

1. Agenda 10/18/2017

Documents:

[AGENDA 10_18_2017.PDF](#)

2. Recommendations To Expand Opportunities For Overnight Parking

Documents:

[PARKING RESTRICTIONS MEMO.PDF](#)

3. Vehicle Towing Fees

Documents:

[CHAPTER 28 - TOW FEES REDLINE.PDF](#)
[ME CITIES.PDF](#)
[MEMO RE TOW COMPANY FEES.PDF](#)
[NEW ENGLAND CITIES.PDF](#)
[PORTLAND TOW RATE HISTORY.PDF](#)

4. Report On Bayside Adapts

Documents:

[2017.09.01 BAYSIDE ADAPTS REPORT - FINAL.PDF](#)
[BAWG_FINALDRAFT_REPORT_AUG_2017_NEEFC \(1\).PDF](#)
[BAYSIDE ADAPTS TO SUST TRANS COMMITTEE, 10-18-17.PDF](#)

CITY OF PORTLAND, MAINE

Standing Committee Sustainability and Transportation

Councilor Spencer Thibodeau (D2), Chair

Councilor Belinda Ray (D1)

Councilor Jill Duson (A/L)

Agenda

October 18, 2017

5:30 PM

Council Chambers

1. Review and approve minutes from October 12, 2017
2. Sustainability Updates
 - a. Ocean Ave Landfill Cap / Solar
 - b. Streetlights / Smart Cities
 - c. Recycling Carts
3. Recommendations to expand opportunities for overnight parking
4. Recommendations for adjustments to fees for vehicle towing
5. Report on Bayside Adapts resiliency project
6. Adjourn

**Memorandum**

TO: Chairman Thibodeau and Members of the Sustainability and Transportation Committee
FROM: Michael Murray, Assistant to the City Manager
CC: Jon Jennings, City Manager
Christopher Branch, Director of Public Works
John Peverada, Parking Manager
Jeremiah Bartlett, Transportation System Engineer
SUBJECT: Street Maintenance Parking Restrictions
DATE: October 5, 2017

OBJECTIVE:

Due to changes in municipal operations, street sweeping is no longer the norm during street maintenance restricted parking. As a result, the City Manager has requested a review of existing street maintenance parking restrictions on and off peninsula. Below is a summary of the background and proposed recommended amendments to those parking restrictions based on that review.

BACKGROUND:

The City of Portland regulates the parking of vehicles on Portland streets in Chapter 28 of the City Code. Street maintenance parking restrictions in that Chapter fall into one of two categories:

First, on peninsula including a concentration of streets in and around the former Nathan Clifford School, parking is prohibited during designated night time hours when signs prohibiting the same have been posted. Additionally, there are day time restrictions for street maintenance in the East End and Parkside neighborhoods. It should also be noted that until 2013 on peninsula streets had a parking restriction one night/day per week. In 2013, however, the restriction was relaxed to one night/day every other week as it was acknowledged that City services were being performed less at night.

Second, off peninsula parking is allowed on even number days on the even numbered side of the street, and on odd numbered days on the odd numbered side of the street. This is more commonly known as "Odd/Even Parking". There are three neighborhood areas where odd/even parking is currently enforced in the City: Deering Center, the USM area, and a section of Libbytown.

In all instances, the above parking restrictions allow for City services such as street sweeping and snow removal to be provided. More recently, sweeping during parking restrictions occurs primarily in the spring to clean up the residual sand/salt from



roadways, and in the fall, to clean up the leaf drop to City streets. During the summer months street sweeping is more commonly performed during the day time hours.

RECOMMENDATIONS:

City staff, comprised of representatives from the Department of Public Works, Parking, and the City Manager's Office convened to review the current City parking restrictions, and recommend possible changes. The following is a list of the staff recommendations:

Peninsula parking (including section around Nathan Clifford School): Staff recommends that streets where parking is restricted to designated hours, with signs specifically prohibiting the same, only be enforced from October 1 to May 31 each year. This time frame allows for City staff to sweep streets due to the annual leaf drop, allow for snow removal during winter months, and allow for the sweeping of the streets in the spring to clean up the residual sand/salt from winter operations.¹ This time frame also allows for a period each fall to warn parkers that the restriction is in effect before actual enforcement commences. This proposed change would not apply to Service Area 3 of Traffic Schedule XXXA, which contains streets within Portland Downtown where staff recommends that the current restrictions remain in place year-round.

It is important to note that this recommendation will result in a decrease in parking ticket revenue of approximately \$150,000 from tickets issued during the parking restrictions.

Off Peninsula: In all other areas of the City, odd/even parking restrictions currently exist; however as stated previously it is only enforced in three neighborhood areas: Deering Center, the USM area, and a section of Libbytown. Staff recommends that the odd/even parking restrictions be removed from City Code and overnight parking be unrestricted. The removal of this parking restriction will not affect Public Works sweeping operations, but there will be a decrease in parking ticket revenue of approximately \$22,500 from tickets issued in the areas where odd/even parking is enforced.

The following attachments are included for your review:

1. Proposed Changes to Chapter 28
2. Traffic Schedule XXXA
3. Traffic Schedule XXXB
4. Traffic Schedule XXXIA
5. List of streets subject to Odd/Even Enforcement
6. Parking Ticket Breakdown

¹ On peninsula streets will see an overall decrease in sweeping, as Public Works currently programs up to eight sweeps per year, and will be decreasing this number in the coming year to four sweeps per year.

City of Portland
Code of Ordinances
Sec. 28-53

Traffic and Motor Vehicles
Chapter 28
Rev. 6-7-12

- (g) Within thirty (30) feet upon the approach to any flashing beacon, stop sign or traffic-control signal located at the side of a roadway;
- (h) Between a safety zone and the adjacent curb or within thirty (30) feet of points on the curb immediately opposite the ends of a safety zone, unless the traffic engineer indicates a different length by signs or markings;
- (i) Within twenty (20) feet of the driveway entrance to any fire station and on the side of a street opposite the entrance to any fire station within seventy-five (75) feet of the entrance when properly signed;
- (j) Alongside or opposite any street excavation or obstruction when such stopping, standing or parking would obstruct traffic or interfere with said excavation;
- (k) On the roadway side of any vehicle stopped or parked at the edge or curb of a street or "double park," so-called;
- (l) At any place where official signs prohibit stopping or parking;
- (m) In front of a place of business for longer than one (1) hour between the hours of 9:00 a.m. and 5:00 p.m., except for Sundays and state and federally sanctioned holidays, unless a different regulation is provided by sign or by meter or by this chapter for such location.

(Ord. No. 183-97, 1-22-97; Ord. No. 275-97, 5-5-97)

Sec. 28-54. Overnight parking.

- (a) No person shall park a vehicle on any street between designated nighttime hours, 12:01 AM - 7:00 A.M., as described in Traffic Schedule XXXA and XXXB; and on any street between designated daytime hours of 10:00 AM - 2:00PM, as described in Traffic Schedule XXXIA, when signs prohibiting same have been posted. Signs prohibiting such ~~overnight~~ parking shall be posted upon the direction of the traffic engineer for reasons of narrowness, traffic hazard, snow removal or other reasons pertaining to the health, safety or welfare of the general public. Effective June 1, 2018, on streets posted

pursuant to the provisions of subsection (a); the restriction shall be suspended from June 1 to September 30 of each calendar year, unless posted by emergency order. The streets within Traffic Schedule XXXA, Service Area 3, shall be excluded from the suspension.

(b) On streets not posted pursuant to the provisions of subsection (a), parking shall be unregulated unless posted by emergency order ~~no persons shall park or leave a vehicle parked between the hours of 12:01 a.m. and 7:00 a.m. of any day, except that persons may park or leave vehicles parked on even house-numbered sides of such streets on even-numbered days of each calendar month, and on the odd-numbered sides of such streets on odd-numbered days of each calendar month.~~

(c) On streets where one (1) side only of an entire block is so posted against parking that the effect is to prohibit parking during the hours of 12:01 a.m. and 7:00 a.m. every day, the provisions of subsection (b) shall not apply to the side of the street directly opposite the side where parking is so prohibited, and parking shall be permitted on such opposite side of the street unless such parking is otherwise specifically prohibited.

(d) Nothing in this section shall be construed so as to permit any vehicle to be parked or to be left parked on any street or way so as to interfere with or hinder the removal or plowing of snow by the city, nor to permit the parking or leaving of a vehicle parked in violation of any other section of this Code including but not limited to declarations of emergency pursuant to section 28-24(15).

(e) Subsections (b) and (c) shall not apply on streets where the traffic engineer has placed signs stating that parking is prohibited between specified nighttime hours on specified days.
(Ord. No. 183-97, 1-22-97)

Sec. 28-55. Bus stops.

(a) The driver of any urban or interurban bus shall not stand or park in any business district at any place other than at a bus stop, except that this provision shall not prevent the driver of any such bus from temporarily stopping in accordance with other stopping or parking regulations at any place designated for the purpose of and while actually engaged in loading or unloading passengers.

