTERED PROFESSIONAL ENGINEER

DATE: 01.19.21
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TERRADYN CONSULTANTS, LLC
Civil Engineering | Land Planning | Stormwater Design | Environmental Permitting

PERMIT DRAWING
NOT FOR CONSTRUCTION

PROJECT:
BELFAST HOUSING
115 CONGRESS STREET, BELFAST, MAINE

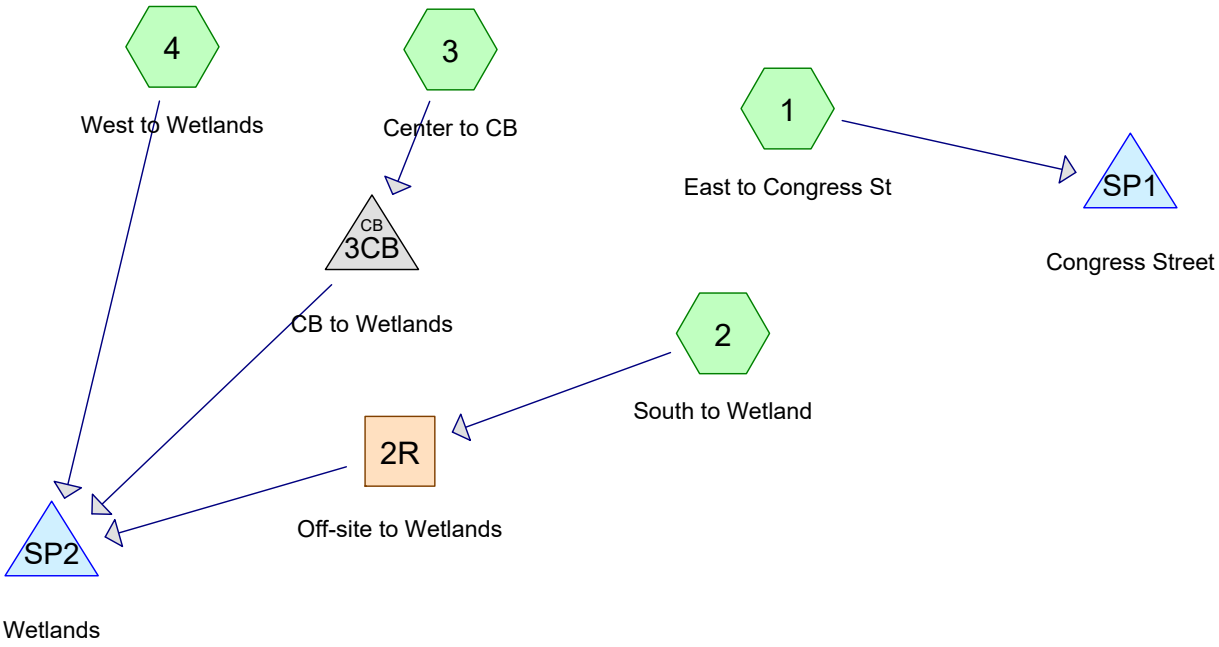
SHEET TITLE:
POST-DEVELOPMENT WATERSHED MAP

CLIENT:
DEVELOPERS COLLABORATIVE
100 COMMERCIAL STREET, SUITE 414
PORTLAND, MAINE 04101

DATE:	12/2/2020
SCALE:	1"=30'
DESIGNED:	ARF
JOB NO:	2033
FILE:	2033-SW.DWG
SHEET	WS-2

Exhibit 6

Pre-Development HydroCAD Model



Subcat Reach Pond Link

Routing Diagram for 2033-PRE

Prepared by {enter your company name here}, Printed 1/19/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.514	84	50-75% Grass cover, Fair, HSG D (4)
0.234	74	>75% Grass cover, Good, HSG C (1)
0.114	80	>75% Grass cover, Good, HSG D (2)
0.082	77	Brush, Fair, HSG D (2)
0.301	73	Brush, Good, HSG D (4)
0.075	72	Woods/grass comb., Good, HSG C (1)
0.863	98	gravel & paved (3)
0.141	98	gravel & pavement (2)
0.702	98	impervious (4)
1.194	98	paved & gravel (1)
4.220	**92**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: East to Congress St Runoff Area=65,437 sf 79.46% Impervious Runoff Depth=2.16"
Flow Length=232' Tc=5.0 min CN=93 Runoff=3.72 cfs 0.270 af

Subcatchment 2: South to Wetland Runoff Area=14,683 sf 41.79% Impervious Runoff Depth=1.65"
Flow Length=70' Slope=0.0400 '/' Tc=5.7 min CN=87 Runoff=0.64 cfs 0.046 af

Subcatchment 3: Center to CB Runoff Area=37,589 sf 100.00% Impervious Runoff Depth=2.67"
Flow Length=211' Tc=5.0 min CN=98 Runoff=2.44 cfs 0.192 af

Subcatchment 4: West to Wetlands Runoff Area=66,093 sf 46.29% Impervious Runoff Depth=1.73"
Flow Length=457' Tc=6.0 min CN=88 Runoff=3.01 cfs 0.219 af

Reach 2R: Off-site to Wetlands Avg. Flow Depth=0.04' Max Vel=0.72 fps Inflow=0.64 cfs 0.046 af
n=0.035 L=225.0' S=0.0222 '/' Capacity=142.44 cfs Outflow=0.55 cfs 0.046 af

Pond 3CB: CB to Wetlands Peak Elev=179.76' Inflow=2.44 cfs 0.192 af
18.0" Round Culvert n=0.013 L=290.0' S=0.0050 '/' Outflow=2.44 cfs 0.192 af