Schedule XXXA**Schedule XXX Repealed 11/2014 by City of Portland Council Order****NO OVERNIGHT PARKING – CITY SERVICE AREAS****Summary:**

Service Area 1:	Twice Monthly per Side of Street Odd: 1 st & 3 rd Tuesday 12:01 to 7:00 AM Even: 2 nd & 4 th Tuesday 12:01 to 7:00 AM
Service Area 2:	Twice Monthly per Side of Street Odd: 1 st & 3 rd Tuesday 12:01 to 7:00 AM Even: 2 nd & 4 th Tuesday 12:01 to 7:00 AM
Service Area 3:	Weekly per Side of Street Odd: Sunday 11:30 PM to Mon. 7:00 AM Even: Tuesday 11:30 PM to Wed. 7:00 AM
Service Area 4:	Twice Monthly per Side of Street Odd: 1 st & 3 rd Tuesday 12:01 to 7:00 AM Even: 2 nd & 4 th Tuesday 12:01 to 7:00 AM
Service Area 5:	Twice Monthly per Side of Street Odd: 1 st & 3 rd Wednesday 12:01 to 7:00 AM Even: 2 nd & 4 th Wednesday 12:01 to 7:00 AM
Service Area 6:	Twice Monthly per Side of Street Odd: 1 st & 3 rd Wednesday 12:01 to 7:00 AM Even: 2 nd & 4 th Wednesday 12:01 to 7:00 AM
Service Area 7:	Twice Monthly per Side of Street Odd: 1 st & 3 rd Wednesday 12:01 to 7:00 AM Even: 2 nd & 4 th Wednesday 12:01 to 7:00 AM
Service Area 8:	Twice Monthly per Side of Street Odd: 1 st & 3 rd Tuesday 12:01 to 7:00 AM Even: 2 nd & 4 th Tuesday 12:01 to 7:00 AM

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DETAILS:**Service Area 1- No Overnight Parking – Twice Monthly Service****No Overnight Parking – Tuesday**

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Tuesday on the 1st and 3rd Tuesday of the month for north & east side on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the south side & west side on the following streets or parts of streets.

Service Area 1 boundaries are described as follows:

West side of Western Promenade, Pine Street to a point following the west side of Western Promenade extended to Commercial Street

South side of Commercial Street, Brackett Street to a point intersecting the west side of the of Western Promenade extended.

West side of Brackett Street, Pine Street to Commercial Street.

South side of Pine Street, Western Promenade to Brackett Street.

The following streets or segments of streets are included within the boundaries of Service Area 1:

Beach Street*
Bond Street*
Bowdoin Street

Brackett Street
Briggs Street
Carroll Street
Chadwick Street
Clark Street
Clifford Street
Cushman Street
Danforth Street
Dermot Court *
Emery Street
Fletcher Street
Gray Street
Lewis Street

May Street
Neal Street
Orange Street*
Orchard Street
Pine Street
Salem Street
School Street
Spring Street
Spruce Street
Storer Street
Summer Street
Taylor Street
Thomas Street
Vaughn Street
West Commercial Street
Western Promenade
York Street

* - Streets included within the designated boundaries, but not affected by the parking project.

BOWDOIN STREET

North side (NP 1st & 3rd Tues.) From Clifford Street westerly to Western Promenade

South side - (NP 2nd & 4th Tues.) From Western Promenade easterly to Clifford Street

BRACKETT STREET

West side - (NP 2nd & 4th Tues.) From Pine Street to a point southerly of Pine Street

BRIGGS STREET

East side (NP 1st & 3rd Tues.) From Salem Street northerly to Danforth Street

CARROLL STREET

North side – (NP 1st & 3rd Tues) From Thomas Street to Western Promenade

South side – (NP 2nd & 4th Tues.) From Western Promenade easterly to Thomas Street

CHADWICK STREET

East side - (NP 1st & 3rd Tues) From Bowdoin Street northerly to Pine Street

West side - (NP 2nd & 4th Tues.) From Pine Street southerly to Bowdoin Street

CLARK STREET

East side - (NP 1st & 3rd Tues) From Beach Street northerly to Spring Street

West side - (NP 2nd & 4th Tues.) From Spring Street southerly to Beach Street

CLIFFORD STREET

North side - (NP 1st & 3rd Tues) From Thomas Street westerly to Vaughan Street

South side - (NP 2nd & 4th Tues.) .From Vaughan Street easterly to Thomas Street

CUSHMAN STREET

North side (NP 1st & 3rd Tues.) From Clark Street westerly to Emery Street

DANFORTH STREET

North side (NP 1st & 3rd Tues.) From Brackett Street westerly to a Point westerly of the Western Promenade.

South side - (NP 2nd & 4th Tues.) From a point opposite Vaughan Street easterly to Brackett Street

EMERY STREET

East side (NP 1st & 3rd Tues.) From dead end northerly to Pine Street

West side - (NP 2nd & 4th Tues.) From Spring Street southerly to dead end

FLETCHER STREET

East side (NP 1st & 3rd Tues.) From Danforth Street northerly to a point opposite Orchard Street

West side - (NP 2nd & 4th Tues.) From Orchard Street southerly to Danforth Street

GRAY STREET

North side (NP 1st & 3rd Tues.) From Brackett Street westerly to Clark Street

South side - (NP 2nd & 4th Tues.) From Clark Street easterly to Brackett Street

LEWIS STREET

West side - (NP 2nd & 4th Tues.) From Pine Street southerly to Cushman Street

MAY STREET

East side (NP 1st & 3rd Tues.) From Spring Street southerly to Danforth Street

NEAL STREET

East side (NP 1st & 3rd Tues.) From Spring Street northerly to Pine Street

West side - (NP 2nd & 4th Tues.) From Pine Street southerly to Spring Street

ORCHARD STREET

South side - (NP 2nd & 4th Tues.) From Vaughan Street easterly to Fletcher Street

PINE STREET

South side - (NP 2nd & 4th Tues.) From Western Promenade easterly to Brackett Street

SALEM STREET

North side (NP 1st & 3rd Tues.) From Brackett Street westerly to dead end

South side - (NP 2nd & 4th Tues.) From dead end easterly to Clark Street

SCHOOL STREET

West side - (NP 2nd & 4th Tues.) From Danforth Street southerly to Bond Street

SPRING STREET

North side (NP 1st & 3rd Tues.) From Brackett Street westerly to Vaughan Street

South side - (NP 2nd & 4th Tues.) From Emery Street easterly to Clark Street

SPRUCE STREET

Northside – (NP 13th & 3rd Tues.) From Clark Street Westerly to Emery Street

STORER STREET

West side - (NP 2nd & 4th Tues.) From a point 164 feet southerly of Spring Street to Danforth Street

SUMMER STREET

North side (NP 1st & 3rd Tues.) From Clark Street westerly to the terminus of the street

South side - (NP 2nd & 4th Tues.) From the terminus easterly to Brackett Street

TAYLOR STREET

North side (NP 1st & 3rd Tues.) From May Street westerly to Emery Street

South side - (NP 2nd & 4th Tues.) From Emery Street easterly to May Street

THOMAS STREET

East side (NP 1st & 3rd Tues.) From Spring Street northerly to Pine Street

West side - (NP 2nd & 4th Tues.) From Pine Street southerly to Spring Street

VAUGHAN STREET

East side (NP 1st & 3rd Tues.) From Danforth Street northerly to Pine Street

West side - (NP 2nd & 4th Tues.) From Pine Street southerly to Western Promenade

WEST COMMERCIAL STREET

North side (NP 1st & 3rd Tues.) From a point south of Brackett Street westerly to Cassidy Point Drive

South side - (NP 2nd & 4th Tues.) From Cassidy Point Dr. easterly to a point south of Brackett Street.

WESTERN PROMENADE

East side – (NP 1st & 3rd Tues.) From Bowdoin Street northerly to Pine Street

West side – (NP 2nd & 4th Tues.) From the southerly curb line of Western Promenade Park southerly to a point opposite Bowdoin Street

YORK STREET

North side – (NP 1st & 3rd Wed.) from Brackett Street westerly to Clark Street

South side – (NP 2nd & 4th Tues.) From Clark Street easterly to Brackett Street

Service Area 2 – No Overnight Parking – Twice Monthly Service

No Overnight Parking – Tuesday

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Tuesday on the 1st and 3rd Tuesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 2 boundaries are described as follows:

West side of Center Street, Congress Street to a line running 5' parallel to the northerly street line of Commercial Street.

A line running 5' parallel to the northerly street line of Commercial Street, Center Street to Brackett Street

East side of Brackett Street, from a line running 5' parallel to the northerly street line of Commercial Street to Pine Street

South side of Pine Street, Brackett Street to State Street

South side of Congress Street, State Street to Center Street

The following streets or segments of street are included within the boundaries of District #2:

Brackett Street
Brown Street
Center Street*
Congress Street
Danforth Street
Foundry Lane*
Free Street
Gray Street
Guilford Court*
High Street
Maple Street
Nye Street*
Oak Street

Park Street
Pine Street
Pleasant Street
South Street
Spring Street
State Street
Stetson Court
Stratton Place*
Tate Street*
Tyng Street
Winter Street
York Street

* - Streets included within the designated boundaries, but not affected by the Parking Project

BRACKETT STREET

East side - (NP 1st & 3rd Tuesday) From York Street northerly to Pine Street

BROWN STREET

East side - (NP 1st & 3rd Tues.) From Congress Street southerly to Free Street

CONGRESS STREET

South side - (NP 2nd & 4th Tues.) State Street easterly to Center Street

DANFORTH STREET

North side - (NP 1st & 3rd Tues.) From York Street westerly to

Brackett Street

South side - (NP 2nd & 4th Tues.) From Brackett Street easterly to York Street

FREE STREET

North side - (NP 1st & 3rd Tues.) From Congress Street easterly to Center Street

South side - (NP 2nd & 4th Tues.) From Congress Street easterly to Center Street

GRAY STREET

North side - (NP 1st & 3rd Tues.) From Park Street westerly to State Street

South side - (NP 2nd & 4th Tues.) From Brackett Street easterly to Center

Street

HIGH STREET

East side - (NP 1st & 3rd Tues.) From York Street northerly to Pleasant Street

East side - (NP 1st & 3rd Tues.) From Spring Street northerly to Free Street

West side - (NP 2nd & 4th Tues.) From York Street southerly to Commercial Street

West side - (NP 2nd & 4th Tues.) From York Street northerly to Pleasant Street

West side - (NP 2nd & 4th Tues.) From Spring Street northerly to Congress Street

MAPLE STREET

East side - (NP 1st & 3rd Tues.) From Commercial Street northerly to Danforth Street

West side - (NP 2nd & 4th Tues.) From York Street southerly to Commercial Street

OAK STREET

East side - (NP 1st & 3rd Tues.) From Congress Street southerly to Free Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Spring Street