Pond SP1: Congress Street Inflow=3.72 cfs 0.270 af
Primary=3.72 cfs 0.270 af

Pond SP2: Wetlands Inflow=5.66 cfs 0.457 af
Primary=5.66 cfs 0.457 af

Total Runoff Area = 4.220 ac Runoff Volume = 0.727 af Average Runoff Depth = 2.07"
31.27% Pervious = 1.320 ac 68.73% Impervious = 2.900 ac

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: East to Congress St Runoff Area=65,437 sf 79.46% Impervious Runoff Depth=4.39"
Flow Length=232' Tc=5.0 min CN=93 Runoff=7.30 cfs 0.550 af

Subcatchment 2: South to Wetland Runoff Area=14,683 sf 41.79% Impervious Runoff Depth=3.76"
Flow Length=70' Slope=0.0400 '/' Tc=5.7 min CN=87 Runoff=1.43 cfs 0.106 af

Subcatchment 3: Center to CB Runoff Area=37,589 sf 100.00% Impervious Runoff Depth=4.96"
Flow Length=211' Tc=5.0 min CN=98 Runoff=4.42 cfs 0.357 af

Subcatchment 4: West to Wetlands Runoff Area=66,093 sf 46.29% Impervious Runoff Depth=3.86"
Flow Length=457' Tc=6.0 min CN=88 Runoff=6.54 cfs 0.488 af

Reach 2R: Off-site to Wetlands Avg. Flow Depth=0.06' Max Vel=1.00 fps Inflow=1.43 cfs 0.106 af
n=0.035 L=225.0' S=0.0222 '/' Capacity=142.44 cfs Outflow=1.28 cfs 0.106 af

Pond 3CB: CB to Wetlands Peak Elev=180.11' Inflow=4.42 cfs 0.357 af
18.0" Round Culvert n=0.013 L=290.0' S=0.0050 '/' Outflow=4.42 cfs 0.357 af

Pond SP1: Congress Street Inflow=7.30 cfs 0.550 af
Primary=7.30 cfs 0.550 af

Pond SP2: Wetlands Inflow=11.71 cfs 0.950 af
Primary=11.71 cfs 0.950 af

Total Runoff Area = 4.220 ac Runoff Volume = 1.500 af Average Runoff Depth = 4.27"
31.27% Pervious = 1.320 ac 68.73% Impervious = 2.900 ac

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: East to Congress St Runoff Area=65,437 sf 79.46% Impervious Runoff Depth=5.28"
Flow Length=232' Tc=5.0 min CN=93 Runoff=8.68 cfs 0.661 af

Subcatchment 2: South to Wetland Runoff Area=14,683 sf 41.79% Impervious Runoff Depth=4.61"
Flow Length=70' Slope=0.0400 '/' Tc=5.7 min CN=87 Runoff=1.74 cfs 0.130 af

Subcatchment 3: Center to CB Runoff Area=37,589 sf 100.00% Impervious Runoff Depth=5.86"
Flow Length=211' Tc=5.0 min CN=98 Runoff=5.19 cfs 0.422 af

Subcatchment 4: West to Wetlands Runoff Area=66,093 sf 46.29% Impervious Runoff Depth=4.72"
Flow Length=457' Tc=6.0 min CN=88 Runoff=7.92 cfs 0.597 af

Reach 2R: Off-site to Wetlands Avg. Flow Depth=0.07' Max Vel=1.08 fps Inflow=1.74 cfs 0.130 af
n=0.035 L=225.0' S=0.0222 '/' Capacity=142.44 cfs Outflow=1.58 cfs 0.130 af

Pond 3CB: CB to Wetlands Peak Elev=180.24' Inflow=5.19 cfs 0.422 af
18.0" Round Culvert n=0.013 L=290.0' S=0.0050 '/' Outflow=5.19 cfs 0.422 af

Pond SP1: Congress Street Inflow=8.68 cfs 0.661 af
Primary=8.68 cfs 0.661 af

Pond SP2: Wetlands Inflow=14.09 cfs 1.148 af
Primary=14.09 cfs 1.148 af

Total Runoff Area = 4.220 ac Runoff Volume = 1.809 af Average Runoff Depth = 5.15"
31.27% Pervious = 1.320 ac 68.73% Impervious = 2.900 ac

Summary for Subcatchment 1: East to Congress St

[49] Hint: Tc<2dt may require smaller dt

Runoff = 7.30 cfs @ 12.07 hrs, Volume= 0.550 af, Depth= 4.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
*	51,998	98	paved & gravel
	3,250	72	Woods/grass comb., Good, HSG C
	10,189	74	>75% Grass cover, Good, HSG C
	65,437	93	Weighted Average
	13,439		20.54% Pervious Area
	51,998		79.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	150	0.0130	1.24		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
0.4	82	0.0300	3.52		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.6					**Direct Entry, MIN 5**
5.0	232	Total			

Summary for Subcatchment 2: South to Wetland

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.43 cfs @ 12.09 hrs, Volume= 0.106 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
	4,969	80	>75% Grass cover, Good, HSG D
*	6,136	98	gravel & pavement
	3,578	77	Brush, Fair, HSG D
	14,683	87	Weighted Average
	8,547		58.21% Pervious Area
	6,136		41.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	70	0.0400	0.21		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"

Summary for Subcatchment 3: Center to CB

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.42 cfs @ 12.07 hrs, Volume= 0.357 af, Depth= 4.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
*	37,589	98	gravel & paved
	37,589		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	150	0.0100	1.11		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
0.5	61	0.0180	2.16		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
2.3					**Direct Entry, MIN 5**
5.0	211	Total			

Summary for Subcatchment 4: West to Wetlands

Runoff = 6.54 cfs @ 12.09 hrs, Volume= 0.488 af, Depth= 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
*	30,595	98	impervious
	13,091	73	Brush, Good, HSG D
	22,407	84	50-75% Grass cover, Fair, HSG D
	66,093	88	Weighted Average
	35,498		53.71% Pervious Area
	30,595		46.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	150	0.0266	1.65		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
0.0	18	0.1330	15.85	77.78	**Pipe Channel, B-C** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.025 Corrugated metal
4.5	289	0.0050	1.06		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
6.0	457	Total			