PARK STREET

East side - (NP 1st & 3rd Tues.) From Congress Street southerly to Spring Street

East side - (NP 1st & 3rd Tues.) From York Street southerly to Commercial Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Commercial Street

PINE STREET

South side - (NP 2nd & 4th Tues.) From State Street westerly to Brackett Street

PLEASANT STREET

North side - (NP 1st & 3rd Tues.) From Center Street westerly to Park Street

South side - (NP 2nd & 4th Tues.) From Park Street easterly to Center Street

SOUTH STREET

West side - (NP 2nd & 4th Tues.) From the terminus southerly to Pleasant Street

SPRING STREET

North side - (NP 1st & 3rd Tues.) From a point westerly of Center Street

to a point westerly of Center Street

North side - (NP 1st & 3rd Tues.) From a point westerly of Oak Street

to a point westerly of Oak Street

North side - (NP 1st & 3rd Tues.) From a point westerly of State Street

to a point easterly of Brackett Street

STATE STREET

East side - (NP 1st & 3rd Tues.) From Congress Street southerly to York Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to York Street

STETSON COURT

South side - (NP 2nd & 4th Tues.) From the terminus easterly to Park Street

TYNG STREET

East side - (NP 1st & 3rd Tues.)) From York Street northerly to Danforth Street

West side - (NP 2nd & 4th Tues.) From Danforth Street southerly to York Street

WINTER STREET

East side - (NP 2nd & 4th Tues.)) From Danforth Street northerly to Pine Street

YORK STREET

North side - (NP 1st & 3rd Tues.)) From Park Street westerly to Brackett Street

South side - (NP 2nd & 4th Tues.) From Brackett Street easterly to State Street

SERVICE AREA 3 – No Overnight Parking - Weekly Service

No Overnight Parking -Sundays & Tuesdays

Parking is prohibited between the hours Sunday, 11:30 PM to 7:00 A.M. Monday on the odd side of the street and is prohibited on the even side of the street from Tuesday 11:30 PM to 7 A.M. Wednesday.

Service Area 3 boundaries are described as follows:

Up to but not including the West side of India, Congress Street to Commercial Street.

South side of Commercial Street, From a point opposite Brackett Street to India Street

A line running 5' parallel to the northerly street line of Commercial Street,
Center Street to a point opposite Brackett Street

East side of Center Street, Commercial Street to Congress Street.

South side of Congress Street, Center Street to India Street

*** The following streets or segments of street are included within the boundaries of Service Area 3:**

Center Street	Free Street
Church Street*	Gold Street *
Commercial Street	Hampshire Street
Congress Street	Market Street
Cotton Street	Middle Street
Cross Street	Milk Street
Custom House Street	Moulton Street
Dana Street	Newbury Street
Elm Street Ext.	Pearl Street
Exchange Street	Silver Street
Federal Street	Spring Street
Fore Street	Temple Street
Fox Court	Union Street
Franklin Street*	Wharf Street*

* - Streets that are included within the designated boundaries, but not affected by the Parking Project

CENTER STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Commercial Street northerly to Fore

Street

East side - NP Sun. 11:30 PM to Mon. 7 AM) From Free Street northerly to Congress

Street

COMMERCIAL STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Franklin Arterial westerly to High Street

South side – (NP Tues. 11:30 PM to Wed. 7 AM) From Deakes Wharf easterly to a point opposite India Street

CONGRESS STREET

South side - (NP Tues. 11:30 PM to Wed. 7 AM) From Temple Street easterly to India Street

COTTON STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Fore Street northerly to dead

end

West side - (NP Tues. 11:30 PM to Wed. 7 AM) From the dead end southerly to

Fore Street

CROSS STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Fore Street southerly to Commercial

Street

West side - (NP Tues. 11:30 PM to Wed. 7 AM) From Free Street to a point southerly of Free

Street

West side - (NP Tues. 11:30 PM to Wed. 7 AM) From Fore Street southerly to

Commercial Street

CUSTOM HOUSE STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From a point northerly of Commercial Street to Fore

Street

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Fore Street to a point southerly of Fore Street

DANA STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Commercial Street northerly to Wharf

Street

West side - (NP Tues. 11:30 PM to Wed. 7 AM) From Wharf Street to a point southerly of

Wharf Street

ELM STREET EXTENTION

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Congress Street southerly to Federal Street

EXCHANGE STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Congress Street southerly to Fore

Street

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Federal Street southerly to Fore

Street

FEDERAL STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From India Street westerly to Hampshire

Street

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Pearl Street easterly to Franklin

Arterial

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Pearl Street westerly to Temple

Street

South side – (NP Tues. 11:30 PM to Wed. 7:00 A.M.) From Elm Street Extension easterly

to Franklin Arterial

South side - NP Tues. 11:30 PM to Wed. 7:00 A.M.) From Franklin Arterial easterly to India

Street

FORE STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From a point westerly of India Street to a point easterly of Franklin Arterial

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Pearl Street westerly to Exchange Street

South side – (NP Tues. 11:30 PM to Wed. 7 AM) From Union Street easterly to India Street

FOX COURT

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Fore Street northerly to dead end

FRANKLIN STREET

East side -- (NP Sun. 11:30 PM to Mon. 7 AM) from Commercial Street northerly to Fore Street

FREE STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Center Street easterly to a point opposite Cross

Street

South side – (NP Tues. 11:30 PM to Wed. 7 AM) From Center Street easterly to Temple Street

HAMPSHIRE STREET

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Congress Street southerly to Middle Street

MARKET STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Fore Street northerly to Federal Street

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Fore Street southerly to Commercial Street

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Fore Street northerly to Congress Street

MIDDLE STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From India Street westerly to Exchange Street

South side – (NP Tues. 11:30 PM to Wed. 7 AM) From Union Street easterly to India Street

MILK STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Pearl Street westerly to Silver Street

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Market Street westerly to Exchange Street

South side (NP Tues. 11:30 PM to Wed. 7 AM) From Exchange Street easterly to Market Street

South side (NP Tues. 11:30 PM to Wed. 7 AM) From Silver Street easterly to Pearl Street

MOULTON STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Fore Street southerly to Commercial Street

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Fore Street southerly to Commercial Street

NEWBURY STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From India Street westerly to Franklin Arterial

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Pearl Street westerly to Market Street

South side – (NP Tues. 11:30 PM to Wed. 7 AM) From Market Street easterly to Pearl Street

South side – (NP Tues. 11:30 PM to Wed. 7 AM) From Franklin Arterial easterly to India Street

PEARL STREET

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Federal Street southerly to

Newbury St.

West side – (NP Tues. 11:30 PM to Wed. 7 AM) From Middle Street southerly to Fore Street

SILVER STREET

West side (NP Tues. 11:30 PM to Wed. 7 AM) From Milk Street southerly to Fore Street

West side (NP Tues. 11:30 PM to Wed. 7 AM) From Milk Street northerly to Middle Street

SPRING STREET

North side - (NP Sun. 11:30 PM to Mon. 7 AM) From Temple Street westerly to Cross Street

South side – (NP Tues. 11:30 PM to Wed. 7 AM) From a point easterly of Center Street to Union Street

TEMPLE STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From a point northerly of Middle Street to Federal Street

UNION STREET

East side - (NP Sun. 11:30 PM to Mon. 7 AM) From Wharf Street northerly to Fore Street

SERVICE AREA 4 – NO OVERNIGHT PARKING – TWICE MONTHLY SERVICE

No Overnight Parking – Tuesday

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Tuesday on the 1st and 3rd Tuesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 4 boundaries are described as follows:

East side of Eastern Promenade, Congress Street to Atlantic Street

South side of Fore Street, Atlantic Street to India Street

West side of India Street, Commercial Street to Congress Street

South side of Congress Street, India Street to Eastern Promenade

The following streets or segments of street are included within the boundaries Service Area #4:

CONGRESS STREET
EASTERN PROMENADE
FEDERAL STREET
FORE STREET
HANCOCK STREET

INDIA STREET
MIDDLE STREET
MOUNTFORT STREET
NEWBURY STREET
THAMES STREET

CONGRESS STREET

South side - (NP 2nd & 4th Tues.) From India Street easterly to Mountfort Street and from Kellogg Street to Munjoy Street

South side - (NP 2nd & 4th Tues.) From Mountfort Street to Kellogg Street and Munjoy Street to Eastern Promenade

EASTERN PROMENADE

East side - (NP 2nd & 4th Tues.) From a point opposite Atlantic Street easterly to the exit of Fort Allen Park

FEDERAL STREET

North side (NP 1st & 3rd Tues.) From Mountfort Street westerly to India Street

South side - (NP 2nd & 4th Tues.) From India Street easterly to Mountfort Street

FORE STREET

North side (NP 1st & 3rd Tues.) From Mountfort Street westerly to India Street

HANCOCK STREET

East side (NP 1st & 3rd Tues.) From Thames Street northerly to Federal Street

West side - (NP 2nd & 4th Tues.) From Federal Street southerly to Thames Street

INDIA STREET

East side (NP 1st & 3rd Wed.) From Fore Street northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Commercial Street

KELLOGG STREET

East side (NP 1st & 3rd Tues.) From Adams Street northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Adams Street

MIDDLE STREET

South side - (NP 2nd & 4th Tues.) From India Street easterly to Hancock Street

MOUNTFORT STREET

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Fore Street

NEWBURY STREET

North side (NP 1st & 3rd Tues.) From Mountfort Street westerly to India Street

South side - (NP 2nd & 4th Tues.) From India Street easterly to Mountfort Street

THAMES STREET

North side - (NP 1st & 3rd Tues.) From terminus westerly to India Street

South side - (NP 2nd & 4th Tues.) From India Street easterly to terminus

SERVICE AREA 5 – NO OVERNIGHT PARKING – TWICE MONTHLY SERVICE

No Overnight Parking – Wednesday

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Wednesday on the 1st and 3rd Wednesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Wednesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 5 boundaries are described as follows:

North side of Pine Street, Congress Street to a point following the North side of Pine Street extended to Valley Street