Summary for Reach 2R: Off-site to Wetlands

Inflow Area = 0.337 ac, 41.79% Impervious, Inflow Depth = 3.76" for 25-YR event
Inflow = 1.43 cfs @ 12.09 hrs, Volume= 0.106 af
Outflow = 1.28 cfs @ 12.19 hrs, Volume= 0.106 af, Atten= 11%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.00 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.33 fps, Avg. Travel Time= 11.5 min

Peak Storage= 295 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.06' , Surface Width= 20.77'
Bank-Full Depth= 1.00' Flow Area= 26.0 sf, Capacity= 142.44 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 10.0 2.0 '/' Top Width= 32.00'
Length= 225.0' Slope= 0.0222 '/'
Inlet Invert= 178.00', Outlet Invert= 173.00'

‡

Summary for Pond 3CB: CB to Wetlands

Inflow Area = 0.863 ac,100.00% Impervious, Inflow Depth = 4.96" for 25-YR event
Inflow = 4.42 cfs @ 12.07 hrs, Volume= 0.357 af
Outflow = 4.42 cfs @ 12.07 hrs, Volume= 0.357 af, Atten= 0%, Lag= 0.0 min
Primary = 4.42 cfs @ 12.07 hrs, Volume= 0.357 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 180.11' @ 12.07 hrs
Flood Elev= 180.40'

Device	Routing	Invert	Outlet Devices
#1	Primary	178.95'	**18.0" Round Culvert** L= 290.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 178.95' / 177.50' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=4.26 cfs @ 12.07 hrs HW=180.08' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 4.26 cfs @ 4.14 fps)

Summary for Pond SP1: Congress Street

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.502 ac, 79.46% Impervious, Inflow Depth = 4.39" for 25-YR event
Inflow = 7.30 cfs @ 12.07 hrs, Volume= 0.550 af
Primary = 7.30 cfs @ 12.07 hrs, Volume= 0.550 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Pond SP2: Wetlands

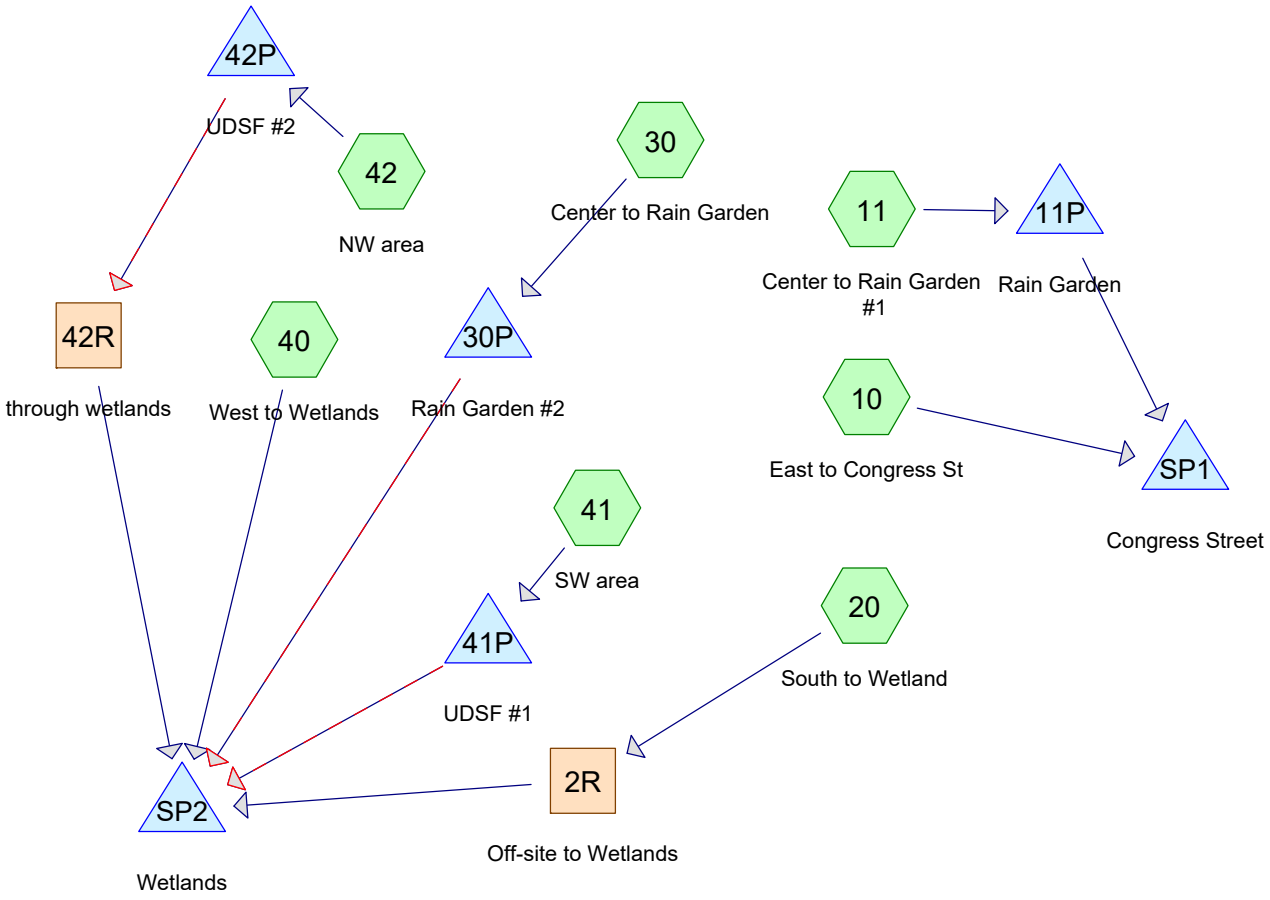
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.717 ac, 62.79% Impervious, Inflow Depth = 4.20" for 25-YR event
Inflow = 11.71 cfs @ 12.09 hrs, Volume= 0.950 af
Primary = 11.71 cfs @ 12.09 hrs, Volume= 0.950 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Exhibit 7

Post-Development HydroCAD Model



Subcat Reach Pond Link

Routing Diagram for 2033-POST

Prepared by {enter your company name here}, Printed 1/19/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.757	74	>75% Grass cover, Good, HSG C (10)
1.369	80	>75% Grass cover, Good, HSG D (11, 20, 30, 40, 41, 42)
0.037	77	Brush, Fair, HSG D (20)
0.038	83	Brush, Poor, HSG D (41)
0.241	98	Paved parking, HSG D (42)
0.038	72	Woods/grass comb., Good, HSG C (10)
0.119	98	gravel & pavement (20)
0.017	98	impervious (40)
1.108	98	paved & roof (10, 11, 30, 41)
0.496	73	wetlands & undeveloped (40)
4.220	**84**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: East to Congress St Runoff Area=59,959 sf 42.24% Impervious Runoff Depth=1.43"
Flow Length=208' Tc=19.1 min CN=84 Runoff=1.58 cfs 0.165 af

Subcatchment 11: Center to Rain Garden Runoff Area=16,390 sf 23.78% Impervious Runoff Depth=1.43"
Flow Length=146' Slope=0.0200 '/' Tc=19.6 min CN=84 Runoff=0.43 cfs 0.045 af

Subcatchment 20: South to Wetland Runoff Area=17,600 sf 29.48% Impervious Runoff Depth=1.50"
Flow Length=70' Slope=0.0400 '/' Tc=5.7 min CN=85 Runoff=0.70 cfs 0.051 af

Subcatchment 30: Center to Rain Garden Runoff Area=8,233 sf 41.47% Impervious Runoff Depth=1.65"
Flow Length=62' Slope=0.0160 '/' Tc=10.0 min CN=87 Runoff=0.32 cfs 0.026 af

Subcatchment 40: West to Wetlands Runoff Area=40,155 sf 1.87% Impervious Runoff Depth=1.00"
Flow Length=151' Tc=7.2 min CN=77 Runoff=0.98 cfs 0.077 af

Subcatchment 41: SW area Runoff Area=22,407 sf 69.68% Impervious Runoff Depth=2.16"
Tc=5.0 min CN=93 Runoff=1.28 cfs 0.093 af

Subcatchment 42: NW area Runoff Area=19,072 sf 54.93% Impervious Runoff Depth=1.89"
Flow Length=75' Slope=0.0400 '/' Tc=8.7 min CN=90 Runoff=0.87 cfs 0.069 af

Reach 2R: Off-site to Wetlands Avg. Flow Depth=0.04' Max Vel=0.74 fps Inflow=0.70 cfs 0.051 af
n=0.035 L=225.0' S=0.0222 '/' Capacity=142.44 cfs Outflow=0.60 cfs 0.051 af

Reach 42R: through wetlands Avg. Flow Depth=0.03' Max Vel=0.35 fps Inflow=0.11 cfs 0.069 af
n=0.035 L=470.0' S=0.0085 '/' Capacity=97.88 cfs Outflow=0.11 cfs 0.069 af

Pond 11P: Rain Garden Peak Elev=179.98' Storage=888 cf Inflow=0.43 cfs 0.045 af
Outflow=0.20 cfs 0.026 af

Pond 30P: Rain Garden #2 Peak Elev=182.02' Storage=62 cf Inflow=0.32 cfs 0.026 af
Primary=0.21 cfs 0.026 af Secondary=0.00 cfs 0.000 af Outflow=0.21 cfs 0.026 af

Pond 41P: UDSF #1 Peak Elev=178.12' Storage=1,609 cf Inflow=1.28 cfs 0.093 af
Primary=0.11 cfs 0.093 af Secondary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.093 af

Pond 42P: UDSF #2 Peak Elev=180.36' Storage=1,085 cf Inflow=0.87 cfs 0.069 af
Primary=0.11 cfs 0.069 af Secondary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.069 af

Pond SP1: Congress Street Inflow=1.58 cfs 0.190 af
Primary=1.58 cfs 0.190 af

Pond SP2: Wetlands Inflow=1.76 cfs 0.315 af
Primary=1.76 cfs 0.315 af

Total Runoff Area = 4.220 ac Runoff Volume = 0.525 af Average Runoff Depth = 1.49"
64.82% Pervious = 2.735 ac 35.18% Impervious = 1.485 ac

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: East to Congress St Runoff Area=59,959 sf 42.24% Impervious Runoff Depth=3.45"
Flow Length=208' Tc=19.1 min CN=84 Runoff=3.80 cfs 0.396 af

Subcatchment 11: Center to Rain Garden Runoff Area=16,390 sf 23.78% Impervious Runoff Depth=3.45"
Flow Length=146' Slope=0.0200 '/' Tc=19.6 min CN=84 Runoff=1.03 cfs 0.108 af

Subcatchment 20: South to Wetland Runoff Area=17,600 sf 29.48% Impervious Runoff Depth=3.55"
Flow Length=70' Slope=0.0400 '/' Tc=5.7 min CN=85 Runoff=1.64 cfs 0.120 af

Subcatchment 30: Center to Rain Garden Runoff Area=8,233 sf 41.47% Impervious Runoff Depth=3.76"
Flow Length=62' Slope=0.0160 '/' Tc=10.0 min CN=87 Runoff=0.70 cfs 0.059 af