East side of Valley Street, Danforth Street to a point intersecting the North side of Pine Street extended

West side of St. John Street, Veteran's Circle to Park Avenue

North side of Park Avenue, St. John Street to Deering Avenue

West side of Deering Avenue, Park Avenue to Congress Street

South side of Congress Street, Deering Avenue to Pine Street

The following streets or segments of street are included within the boundaries of Service Area 5:

A STREET	HILL STREET
BLYTHE COURT*	HORTON PLACE*
BOYNTON STREET	HOULTON STREET
BRACKETT STREET	MACMILLEN ROAD
BRAMHALL PLACE*	MARSHALL STREET*
BRAMHALL STREET	NEAL STREET
C STREET	PARK AVENUE
CARLETON STREET	PINE STREET
CHADWICK STREET	RUSSELL STREET*
CHARLES STREET*	ST. JOHN STREET
CONGRESS STREET	TROWBRIDGE PLACE*
CRESCENT STREET	VALLEY STREET
D STREET	VAUGHN STREET
DEERING AVENUE	WALKER STREET*
DOW STREET	WEST STREET
ELLSWORTH STREET	WESCOTT STREET*
FOREST STREET	WESTERN PROMENADE
GILMAN STREET	WEYMOUTH STREET
GRANT STREET	

* Streets included within the designated boundaries, but not affected by the Parking Project

A STREET

North side (NP 1st & 3rd Wed.) From Gilman Street westerly to St. John Street

South side (NP 2nd & 4th Wed.) From St. John Street easterly to Gilman Street

BOYNTON STREET

South side (NP 2nd & 4th Wed.) From Forest Street easterly to Weymouth Street

BRACKETT STREET

North side (NP 1st & 3rd Wed.) From Pine Street westerly to Vaughan Street

South side (NP 2nd & 4th Wed.) From Bramhall Street easterly to Pine Street

BRAMHALL STREET

East side (NP 1st & 3rd Wed.) From Brackett Street northerly to Vaughan Street

East side (NP 1st & 3rd Wed.) From Chadwick Street southerly to West Street

West side (NP 2nd & 4th Wed.) From Bramhall Place southerly to West Street

C STREET

North side (NP 1st & 3rd Wed.) From Valley Street westerly to St. John Street

South side (NP 2nd & 4th Wed.) From St. John Street easterly to Valley Street

CARLETON STREET

East side (NP 1st & 3rd Wed.) From Pine Street northerly to Congress Street

CHADWICK STREET

East side (NP 1st & 3rd Wed.) From Bramhall Street southerly to Pine Street

West side (NP 2nd & 4th Wed.) From Bramhall Street southerly to Pine Street

CONGRESS STREET

North side (NP 1st & 3rd Wed.) From Deering Avenue westerly to St. John Street

South side (NP 2nd & 4th Wed.) From St. John Street easterly to a point opposite State Street

CRESENT STREET

North side (NP 1st & 3rd Wed.) From Charles Street easterly to Ellsworth Street

D STREET

North side (NP 1st & 3rd Wed.) From Valley Street westerly to St. John Street

South side (NP 2nd & 4th Wed.) From St. John Street easterly to Valley Street

DEERING AVENUE

West side (NP 2nd & 4th Wed.) From Grant Street southerly to a point opposite Cumberland Avenue

DOW STREET

West side (NP 2nd & 4th Wed.) From Brackett Street northerly to Congress Street

ELLSWORTH STREET

East side (NP 1st & 3rd Wed.) From Charles Street northerly to Hill Street

FOREST STREET

West side (NP 2nd & 4th Wed.) From Congress Street northerly to Park Avenue

GILMAN STREET

East side (NP 1st & 3rd Wed.) From Park Avenue southerly to Congress Street

East side (NP 1st & 3rd Wed.) From the terminus northerly to Congress Street

West side (NP 2nd & 4th Wed.) From Park Avenue southerly to the terminus

GRANT STREET

North side (NP 1st & 3rd Wed.) From Deering Avenue westerly to Weymouth Street

South side (NP 2nd & 4th Wed.) From Weymouth Street easterly to Deering Avenue

HILL STREET

North side (NP 1st & 3rd Wed.) From Bramhall Street westerly to Ellsworth Street

South side (NP 2nd & 4th Wed.) From Ellsworth Street easterly to Bramhall Street

MACMILLAN ROAD

West side (NP 2nd & 4th Wed.) From a point southerly of Congress Street (1 space)

NEAL STREET

East side (NP 1st & 3rd Wed.) From Brackett Street southerly to Pine Street

West side (NP 2nd & 4th Wed.) From Congress Street southerly to Pine Street

PARK AVENUE

North side (NP 1st & 3rd Wed.) From Deering Avenue westerly to St. John Street

South side (NP 2nd & 4th Wed.) From Gilman Street easterly to Deering Avenue

PINE STREET

North side (NP 1st & 3rd Wed.) From State Street westerly to Brackett Street

North side (NP 1st & 3rd Wed.) From Carleton Street westerly to Western Promenade

ST. JOHN STREET

East side (NP 1st & 3rd Wed.) From a point northerly the Valley Street, northerly to A Street

West side (NP 2nd & 4th Wed.) From a point northerly of Valley Street,, southerly to a point northerly of Valley Street

VALLEY STREET

East side (NP 1st & 3rd Wed.) From Danforth Street northerly to Park Avenue

West side (NP 2nd & 4th Wed.) From Congress Street southerly to St. John Street

West side (NP 2nd & 4th Wed.) From Congress Street northerly to Park Avenue

VAUGHAN STREET

East side (NP 1st & 3rd Wed.) From Pine Street northerly to Bramhall Street

West side (NP 2nd & 4th Wed.) From Bramhall Street southerly to Pine Street

WEST STREET

North side (NP 1st & 3rd Wed.) From Blyth Court westerly to Western Promenade

South side (NP 2nd & 4th Wed.) From Western Promenade easterly to Pine Street

WESTERN PROMENADE

East side (NP 1st & 3rd Wed.) From Pine Street northerly to West Street

West side - (NP Tues) From a point opposite West Street southerly to a point opposite Pine Street

WEYMOUTH STREET

East side (NP 1st & 3rd Wed.) From Congress Street northerly to Park Avenue

West side (NP 2nd & 4th Wed.) From Park Avenue southerly to Congress Street

SERVICE AREA 6 – NO OVERNIGHT PARKING – TWICE MONTHLY SERVICE

No Overnight Parking – Wednesday

Parking is prohibited between the hours of 12:01 AM Wednesday to 7:00 A.M. Wednesday on the 1st and 3rd Wednesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Wednesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 6 boundaries are described as follows:

West side of Preble Street, Marginal Way to Congress Street

North side of Congress Street, Preble Street to Deering Avenue

East side of Deering Avenue, Congress Street to Park Avenue

North side of Park Avenue, Deering Avenue to State Street.

West side of State Street, Park Avenue to Forest Avenue

North side of Marginal Way, Forest Avenue to Preble Street

The following streets or segments of street are included within the boundaries of Service area 6:

ALDER STREET
BRATTLE STREET
BROWN STREET
CASCO STREET
CONGRESS STREET
CUMBERLAND AVE
DEERING AVENUE
DEERING STREET PLACE
DEERING STREET
FOREST AVE
GRANT STREET
HANOVER STREET
HENRY STREET

HIGH STREET
MELLEN STREET
OAK STREET
OXFORD STREET
PARK AVENUE
PARRIS STREET
PORTLAND STREET
PREBLE STREET
SHEPLEY STREET
SHERMAN STREET
STATE STREET
VERNON PLACE*

* Streets included within the designated boundaries, but not affected by the parking project.

ALDER STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Portland Street northerly to

Kennebec Street

West side – (NP 2nd & 4th Wed 12:01 - 7:00 AM) from Portland Street northerly to Lancaster Street (April 1st to November 30th)

West side – (NP except 1st & 3rd Wed. 12:01 -7 AM, December 1st to March 31st.)
from Portland Street northerly to Lancaster Street

BROWN STREET

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Congress Street to a point northerly of Congress Street

CASCO STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From a point northerly of Congress Street to Cumberland Avenue

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Cumberland Avenue southerly to Congress Street

CONGRESS STREET

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Preble Street westerly to Deering Avenue

CUMBERLAND AVENUE

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Preble Street westerly to

Mechanic Street

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Mellen Street westerly to

Deering Avenue

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Mellen Street easterly to State

Street

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From High Street easterly to Forest

Avenue

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Casco Street easterly to

Brown Street

DEERING AVENUE

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue northerly to Grant Street

DEERING STREET PLACE

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Deering Street to a point southerly of Deering Street

FOREST AVENUE

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Portland Street northerly to a point opposite High Street

Extentsion

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From High Street Extention southerly to Park Avenue

HENRY STREET

Eastside - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From the terminus northerly to Deering Street

HIGH STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Congress Street northerly to Park

Avenue

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Congress Street northerly to

Grant Street

HIGH STREET EXTENTION

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Park Avenue to Forest Avenue

MARGINAL WAY

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From a point westerly of Preble Street Extention to a point easterly of Forest Avenue

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From a point easterly of Forest Avenue to Hanover Street

MELLEN STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Congress Street northerly to

Park Avenue

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Park Avenue southerly to

Congress Street

OAK STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Congress Street northerly to Cumberland Avenue

OXFORD STREET

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Preble Street westerly to Portland Street

PARK AVENUE

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From High Street westerly to

Deering Avenue

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Deering Avenue easterly to

High Street

PORTLAND STREET

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Preble Street westerly to Forest Avenue

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Forest Avenue easterly to Preble Street

PREBLE STREET

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Kennebec Street southerly to Congress Street

SHEPLEY STREET

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Casco Street westerly to Oak Street

South side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Oak Street easterly to Casco Street

STATE STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Park Avenue southerly to Congress Street

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Park Avenue southerly to Congress Street

STATE STREET EXTENSION

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Forest Avenue southerly to Park Avenue

SERVICE AREA 7 – NO OVERNIGHT PARKING – TWICE MONTHLY SERVICE

No Overnight Parking – Wednesday

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Wednesday on the 1st and 3rd Wednesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Wednesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 7 boundaries are described as follows:

Eastside of Preble Street, Marginal Way to Congress

Northside of Congress Street, Preble Street to Smith Street

Up to but not including the Westside of Smith Street, Congress Street to Fox Street

Up to but not including the Westside of Diamond Street, Fox Street to Marginal Way

Northside of Marginal Way, Diamond Street to Preble Street

The following streets or segments of street are included within the boundaries of Service Area 7:

BOYD STREET	LOCUST STREET
CEDAR STREET	MARGINAL WAY*
CHAPEL STREET*	MAYO STREET
CHESTNUT STREET	MYRTLE STREET
CONGRESS STREET	NORTH BOYD STREET*
CUMBERLAND AVE	OXFORD STREET
ELM STREET	PEARL STREET
FOX STREET	PREBLE STREET
FRANKLIN STREET*	SOMERSET STREET
KENNEBEC STREET	STONE STREET
LANCASTER STREET	WILMOT STREET

* Streets included within the designated boundaries, but not affected by Parking Project

BOYD STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue northerly to
end of street

West side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From end of street southerly to
Cumberland Avenue

CEDAR STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue northerly to Lancaster Street

West side – (EXCEPT 1ST & 3RD Wed. 12:01 - 7 AM) From Cumberland Avenue northerly to Lancaster Street

CHESTNUT STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue southerly to Congress Street

East side – (NP except 1ST & 3RD Wed. 12:01 - 7 AM.) From Cumberland Avenue northerly to Oxford Street

East side – (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Oxford Street to Lancaster Street

West side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Somerset Street southerly to Congress Street

CONGRESS STREET

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Smith Street westerly to Elm Street

CUMBERLAND AVENUE

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Smith Street westerly to Elm
Street

South side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Pearl Street easterly to Smith
Street

ELM STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue northerly to Kennebec
Street

West side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Congress Street northerly to Cumberland
Avenue

FOX STREET

Southside (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Franklin Arterial easterly to a point opposite Diamond
Street

KENNEBEC STREET

North side – (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Pearl Street westerly to Chestnut Street

Southside - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Chestnut street easterly to Pearl Street

LANCASTER STREET

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM)From Pearl Street westerly to Preble Street

South side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Cedar Street easterly to Pearl Street

LOCUST STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Congress Street northerly to Cumberland Avenue

MAYO STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue northerly to the terminus

West side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From the terminus southerly to Cumberland Avenue

MYRTLE STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Congress Street northerly to Oxford Street

West side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Congress Street northerly to Cumberland Avenue

West side - (NP except 1st & 3rd Wed. 12:01 – 7 AM) From Cumberland Avenue northerly to Oxford Street

OXFORD STREET

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Smith Street westerly to Boyd Street

North side – (NP except 1st & 3rd Wed. 12:01 – 7 AM) from Wilmot Street westerly to Pearl Street

Southside (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Preble Street easterly to Smith Street

PEARL STREET

East side-(NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue northerly to Oxford Street

PREBLE STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Lancaster Street southerly to Oxford

Street

East side (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue southerly to

Congress Street

SOMERSET STREET

North side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From a point opposite Pearl Street westerly to

Elm Street

South side (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Elm Street easterly to Franklin Arterial

STONE STREET

East side – (NP except 2nd & 4th Wed. 12:01- 7AM) From Oxford southerly to Cumberland

West side – (NP 2nd & 4th Wed. 12:01 – 7 AM) From oxford southerly to Cumberland

WILMOT STREET

East side - (NP 1st & 3rd Wed 12:01 - 7:00 AM) From Cumberland Avenue northerly to Oxford Street

West side - (NP 2nd & 4th Wed 12:01 - 7:00 AM) From Oxford Street southerly to Cumberland Avenue

SERVICE AREA 8– NO OVERNIGHT PARKING – TWICE MONTHLY SERVICE

No Overnight Parking – Tuesday

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Tuesday on the 1st and 3rd Tuesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 8 boundaries are described as follows:

West side of Diamond Street, Marginal Way to Fox Street

West side of Smith Street, Fox Street to Congress Street

North side of Congress Street, Smith Street to Eastern Promenade

East side of Eastern Promenade, Congress Street to Washington Avenue

North side of Plowman Street, Washington Avenue to Marginal Way

North side of Marginal Way, Plowman Street to Diamond Street

The following streets or segments of streets are included within the boundaries of Service

Area 8:

ANDERSON STREET	MARION STREET
CLEEVES STREET	MELBOURNE STREET
CONGRESS STREET	MERRILL STREET
COVE STREET	MONROE STREET
CUMBERLAND AVE	MONTGOMERY STREET*
DIAMOND STREET	MONTREAL STREET
EASTERN PROMENADE	MORNING STREET
E. LANCASTER STREET	NORTH STREET
EMERSON STREET	OXFORD STREET
EVERETT STREET	PLOWMAN STREET*
FOX STREET	QUEBEC STREET
GOULD STREET	ROMASCO LANE*
GREENLEAF STREET	SHERIDAN STREET
HAMMOND STREET	SMITH STREET

HOWARD STREET	30 SUMNER COURT*
LAFAYETTE STREET	TURNER STREET
MADISON STREET	WALNUT STREET
MARGINAL WAY	WASHINGTON AVE
	WILLIS STREET
	WINTHROP STREET

* Streets included within the designated boundaries, but not affected by the parking project.

CONGRESS STREET

North side (NP 1st & 3rd Tues. 12:01 - 7:00 AM) from Merrill Street to a point westerly of North Street and from Washington Avenue to Smith Street

CUMBERLAND AVENUE

North side - (NP 1st & 3rd Tues. 12:01 - 7:00 AM) from Washington Avenue westerly to Smith Street

South side - (NP 2nd & 4th Tues. 12:01 - 7:00 AM) From Smith Street easterly to Washington Avenue

EASTERN PROMENADE

East side - (NP 1st & 3rd Tues. 12:01 - 7 AM) From a point opposite Congress Street northerly to a point opposite Walnut Street

East side - (NP 1st & 3rd Tues. 4 - 6 AM) From a point opposite Walnut Street northerly to a point opposite East End School

West side - (NP 2nd & 4th Tues. 4 - 6 AM) From North Street southerly to Walnut Street

West side - (NP 2nd & 4th Tues. 12:01 - 7:00 AM) From Walnut Street southerly to Congress Street

NORTH STREET

East side - (NP 4 a.m. to 6 a.m. Mon.) from a point northerly of Walnut Street to Eastern Prom

West side - (NP 4 a.m. to 6 a.m. Mon.) from E. Prom to a point northerly of Walnut Street

WASHINGTON AVENUE

East side (NP 1st & 3rd Tues. 12:01 - 7:00 AM) From Congress Street northerly to Eastern Promenade

West side - (NP 2nd & 4th Tues. 12:01 - 7:00 AM)) From a point opposite Eastern Promenade southerly to Cumberland Avenue

Schedule XXXB

Schedule XXXB Added to the Traffic Schedule 11/2014

Service Area - "Nathan Clifford" -- No Overnight Parking – Twice Monthly Service

No Overnight Parking – Wednesday

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Tuesday on the 1st and 3rd Tuesday of the month for north & east side on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the south side & west side on the following streets or parts of streets.

Service Area " Nathan Clifford" boundaries are described as follows:

South side of Washburn Ave. – From the west side of Deering Ave. to the west side of Payson Street.

West side of Payson Street – From the south side of Washburn Ave. to the south side of Granite Street.

South side of Granite Street – From the west side of Payson Street to the east side of St. John Street,

North side of Falmouth Street – From the east side of St. John Street to the west side of Deering Ave.

West side of Deering Ave. – From the north side of Falmouth Street to the south side of Washburn Ave.

The following streets or segments of streets are included within the boundaries of the service area:

Deane Street	Deering Ave
Exeter Street*	Falmouth Street
Granite Street	Payson Street
Roberts Street	Washburn Ave.

* Streets included within the designated boundaries, but not affected by the Parking Project.

Deane Street

East side (NP 1st & 3rd Wed.) From Washburn Ave northerly to Falmouth Street

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Washburn Ave.

Deering Avenue

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Washburn Ave.

Falmouth Street

North side (NP 1st & 3rd Wed.) From Deering Avenue westerly to St. John Street.

South side (NP 2nd & 4th Wed.) From St. John Street easterly to Deering Avenue.

Granite Street

North Side (NP 1st & 3rd Wed.) From Deering Ave. westerly to St. John Street.

Payson Street

East Side (NP 1st & 3rd Wed.) From Washburn Avenue northerly to Falmouth Street

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Washburn Ave.

Roberts Street

East side (NP 1st & 3rd Wed.) From Granite Street northerly to Falmouth Street

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Granite Street

Washburn Avenue

North side (NP 1st & 3rd Wed.) From Deering Avenue westerly to Payson Street

Southside (NP 2nd & 4th Wed.) From Payson Street easterly to Deering Ave.

Schedule XXXB**Schedule XXXB Added to the Traffic Schedule 11/2014****Service Area - "Nathan Clifford" -- No Overnight Parking – Twice Monthly Service****No Overnight Parking – Wednesday**

Parking is prohibited between the hours of 12:01 AM to 7:00 A.M. Tuesday on the 1st and 3rd Tuesday of the month for north & east side on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the south side & west side on the following streets or parts of streets.

Service Area "Nathan Clifford" boundaries are described as follows:

South side of Washburn Ave. – From the west side of Deering Ave. to the west side of Payson Street.

West side of Payson Street – From the south side of Washburn Ave. to the south side of Granite Street.

South side of Granite Street – From the west side of Payson Street to the east side of St. John Street,

North side of Falmouth Street – From the east side of St. John Street to the west side of Deering Ave.

West side of Deering Ave. – From the north side of Falmouth Street to the south side of Washburn Ave.