Subcatchment 40: West to Wetlands Runoff Area=40,155 sf 1.87% Impervious Runoff Depth=2.79"
Flow Length=151' Tc=7.2 min CN=77 Runoff=2.86 cfs 0.214 af

Subcatchment 41: SW area Runoff Area=22,407 sf 69.68% Impervious Runoff Depth=4.39"
Tc=5.0 min CN=93 Runoff=2.50 cfs 0.188 af

Subcatchment 42: NW area Runoff Area=19,072 sf 54.93% Impervious Runoff Depth=4.07"
Flow Length=75' Slope=0.0400 '/' Tc=8.7 min CN=90 Runoff=1.81 cfs 0.148 af

Reach 2R: Off-site to Wetlands Avg. Flow Depth=0.07' Max Vel=1.05 fps Inflow=1.64 cfs 0.120 af
n=0.035 L=225.0' S=0.0222 '/' Capacity=142.44 cfs Outflow=1.48 cfs 0.120 af

Reach 42R: through wetlands Avg. Flow Depth=0.07' Max Vel=0.61 fps Inflow=0.73 cfs 0.148 af
n=0.035 L=470.0' S=0.0085 '/' Capacity=97.88 cfs Outflow=0.51 cfs 0.148 af

Pond 11P: Rain Garden Peak Elev=180.11' Storage=1,008 cf Inflow=1.03 cfs 0.108 af
Outflow=1.01 cfs 0.089 af

Pond 30P: Rain Garden #2 Peak Elev=183.00' Storage=465 cf Inflow=0.70 cfs 0.059 af
Primary=0.24 cfs 0.059 af Secondary=0.00 cfs 0.000 af Outflow=0.24 cfs 0.059 af

Pond 41P: UDSF #1 Peak Elev=179.06' Storage=3,488 cf Inflow=2.50 cfs 0.188 af
Primary=0.13 cfs 0.172 af Secondary=0.39 cfs 0.016 af Outflow=0.52 cfs 0.188 af

Pond 42P: UDSF #2 Peak Elev=181.08' Storage=2,252 cf Inflow=1.81 cfs 0.148 af
Primary=0.12 cfs 0.128 af Secondary=0.61 cfs 0.020 af Outflow=0.73 cfs 0.148 af

Pond SP1: Congress Street Inflow=4.78 cfs 0.485 af
Primary=4.78 cfs 0.485 af

Pond SP2: Wetlands Inflow=4.48 cfs 0.730 af
Primary=4.48 cfs 0.730 af

Total Runoff Area = 4.220 ac Runoff Volume = 1.235 af Average Runoff Depth = 3.51"
64.82% Pervious = 2.735 ac 35.18% Impervious = 1.485 ac

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: East to Congress St Runoff Area=59,959 sf 42.24% Impervious Runoff Depth=4.29"
Flow Length=208' Tc=19.1 min CN=84 Runoff=4.69 cfs 0.492 af

Subcatchment 11: Center to Rain Garden Runoff Area=16,390 sf 23.78% Impervious Runoff Depth=4.29"
Flow Length=146' Slope=0.0200 '/' Tc=19.6 min CN=84 Runoff=1.27 cfs 0.135 af

Subcatchment 20: South to Wetland Runoff Area=17,600 sf 29.48% Impervious Runoff Depth=4.40"
Flow Length=70' Slope=0.0400 '/' Tc=5.7 min CN=85 Runoff=2.01 cfs 0.148 af

Subcatchment 30: Center to Rain Garden Runoff Area=8,233 sf 41.47% Impervious Runoff Depth=4.61"
Flow Length=62' Slope=0.0160 '/' Tc=10.0 min CN=87 Runoff=0.86 cfs 0.073 af

Subcatchment 40: West to Wetlands Runoff Area=40,155 sf 1.87% Impervious Runoff Depth=3.57"
Flow Length=151' Tc=7.2 min CN=77 Runoff=3.65 cfs 0.274 af

Subcatchment 41: SW area Runoff Area=22,407 sf 69.68% Impervious Runoff Depth=5.28"
Tc=5.0 min CN=93 Runoff=2.97 cfs 0.226 af

Subcatchment 42: NW area Runoff Area=19,072 sf 54.93% Impervious Runoff Depth=4.94"
Flow Length=75' Slope=0.0400 '/' Tc=8.7 min CN=90 Runoff=2.18 cfs 0.180 af

Reach 2R: Off-site to Wetlands Avg. Flow Depth=0.08' Max Vel=1.15 fps Inflow=2.01 cfs 0.148 af
n=0.035 L=225.0' S=0.0222 '/' Capacity=142.44 cfs Outflow=1.85 cfs 0.148 af

Reach 42R: through wetlands Avg. Flow Depth=0.10' Max Vel=0.74 fps Inflow=1.37 cfs 0.180 af
n=0.035 L=470.0' S=0.0085 '/' Capacity=97.88 cfs Outflow=0.92 cfs 0.180 af

Pond 11P: Rain Garden Peak Elev=180.14' Storage=1,038 cf Inflow=1.27 cfs 0.135 af
Outflow=1.25 cfs 0.115 af

Pond 30P: Rain Garden #2 Peak Elev=183.20' Storage=674 cf Inflow=0.86 cfs 0.073 af
Primary=0.25 cfs 0.073 af Secondary=0.00 cfs 0.000 af Outflow=0.25 cfs 0.073 af

Pond 41P: UDSF #1 Peak Elev=179.12' Storage=3,626 cf Inflow=2.97 cfs 0.226 af
Primary=0.13 cfs 0.184 af Secondary=1.05 cfs 0.042 af Outflow=1.18 cfs 0.226 af

Pond 42P: UDSF #2 Peak Elev=181.14' Storage=2,357 cf Inflow=2.18 cfs 0.180 af
Primary=0.12 cfs 0.139 af Secondary=1.25 cfs 0.041 af Outflow=1.37 cfs 0.180 af

Pond SP1: Congress Street Inflow=5.91 cfs 0.607 af
Primary=5.91 cfs 0.607 af

Pond SP2: Wetlands Inflow=5.54 cfs 0.901 af
Primary=5.54 cfs 0.901 af

Total Runoff Area = 4.220 ac Runoff Volume = 1.528 af Average Runoff Depth = 4.35"
64.82% Pervious = 2.735 ac 35.18% Impervious = 1.485 ac

Summary for Subcatchment 10: East to Congress St

Runoff = 3.80 cfs @ 12.26 hrs, Volume= 0.396 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
*	25,329	98	paved & roof
	1,674	72	Woods/grass comb., Good, HSG C
	32,956	74	>75% Grass cover, Good, HSG C
	59,959	84	Weighted Average
	34,630		57.76% Pervious Area
	25,329		42.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	150	0.0230	0.13		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
0.1	58	0.1293	7.30		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
19.1	208	Total			

Summary for Subcatchment 11: Center to Rain Garden #1

Runoff = 1.03 cfs @ 12.27 hrs, Volume= 0.108 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
*	3,897	98	paved & roof
	12,493	80	>75% Grass cover, Good, HSG D
	16,390	84	Weighted Average
	12,493		76.22% Pervious Area
	3,897		23.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.6	146	0.0200	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"

Summary for Subcatchment 20: South to Wetland

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.64 cfs @ 12.09 hrs, Volume= 0.120 af, Depth= 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
	10,816	80	>75% Grass cover, Good, HSG D
*	5,188	98	gravel & pavement
	1,596	77	Brush, Fair, HSG D
	17,600	85	Weighted Average
	12,412		70.52% Pervious Area
	5,188		29.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	70	0.0400	0.21		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"

Summary for Subcatchment 30: Center to Rain Garden

Runoff = 0.70 cfs @ 12.14 hrs, Volume= 0.059 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
*	3,414	98	paved & roof
	4,819	80	>75% Grass cover, Good, HSG D
	8,233	87	Weighted Average
	4,819		58.53% Pervious Area
	3,414		41.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	56	0.0160	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
0.0	6	0.0160	2.57		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
10.0	62	Total			

Summary for Subcatchment 40: West to Wetlands

Runoff = 2.86 cfs @ 12.11 hrs, Volume= 0.214 af, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
*	750	98	impervious
	17,785	80	>75% Grass cover, Good, HSG D
*	21,620	73	wetlands & undeveloped
	40,155	77	Weighted Average
	39,405		98.13% Pervious Area
	750		1.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	39	0.0250	0.10		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
0.2	32	0.2500	3.50		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.8	80	0.0140	1.77		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
7.2	151	Total			

Summary for Subcatchment 41: SW area

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.50 cfs @ 12.07 hrs, Volume= 0.188 af, Depth= 4.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

	Area (sf)	CN	Description
	1,653	83	Brush, Poor, HSG D
*	15,614	98	paved & roof
	5,140	80	>75% Grass cover, Good, HSG D
	22,407	93	Weighted Average
	6,793		30.32% Pervious Area
	15,614		69.68% Impervious Area

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

Summary for Subcatchment 42: NW area

Runoff = 1.81 cfs @ 12.12 hrs, Volume= 0.148 af, Depth= 4.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.20"

Area (sf)	CN	Description
10,477	98	Paved parking, HSG D
8,595	80	>75% Grass cover, Good, HSG D
19,072	90	Weighted Average
8,595		45.07% Pervious Area
10,477		54.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	75	0.0400	0.14		**Sheet Flow, A-B**
					Grass: Dense n= 0.240 P2= 3.10"

Summary for Reach 2R: Off-site to Wetlands

Inflow Area = 0.404 ac, 29.48% Impervious, Inflow Depth = 3.55" for 25-YR event
Inflow = 1.64 cfs @ 12.09 hrs, Volume= 0.120 af
Outflow = 1.48 cfs @ 12.18 hrs, Volume= 0.120 af, Atten= 10%, Lag= 5.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.05 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 0.33 fps, Avg. Travel Time= 11.2 min

Peak Storage= 322 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.07' , Surface Width= 20.84'
Bank-Full Depth= 1.00' Flow Area= 26.0 sf, Capacity= 142.44 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 10.0 2.0 '/' Top Width= 32.00'
Length= 225.0' Slope= 0.0222 '/'
Inlet Invert= 178.00', Outlet Invert= 173.00'

‡

Summary for Reach 42R: through wetlands

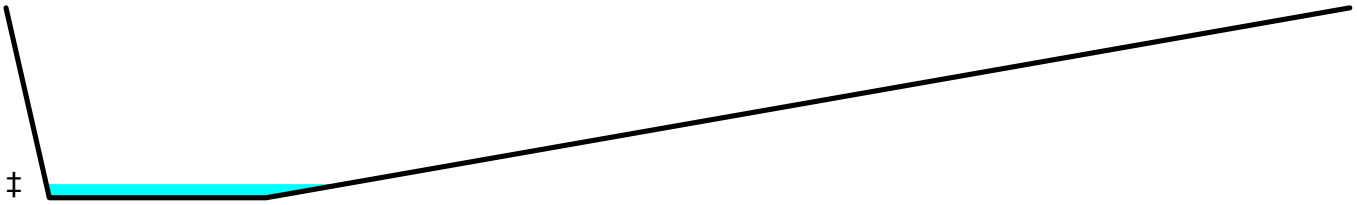
[79] Warning: Submerged Pond 42P Primary device # 1 OUTLET by 0.07'

Inflow Area = 0.438 ac, 54.93% Impervious, Inflow Depth = 4.07" for 25-YR event
Inflow = 0.73 cfs @ 12.40 hrs, Volume= 0.148 af
Outflow = 0.51 cfs @ 12.77 hrs, Volume= 0.148 af, Atten= 30%, Lag= 21.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.61 fps, Min. Travel Time= 12.8 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 27.7 min