The following streets or segments of streets are included within the boundaries of the service area:

Deane Street	Deering Ave
Exeter Street*	Falmouth Street
Granite Street	Payson Street
Roberts Street	Washburn Ave.

* Streets included within the designated boundaries, but not affected by the Parking Project.

Deane Street

East side (NP 1st & 3rd Wed.) From Washburn Ave northerly to Falmouth Street

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Washburn Ave.

Deering Avenue

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Washburn Ave.

Falmouth Street

North side (NP 1st & 3rd Wed.) From Deering Avenue westerly to St. John Street.

South side (NP 2nd & 4th Wed.) From St. John Street easterly to Deering Avenue.

Granite Street

North Side (NP 1st & 3rd Wed.) From Deering Ave. westerly to St. John Street.

Payson Street

East Side (NP 1st & 3rd Wed.) From Washburn Avenue northerly to Falmouth Street

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Washburn Ave.

Roberts Street

East side (NP 1st & 3rd Wed.) From Granite Street northerly to Falmouth Street

West side (NP 2nd & 4th Wed.) From Falmouth Street southerly to Granite Street

Washburn Avenue

North side (NP 1st & 3rd Wed.) From Deering Avenue westerly to Payson Street

Southside (NP 2nd & 4th Wed.) From Payson Street easterly to Deering Ave.

SCHEDULE XXXIA**SCHEDULE XXXI REPEALED BY CITY OF PORTLAND COUNCIL ORDER 11/2014****NO DAYTIME PARKING – CITY SERVICE AREAS****Summary:**

Service Area 4: Twice Monthly per Side of Street

Odd: 1st & 3rd Tuesday 10:00 AM to 2:00 PM

Even: 2nd & 4th Tuesday 10:00 AM to 2:00 PM

Service Area 6: Twice Monthly per Side of Street

Odd: 1st & 3rd Thursday 10:00 AM to 2:00 PM

Even: 2nd & 4th Thursday 10:00 AM to 2:00 PM

Service Area 8: Twice Monthly per Side of Street

Odd: 1st & 3rd Tuesday 10:00 AM to 2:00 PM

Even: 2nd & 4th Tuesday 10:00 AM to 2:00 PM

Details: Service Area 4: Page 2

Service Area 6: Page 5

Service Area 8: Page 7

Service Area 4 – No Daytime Parking – Twice Monthly Service

No Daytime Parking – Tuesday

Parking is prohibited between the hours of 10:00 AM to 2:00 PM Tuesday on the 1st and 3rd Tuesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 4 boundaries are described as follows:

East side of Eastern Promenade, Congress Street to Atlantic Street

South side of Fore Street, Atlantic Street to India Street

West side of India Street, Commercial Street to Congress Street

South side of Congress Street, India Street to Eastern Promenade

The following streets or segments of street are included within the boundaries Service Area #4:

ADAMS STREET	MOODY STREET
ATLANTIC STREET	MORNING STREET
BECKETT STREET	MOUNTFORT STREET
CONGRESS STREET	MUNJOY STREET
CUTTER STREET*	
EASTERN PROMENADE	NEWBURY STREET
FEDERAL STREET	O'BRIEN STREET
FORE STREET	PONCE STREET
GILBERT LANE*	SHERBROOK STREET
HANCOCK STREET	SHERIDAN STREET
HOYT'S LANE*	ST. LAWRENCE STREET
	THAMES STREET
INDIA STREET	VESPER STREET
KELLOGG STREET	WATERVILLE ST.
MIDDLE STREET	WILSON STREET
MONUMENT STREET	

***Streets included within the designated boundaries, but not affected by the parking project.**

ADAMS STREET

North side (NP 1st & 3rd Tues.) From Waterville Street westerly to Sheridan Street

South side - (NP 2nd & 4th Tues.) From a point opposite Sheridan Street easterly to Waterville Street

ATLANTIC STREET

East side (NP 1st & 3rd Tues.) From Eastern Promenade northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Fore Street

BECKETT STREET

East side (NP 1st & 3rd Tues.) From Moody Street northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Moody Street

CONGRESS STREET

South side – (NP 2nd & 4th Tues.) From Mountfort Stree easterly to Kellogg Street and Munjoy Street easterly to Eastern Promenade

EASTERN PROMENADE

East side - (NP 2nd & 4th Tues.) From a point opposite Atlantic Street easterly to the exit of Fort Allen Park

East side – (NP 2nd & 4th Tues.) From Cutter Street to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to a point opposite Cutter Street

West side – (NP 2nd & 4th Tues.) From Vesper Street to Atlantic Street

FORE STREET

North side (NP 1st & 3rd Tues.) From Atlantic Street to Mountfort Street

North side (NP 1st & 3rd Tues.) From Mountfort Street westerly to India Street

South side - (NP 2nd & 4th Tues.) From India Street to a point opposite Mountfort Street

South side – (NP 2nd & 4th Tues.) From a point opposite Mountfort Street to opposite Atlantic Street

KELLOGG STREET

East side (NP 1st & 3rd Tues.) From Adams Street northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Adams Street

MONUMENT STREET

North side (NP 1st & 3rd Tues.) From Munjoy Street westerly to Ponce Street

South side - (NP 2nd & 4th Tues.) From Ponce Street easterly to Munjoy Street

MOODY STREET

North side (NP 1st & 3rd Tues.) From Eastern Promenade westerly to Munjoy Street

South side - (NP 2nd & 4th Tues.) From Munjoy Street easterly to Eastern Promenade

MORNING STREET

East side (NP 1st & 3rd Tues.) From Eastern Promenade northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Eastern Promenade

MUNJOY STREET

East side (NP 1st & 3rd Tues.) From Eastern Promenade northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Eastern Promenade

O'BRION STREET

East side (NP 1st & 3rd Tues.) From Eastern Promenade northerly to Wilson Street

West side - (NP 2nd & 4th Tues.) From Wilson Street southerly to Eastern Promenade

PONCE STREET

East side (NP 1st & 3rd Tues.) From Monument Street northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Monument Street

SHERBROOK STREET

North side (NP 1st & 3rd Tues.) From St. Lawrence Street westerly to Waterville Street

SHERIDAN STREET

East side (NP 1st & 3rd Tues.) From Adams Street northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Adams Street

ST. LAWRENCE STREET

East side (NP 1st & 3rd Tues.) From Fore Street northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Fore Street

VESPER STREET

East side (NP 1st & 3rd Tues.) From Eastern Promenade northerly to Congress Street

West side - (NP 2nd & 4th Tues.) From Congress Street southerly to Eastern Promenade

WATERVILLE STREET

East side (NP 1st & 3rd Tues.) From Fore Street northerly to Monument Street

West side - (NP 2nd & 4th Tues.) From Monument Street southerly to Fore Street

WILSON STREET

North side (NP 1st & 3rd Tues.) From Eastern Promenade westerly to Atlantic Street

South side - (NP 2nd & 4th Tues.) From Atlantic Street easterly to Eastern Promenade

SERVICE AREA 6 – NO DAYTIME PARKING – TWICE MONTHLY SERVICE

No Daytime Parking – Thursday

Parking is prohibited between the hours of 10:00 AM to 2:00 PM on the 1st and 3rd Thursday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Thursday of the month for the South & West sides on the following streets or parts of streets.

Service Area 6 boundaries are described as follows:

West side of Preble Street, Marginal Way to Congress Street

North side of Congress Street, Preble Street to Deering Avenue

East side of Deering Avenue, Congress Street to Park Avenue

North side of Park Avenue, Deering Avenue to State Street.

West side of State Street, Park Avenue to Forest Avenue

North side of Marginal Way, Forest Avenue to Preble Street

The following streets or segments of street are included within the boundaries of Service area 6:

ALDER STREET
BRATTLE STREET
BROWN STREET
CASCO STREET
CONGRESS STREET
CUMBERLAND AVE
DEERING AVENUE
DEERING STREET PLACE
DEERING STREET
FOREST AVE
GRANT STREET
HANOVER STREET
HENRY STREET

HIGH STREET
MELLEN STREET
OAK STREET
OXFORD STREET
PARK AVENUE
PARRIS STREET
PORTLAND STREET
PREBLE STREET
SHEPLEY STREET
SHERMAN STREET
STATE STREET
VERNON PLACE*

* Streets included within the designated boundaries, but not affected by the parking project.

ALDER STREET

East side - (NP 1st & 3rd Thurs.) From Portland Street southerly to Cumberland Avenue

AVON PLACE

North side - (NP 1st & 3rd Thurs.) From a point westerly of the terminus to a point easterly of Avon Street

AVON STREET

East side - (NP 1st & 3rd Thurs.) From Deering Street northerly to Cumberland

Avenue

West side - (NP 2nd & 4th Thurs.) From Deering Street northerly to Cumberland Avenue

DEERING STREET

North side - (NP 1st & 3rd Thurs.) From High Street westerly to Mellen

Street

South side - (NP 2nd & 4th Thurs.) From Mellen Street easterly to High Street

GRANT STREET

North side - (NP 1st & 3rd Thurs.) From Deering Avenue easterly to High Street

South side - (NP 2nd & 4th Thurs.) From Deering Avenue easterly to High Street

HANOVER STREET

East side - (NP 1st & 3rd Thurs.) From Portland Street southerly to Cumberland Avenue (April 1st to November 30¹)
h

East side - (NP 2nd & 4th Thurs.. December 1st to March 31st)
from Portland Street southerly to Cumberland Avenue

West side - (NP 2nd & 4th Thurs.) From a point northerly of Portland Street southerly to Cumberland Avenue

HENRY STREET

Eastside - (NP 1st & 3rd Thurs.) From the terminus northerly to Deering Street

MECHANIC STREET

East side - (NP 1st & 3rd Thurs.) From Portland Street southerly to Cumberland Avenue (April 1st to November 30th)

East side - (NP except 11:30 P.M. Tue. to 7:00 AM. Wed. December 1st to March 31st)
from Portland Street southerly to Cumberland Avenue

West side - (NP 2nd & 4th Thurs.) From Portland Street southerly to Cumberland Avenue

PARRIS STREET

East side - (NP 1st & 3rd Thurs.) From Cumberland Avenue northerly to Portland Street

West side - (NP 2nd & 4th Thurs.) From Cumberland Avenue northerly to Portland Street (April 1st to November 30th)

West side - (NP 1st & 3rd Thursday Mon. Dec. 1st to March 31st)
from Cumberland Avenue northerly to Portland Street)

SHERMAN STREET

North side - (NP 1st & 3rd Thurs.) From High Street westerly to Deering Avenue

South side - (NP 2nd & 4th Thurs.) From High Street westerly to Deering Avenue

SERVICE AREA 8– NO DAYTIME PARKING – TWICE MONTHLY SERVICE

No Daytime Parking – Tuesday

Parking is prohibited between the hours of 10:00 AM to 2:00 PM Tuesday on the 1st and 3rd Tuesday of the month for North & East sides on the following streets or parts of the streets and on the 2nd and 4th Tuesday of the month for the South & West sides on the following streets or parts of streets.