Peak Storage= 397 cf @ 12.55 hrs
Average Depth at Peak Storage= 0.07' , Surface Width= 13.71'
Bank-Full Depth= 1.00' Flow Area= 36.0 sf, Capacity= 97.88 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 50.0 '/' Top Width= 62.00'
Length= 470.0' Slope= 0.0085 '/'
Inlet Invert= 177.00', Outlet Invert= 173.00'



Summary for Pond 11P: Rain Garden

Inflow Area = 0.376 ac, 23.78% Impervious, Inflow Depth = 3.45" for 25-YR event
Inflow = 1.03 cfs @ 12.27 hrs, Volume= 0.108 af
Outflow = 1.01 cfs @ 12.31 hrs, Volume= 0.089 af, Atten= 2%, Lag= 2.4 min
Primary = 1.01 cfs @ 12.31 hrs, Volume= 0.089 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 180.11' @ 12.31 hrs Surf.Area= 1,053 sf Storage= 1,008 cf

Plug-Flow detention time= 111.6 min calculated for 0.089 af (82% of inflow)
Center-of-Mass det. time= 40.5 min (862.1 - 821.6)

Volume	Invert	Avail.Storage	Storage Description
#1	178.50'	2,590 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
178.50	465	0	0
179.00	465	233	233
180.00	875	670	903
181.00	2,500	1,688	2,590

Device	Routing	Invert	Outlet Devices
#1	Primary	179.92'	**5.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=1.00 cfs @ 12.31 hrs HW=180.11' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.00 cfs @ 1.06 fps)

Summary for Pond 30P: Rain Garden #2

[44] Hint: Outlet device #1 is below defined storage
[58] Hint: Peaked 2.60' above defined flood level
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=1)

Inflow Area = 0.189 ac, 41.47% Impervious, Inflow Depth = 3.76" for 25-YR event
Inflow = 0.70 cfs @ 12.14 hrs, Volume= 0.059 af
Outflow = 0.24 cfs @ 12.48 hrs, Volume= 0.059 af, Atten= 65%, Lag= 20.5 min
Primary = 0.24 cfs @ 12.48 hrs, Volume= 0.059 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 183.00' @ 12.48 hrs Surf.Area= 645 sf Storage= 465 cf
Flood Elev= 180.40' Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 9.8 min (813.3 - 803.5)

Volume	Invert	Avail.Storage	Storage Description
#1	181.80'	3,276 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
181.80	286	0	0
182.30	286	143	143
183.00	627	320	463
184.00	5,000	2,814	3,276

Device	Routing	Invert	Outlet Devices
#1	Primary	180.13'	**4.0" Round Culvert** L= 202.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 180.13' / 179.12' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#2	Secondary	183.75'	**5.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.24 cfs @ 12.48 hrs HW=183.00' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.24 cfs @ 2.80 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=181.80' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: UDSF #1

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 0.514 ac, 69.68% Impervious, Inflow Depth = 4.39" for 25-YR event
Inflow = 2.50 cfs @ 12.07 hrs, Volume= 0.188 af
Outflow = 0.52 cfs @ 12.49 hrs, Volume= 0.188 af, Atten= 79%, Lag= 25.3 min
Primary = 0.13 cfs @ 12.49 hrs, Volume= 0.172 af
Secondary = 0.39 cfs @ 12.49 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 179.06' @ 12.49 hrs Surf.Area= 2,311 sf Storage= 3,488 cf

Plug-Flow detention time= 233.1 min calculated for 0.188 af (100% of inflow)
Center-of-Mass det. time= 233.0 min (1,009.2 - 776.2)

Volume	Invert	Avail.Storage	Storage Description
#1	177.00'	6,213 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
177.00	1,131	0	0
178.00	1,665	1,398	1,398
179.00	2,232	1,949	3,347
180.00	3,500	2,866	6,213

Device	Routing	Invert	Outlet Devices
#1	Primary	175.37'	**2.5" Round Culvert** L= 63.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 175.37' / 175.00' S= 0.0059 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.03 sf
#2	Secondary	179.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.13 cfs @ 12.49 hrs HW=179.06' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.13 cfs @ 3.74 fps)

Secondary OutFlow Max=0.38 cfs @ 12.49 hrs HW=179.06' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.38 cfs @ 0.62 fps)

Summary for Pond 42P: UDSF #2

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 0.438 ac, 54.93% Impervious, Inflow Depth = 4.07" for 25-YR event
Inflow = 1.81 cfs @ 12.12 hrs, Volume= 0.148 af
Outflow = 0.73 cfs @ 12.40 hrs, Volume= 0.148 af, Atten= 60%, Lag= 17.0 min
Primary = 0.12 cfs @ 12.40 hrs, Volume= 0.128 af
Secondary = 0.61 cfs @ 12.40 hrs, Volume= 0.020 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 181.08' @ 12.40 hrs Surf.Area= 1,943 sf Storage= 2,252 cf

Plug-Flow detention time= 141.9 min calculated for 0.148 af (100% of inflow)
Center-of-Mass det. time= 141.8 min (933.7 - 791.9)

Volume	Invert	Avail.Storage	Storage Description
#1	179.50'	5,160 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
179.50	1,094	0	0
180.00	1,288	596	596
181.00	1,717	1,503	2,098
182.00	4,406	3,062	5,160

Device	Routing	Invert	Outlet Devices
#1	Primary	177.37'	**2.5" Round Culvert** L= 73.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 177.37' / 177.00' S= 0.0051 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.03 sf
#2	Secondary	181.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.12 cfs @ 12.40 hrs HW=181.08' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.12 cfs @ 3.51 fps)