Service Area 8 boundaries are described as follows:

West side of Diamond Street, Marginal Way to Fox Street

West side of Smith Street, Fox Street to Congress Street

North side of Congress Street, Smith Street to Eastern Promenade

East side of Eastern Promenade, Congress Street to Washington Avenue

North side of Plowman Street, Washington Avenue to Marginal Way

North side of Marginal Way, Plowman Street to Diamond Street

The following streets or segments of streets are included within the boundaries of Service

Area 8:

ANDERSON STREET	MARION STREET
CLEVES STREET	MELBOURNE STREET
CONGRESS STREET	MERRILL STREET
COVE STREET	MONROE STREET
CUMBERLAND AVE	MONTGOMERY STREET*
DIAMOND STREET	MONTREAL STREET
EASTERN PROMENADE	MORNING STREET
E. LANCASTER STREET	NORTH STREET
EMERSON STREET	OXFORD STREET
EVERETT STREET	PLOWMAN STREET*
FOX STREET	QUEBEC STREET
GOULD STREET	ROMASCO LANE*
GREENLEAF STREET	SHERIDAN STREET
HAMMOND STREET	SMITH STREET
HOWARD STREET	SUMNER COURT*

LAFAYETTE STREET

TURNER STREET

MADISON STREET

WALNUT STREET

MARGINAL WAY

WASHINGTON AVE

WILLIS STREET

WINTHROP STREET

* Streets included within the designated boundaries, but not affected by the parking project.

ANDERSON STREET

East side - (NP 1st & 3rd Tues.) From Cumberland Avenue northerly to Gould Street

East side - (NP 1st & 3rd Tues.) From Gould Street to Plowman Street

West side- (NP 2nd & 4th Tues.) from a point south of Plowman Street to a point north of Gould Street

West side - (NP 2nd & 4th Tues.) from Fox Street to Cumberland Avenue

CLEEVE STREET

East side - (NP 1st & 3rd Tues.) From Cumberland Avenue northerly to Oxford Street

West side (NP 2nd & 4th Tues.) From Oxford Street southerly to Cumberland Avenue

CONGRESS STREET

North side - (NP 1st & 3rd Tues.) From Eastern Promenade westerly to Merrill Street and from a point west of North Street to Washington Avenue

COVE STREET

East side - (NP 1st & 3rd Tues.) From Anderson Street northerly to Marginal Way

West side (NP 2nd & 4th Tues.) From Marginal Way southerly to Anderson Street

CUMBERLAND AVENUE

North side - (NP 1st & 3rd Tues.) From Merrill Street westerly to Washington Avenue

South side - (NP 2nd & 4th Tues.) from Washington Avenue easterly to Merrill Street

DIAMOND STREET

East side - NP 1st & 3rd Tues.) From Fox Street to a point northerly of Fox Street

West side (NP 2nd & 4th Tues.) from Marginal Way southerly to Fox Street

EASTERN PROMENADE

East side - (NP 1st & 3rd Tues.) From a point opposite Congress Street northerly to a point opposite

Walnut Street

West side (NP 2nd & 4th Tues.) From Walnut Street southerly to Congress Street

EAST LANCASTER STREET

North side - (NP 1st & 3rd Tues.) From Anderson Street westerly to Smith Street

South side (NP 2nd & 4th Tues.) From Smith Street easterly to Anderson Street

EMERSON STREET

East side - (NP 1st & 3rd Tues.) From Melbourne Street southerly to Congress Street

West side (NP 2nd & 4th Tues.) From Melbourne Street southerly to Congress Street

EVERETT STREET

North side - (NP 1st & 3rd Tues.) From Winthrop Street westerly to Anderson Street

South side (NP 2nd & 4th Tues.) From Anderson Street easterly to Winthrop Street

FOX STREET

North side - (NP 1st & 3rd Tues.) From Washington Avenue westerly to Anderson Street

South side (NP 2nd & 4th Tues.) From Anderson Street easterly to Washington Avenue

GOULD STREET

North side - (NP 1st & 3rd Tues.) From the terminus westerly to Anderson Street

South side (NP 2nd & 4th Tues.) From Anderson Street easterly to the terminus

GREENLEAF STREET

East side - (NP 1st & 3rd Tues.) From Oxford Street northerly to Madison Street

East side - (NP 1st & 3rd Tues.) From Everett Street northerly to Fox Street

West side (NP 2nd & 4th Tues.) From Fox Street southerly to Everett Street

West side (NP 2nd & 4th Tues.) From Madison Street southerly to Oxford Street

HAMMOND STREET

East side - (NP 1st & 3rd Tues.) From Fox Street northerly to Gould Street

West side (NP 2nd & 4th Tues.) From Gould Street southerly to Fox Street

HOWARD STREET

East side - (NP 1st & 3rd Tues.) From Congress Street northerly to Quebec Street

West side - (NP 2nd & 4th Tues.)

LAFAYETTE STREET

East side - (NP 1st & 3rd Tues.) From Congress Street northerly to Quebec Street

West side (NP 2nd & 4th Tues.) From Quebec Street southerly to Congress Street

MADISON STREET

North side - (NP 1st & 3rd Tues.) From Washington Avenue westerly to Anderson Street

South side (NP 2nd & 4th Tues.) From Anderson Street easterly to Washington Avenue

MARGINAL WAY

North side - (NP 1ST & 3RD Tues.) From a point opposite Plowman Street westerly to Diamond Street

South side (NP 2nd & 4th Tues.) From Diamond Street easterly to Plowman Street

MARION STREET

North side - (NP 1st & 3rd Tues.) From the terminus westerly to a point opposite Romasco Lane

South side - (NP 2nd & 4th Tues..) From Washington Avenue easterly to the terminus.

MELBOURNE STREET

North side - (NP 1st & 3rd Tues.) From Eastern Promenade westerly to North Street

South side (NP 2nd & 4th Tues.) From North Street easterly to Eastern Promenade

MERRILL STREET

East side - NP 1st & 3rd Tues.) From Congress Street northerly to Melbourne Street

West side (NP 2nd & 4th Tues.) From Melbourne Street southerly to Congress Street

MONROE STREET

North side - (NP 1st & 3rd Tues.) From Washington Avenue westerly to Greenleaf Street

South side (NP 2nd & 4th Tues.) From Greenleaf Street easterly to Washington Avenue

MONTREAL STREET

North side - (NP 1st & 3rd Tues.) From Eastern Promenade westerly to North Street

South side (NP 2nd & 4th Tues.) From North Street easterly to Eastern Promenade

MORNING STREET

East side - (NP 1st & 3rd Tues.) From Congress Street northerly to Turner Street

West side (NP 2nd & 4th Tues.) From Congress Street northerly to Turner Street

NORTH STREET

East side - (NP 1st & 3rd Tues.) From Congress Street northerly to a point north of Walnut Street

West side (NP 2nd & 4th Tues.) From a point northerly of Walnut Street to a point southerly of

Cumberland Avenue

West side (NP 2nd & 4th Tues.) From a point southerly of Cumberland Avenue to Congress Street

QUEBEC STREET

North side - (NP 1st & 3rd Tues.) From Eastern Promenade westerly to North Street

South side (NP 2nd & 4th Tues.) From North Street easterly to Eastern Promenade

SHERIDAN STREET

West side (NP 2nd & 4th Tues.) From Walnut Street southerly to Congress Street

East side - (NP 2ND & 4TH Tues.) from Congress Street northerly to Walnut Street

SMITH STREET

East side - (NP except 10 am To 2 PM 2nd & 4th Tues.) From Congress Street northerly to Cumberland Avenue

East side - (NP 1st & 3rd Tues.) From Cumberland Avenue northerly to the terminus

West side (NP 2nd & 4th Tues.) From the terminus southerly to Congress Street

TURNER STREET

North side - (NP 1st & 3rd Tues.) From Eastern Promenade westerly to Merrill Street

South side (NP 2nd & 4th Tues.) From Merrill Street easterly to Eastern Promenade

WALNUT STREET

North side - (NP 1st & 3rd Tues.) From Eastern Promenade westerly to Washington Avenue

South side (NP 2nd & 4th Tues.) From Washington Avenue easterly to Eastern Promenade

WILLIS STREET

East side - (NP 1st & 3rd Tues.) From Melbourne Street northerly to Walnut Street

West side (NP 2nd & 4th Tues.) From Walnut Street southerly to Melbourne Street

WINTHROP STREET

West side (NP 2nd & 4th Tues.) From Fox Street southerly to Madison Street

East side - (NP 2nd & 4th Tues.) - Madison Street to Fox Street

Odd/Even Parking Enforcement

Areas ticketed for odd/even are

- A. USM:** Freeman St., Falmouth St., Noyes, Deerfield, Dartmouth, and William Streets
- B. Libbytown:** Douglass St., Mass. Ave., Bolton St., Whitney Ave., Frances St., Scott St. Elizabeth Rd., & Huntress St
- C. DHS Area:** Columbia Rd, Lawn Ave., Pleasant Ave, Norwood St., Amherst St., Berkley St., Glenwood Ave. (between Pleasant and Woodfords), Higgins, Orkney, Tremont, Concord, and Crosby Streets.