Secondary OutFlow Max=0.60 cfs @ 12.40 hrs HW=181.08' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.60 cfs @ 0.72 fps)

Summary for Pond SP1: Congress Street

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.753 ac, 38.28% Impervious, Inflow Depth = 3.32" for 25-YR event
Inflow = 4.78 cfs @ 12.27 hrs, Volume= 0.485 af
Primary = 4.78 cfs @ 12.27 hrs, Volume= 0.485 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Pond SP2: Wetlands

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.467 ac, 32.98% Impervious, Inflow Depth = 3.55" for 25-YR event
Inflow = 4.48 cfs @ 12.13 hrs, Volume= 0.730 af
Primary = 4.48 cfs @ 12.13 hrs, Volume= 0.730 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Exhibit 8

Inspection & Maintenance Plan

TERRADYN CONSULTANTS, LLC

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New Gloucester, ME 04260

Portland
565 Congress Street, Suite 201
Portland, ME 04101

115 CONGRESS STREET
BELFAST, MAINE
STORMWATER MANAGEMENT SYSTEM
INSEPCTION & MAINTENANCE PLAN

Project Owner/Developer: DC 115 Congress LP
100 Commercial Street, Suite 4144
Portland, Maine 04101
(207) 772-7673

Responsible Party: Owner

Prepared By: Terradyn Consultants, LLC
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INTRODUCTION:

Regular inspection and maintenance of the entire stormwater management system is crucial to the long-term effectiveness of the system. The responsible party must provide regular inspection and maintenance of all permanent erosion control measures and stormwater management structures, establish any contract services required to implement the program, and keep records and a maintenance log book of inspection and maintenance activities. At a minimum, the inspection and maintenance activities outlined herein should be performed at the recommended intervals.

All measures must be maintained in effective operating condition. A person with knowledge of erosion and sedimentation practices, stormwater management, and the standards and conditions of all local, state and federal permits for the project shall conduct the inspections. The following areas, facilities, and measures must be inspected and identified deficiencies must be corrected.

INSPECTION TASKS

1. Inspect **vegetated areas**, particularly slopes and embankments, early in the growing season or after heavy rains to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

2. Inspect **ditches, swales and other open stormwater channels** in the spring, late fall and after heavy rains to remove any obstructions to flow. Remove accumulated sediments and debris, control vegetated growth that could obstruct flow and repair any erosion of the ditch lining. Vegetated ditches must be mowed at least annually or otherwise maintained to control the growth of woody vegetation and maintain flow capacity. Any woody vegetation growing through riprap linings must also be removed. Repair any slumping side slopes as soon as practicable. If the ditch has a riprap lining, replace riprap on areas where any underlying filter fabric or underdrain gravel is showing through the stone or where stones have dislodged. The channel must receive routine maintenance to maintain capacity and prevent or correct any erosion of the channel's bottom or sideslopes.

3. Inspect **culverts** in the spring, in late fall, and after heavy rains to remove any obstructions to flow. Remove accumulated sediments and debris at the inlet, the outlet and within the culvert. Repair any erosion damage at the culvert's inlet and outlet.

4. Inspect and clean out **catch basins**. Clean-out must include the removal and legal disposal of any accumulated sediments and debris at the bottom of the basin, at any inlet grates, at any inflow channels to the basin and at any pipes between basins. If the basin outlet is designed to trap floatable materials, then remove the floating debris and any floating oils (using oil-absorptive pads).

5. Inspect **grassed underdrained soil filters** semi-annually and following major storm events. Debris and sediment buildup shall be removed from the forebay and basin as needed. Mowing of the grassed basin shall occur semi-annually to a height of no less than 6-inches. Any bare area or erosion rills shall be repaired with new filter media or sandy loam then seeded and mulched. Maintaining good grass cover will minimize clogging with fine sediments. If drain time exceeds 48 hours, the top of the filter bed must be rototilled to reestablish the soil's filtration capacity.

6. Inspect **rain gardens** semi-annually and following major storm events. Debris and sediment buildup shall be removed from the forebay and basin as needed. Any bare area or erosion rills should be repaired with new filter media, seeded and mulched. Harvesting and pruning of excessive growth should be done occasionally and weeding to control unwanted or invasive plants may be necessary. If drain time exceeds 48 hours, the top of the filter bed should be rototilled to reestablish the soils's filtration capacity. The soil filter mulch shall be replaced on a yearly basis.

DOCUMENTATION

Keep a log (report) summarizing inspections, maintenance, and any corrective actions taken. The log must include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, indicate where the sediment and debris was disposed after removal. The log must be made accessible to city staff and a copy provided to the city upon request. The permittee shall retain a copy of the log for a period of at least five years from the completion of permanent stabilization.

The log attached at the end of this plan is from the *Maine Erosion and Sediment Control Best Management Practices (BMPs) Manual for Designers and Engineers (May 2016)*. The log may be used or adapted for this project.

ATTACHMENTS:
Stormwater Management Facilities Inspection & Maintenance Log

Stormwater Management Facilities
Inspection & Maintenance Log
115 Congress Street, Belfast, Maine

General Information:

Inspected by:	Date:	Weather:

Reason for Inspection: (Regular Inspection) (Major Rain Event)

BMP	Conditions Observed	Repairs Needed?
1. Vegetated Areas		
2. Ditches, Swales, Open Channels		
3. Culverts		
4. Catch Basins		
5. Grassed Underdrained Soil Filter		
6. Rain Garden		

Detailed Repair Notes:

BMP Type	Date	Description of Repairs & Sediment Disposal

Notes:
If a maintenance task requires the clean-out of any sediments or debris, indicate where the sediment and debris was disposed after removal. A copy of this log shall be retained for a period of at least five years from the completion of permanent stabilization. The log must be made accessible to Department of Environmental Protection staff and a copy provided to the Department upon request.