Parking Tickets Issued for Street Maintenance Violations June-Sept. 2016

		# Tickets	Value
Penninsula Code 4	12:01a-7a	5,527	\$165,810
Old Port Code 4	11p-7a	<u>-715</u>	<u>\$21,450</u>
		\$6,242	\$144,360
East End Code 4	10a-2p Tues.	1,676	\$50,280
Parkside Code E	10a-2p Thurs.	658	<u>\$19,740</u>
	Subtotal		\$214,380
Odd/Even Libbytown, USM, Deerin		2,149	<u>\$32,250</u>
	TOTAL		\$246,630
			<u>X 70% collect rate</u>
			\$172,641 Est. Revenue

except while assisting a passenger to enter or exit the vehicle or to load or unload a passenger's baggage.

(Ord. No. 183-97, 1-22-97)

Sec. 28-114. Reserved.
Sec. 28-115. Reserved.
Sec. 28-116. Reserved.
Sec. 28-117. Reserved.
Sec. 28-118. Reserved.
Sec. 28-119. Reserved.
Sec. 28-120. Reserved.

ARTICLE IV. LICENSING OF TOW OPERATORS

*Editor's note--The schedule of tow fees is set by the City in Ord. No. 161-07/08, 3-3-08 as follows:

ORDERED, that the schedule of maximum rates permitted to be charged vehicle owners by wreckers for specified services listed below adopted pursuant to Chapter 28, Sections 275 and 303 (NOTE: now Section 125) of the Portland City Code, and by Council Order #30, dated June 7, 1989 and amended on May 16, 1994, January 19, 2000, Ord. No. 155-04/05, February 2, 2005, March 3, 2008, and Order 14-13/14 on July 15, 2013 is hereby replaced and amended as follows:

1. Towing of Vehicles or All-Terrain Vehicles

~~\$100.00~~~~85.00~~ per non-accident tow.

*The increase authorized by this subparagraph shall not go into effect until July 1, 2013 for the towing of a car during a declared snow ban.

~~\$125.00~~~~95.00~~ per accident tow.

\$105.00 for any vehicle with dual tires on the rear axle.

When a vehicle is off-road, submerged, rolled over or otherwise requires special equipment for retrieval before it can be towed, a charge of \$80 may be assessed in addition to the towing fee. If the recovery takes longer than one hour, a rate of \$80 per hour after the first hour may be charged.

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2. Once a wrecker has hooked a vehicle to the wrecker, a vehicle owner may take possession of his vehicle if the wrecker has not started to leave the scene with the vehicle and if the owner pays a ~~\$30.00~~~~25.00~~ fee in cash to the wrecker driver. Upon such payment, the wrecker shall release the vehicle. No towing fee shall be charged if the owner arrives to move his vehicle prior to the wrecker hooking up to the vehicle. In the case of a police-requested tow and to the extent possible, the wrecker shall not lose its place in rotation on the police

towing list if the tow is either cancelled or if the owner retrieves his vehicle prior to tow under this subsection. "Hooked or hooked up" for purposes of this subsection means that the wrecker has attached the vehicle to the wrecker by chains or by hook, or some other similar physical connection that must be detached before the vehicle can move, regardless of whether it has been lifted or moved. "Starts to leave the scene" means that the vehicle is fully attached for towing and the wrecker has begun to move from the scene.

When a vehicle is shoveled out by a tow operator in order to hook it up during a snow ban or for a snow removal conducted by or for the City, and a City employee engaged or participating in the snow removal process determines that the shoveling was reasonable and necessary to accomplish a hook up, the fee shall be \$25 regardless of whether the vehicle is hooked up when the vehicle owner arrives at the scene. In cases where the vehicle is shoveled out and hooked up the total fee to release the vehicle shall be \$25.

3. Storage of vehicles: ~~\$30.00~~ per day or part thereof. Storage charges shall begin twenty-four hours after the vehicle is towed.
4. The charge by the City for vehicles impounded or stored on City property pursuant to Chapter 28 shall be \$25.00 for impoundment and storage for the first twenty-four hours from the date and time of impoundment, and shall be \$10.00 for each day, or part thereof, thereafter.
5. Wrecker owners may charge a ~~\$30.00~~ release fee for vehicles released from storage after 7:00 p.m. and prior to 7:00 a.m. seven days a week and from 7:00 a.m. to 7:00 p.m. on Sundays or on official City holidays.
6. The Chief of police or his designee may authorize additional charges in unusual circumstances.
7. If a vehicle must be towed after the initial tow, wrecker owners may charge a ~~\$100.00~~ fee for each additional tow of the same vehicle performed at the City's request.
8. When a vehicle and trailer or two vehicles are towed at the same time the tow fee shall be \$130.

BE IT FURTHER ORDERED, that the above provisions apply to any tow of a vehicle without the owner's consent, including but not limited to private lot tows requested by a lot owner or manager, and to police requested tows of private vehicles, including but not limited to abandoned vehicle tows, snow tows, scofflaw tows and accident scene tows.

DIVISION 1. GENERALLY

Sec. 28-121. Purpose.

In order to protect the safety of persons who operate motor vehicles within the corporate limits of the city, to ensure that the streets and public ways of the city remain open and free of hazard to the public and to further effectuate the efficient enforcement of the city's traffic, parking, snow removal and other regulatory ordinances, it is determined necessary to ensure by licensing the regulation of persons engaged in the business of providing vehicle wrecker or towing and required repair services, to establish rates for such service to the extent permitted by law, to regulate the storage and disposition of vehicles so towed, and to set fees and penalties for the enforcement thereof.
(Ord. No. 183-97, 1-22-97)

Sec. 28-122. Definitions.

The following words and terms as used in this article shall have the common meanings ascribed thereto, except that the definitions set forth in chapter 15 or in this section shall apply, unless the context clearly indicates a different meaning:

Towing list means a list or lists maintained by the police department containing the names of those wreckers licensed by the city to respond to requests for the towing of vehicles made by the police department.

Wrecker means a person engaged in the business of, or offering the services of, a vehicle wrecker or towing service, whereby motor vehicles are or may be towed or otherwise removed from one (1) place to another by the use of a motor vehicle adapted to and designed for that purpose.
(Ord. No. 183-97, 1-22-97)

Cross reference(s)--Definitions and rules of construction generally, § 1-2.

Sec. 28-123. Minimum continuous regulations.

The following minimum regulations will be met on a continuous basis by all licensees:

- (a) Licensees shall operate and maintain storage and release facilities within the city, or within a radius of five

(5) miles from Portland City Hall, as may be necessary for safe and proper conduct of towing activities.

- (b) Licensees shall permit the chief of police to conduct one (1) regular and two (2) random inspections of each towing vehicle during the term of the license.
- (c) Licensees shall permit the chief of police to conduct one (1) regular and two (2) random inspections of each storage and release areas during the term of the license.
- (d) Licensees shall maintain such records as required by regulations promulgated by the chief of police pursuant to section 28-124 and shall permit their inspection by the chief or his or her designee during normal business hours.
- (e) Vehicles must be towed, not driven, to storage lots.
- (f) Licensees must provide a secure storage area in accordance with regulations promulgated in accordance with section 28-124.
- (g) No vehicle shall be towed to a lot outside of the city unless pursuant to subsection (1) of this section or unless it has been unclaimed for thirty (30) days and only upon the prior written notice to the police chief or his or her designee.
- (h) The police chief or his or her designee must be notified of any unclaimed vehicle by electronically reporting the relevant information from the invoice or tow slip for any unclaimed vehicle once a week to the police chief or his or her designee. Said information shall be electronically reported by Tuesday each week and shall include information for each vehicle in licensee's possession that remains unclaimed on the last day of the preceding week.
- (i) Licensees shall clean the accident area of all nonhazardous vehicular debris resulting from the accident, if there be any.
- (j) Licensees shall not make any repairs to vehicles without the consent of the owner.

- (k) Vehicles shall be released from storage in accordance with regulations promulgated by the chief of police pursuant to section 28-124.
- (l) Licensees shall hold the city harmless from all claims for damages to property and injuries to persons resulting from the licensees' negligence in the towing or storage of vehicles pursuant hereto.
- (m) Licensees shall not require the owner of the towed vehicle to pay any charge unless signage warning that unauthorized vehicles will be towed at the vehicle owner's expense is posted clearly and conspicuously at each entrance and exit of nonresidential property from which the vehicle is removed or said signage is clearly and conspicuously visible from all entrances of the lot. Signs must include information about how a missing vehicle may be located.
- (n) Licensees shall conspicuously post current rates for services under this article at the release facility.
- (o) Licensees shall release vehicles within one (1) hour of the owner's request.

(Ord. No. 183-97, 1-22-97; Ord. No. 27-08/09, 8-4-08)

Sec. 28-124. Regulations may be promulgated by chief of police.

The chief of police is hereby authorized to promulgate regulations not inconsistent with this article to carry out the intent of the article. All licenses issued pursuant to this article shall be subject to such applicable regulations as are adopted hereunder either prior to or after the date of the issuance thereof.

(Ord. No. 183-97, 1-22-97)

Sec. 28-125. Rates for services.

Maximum rates for services regulated by this article shall be established by the city council after written notice to licensees and a public hearing thereon.

(Ord. No. 183-97, 1-22-97)

Sec. 28-126. Disposition of abandoned vehicles.

- (a) The licensee shall comply with the procedures set forth

in Title 29-A M.R.S.A., Chapter 15, Subchapter III.

(b) In the event of an unclaimed or abandoned vehicle, the licensee's sole remedy shall be as outlined in Title 29-A M.R.S.A., Chapter 15, Subchapter III regarding unclaimed and abandoned vehicles. A licensee may be reimbursed for administrative and legal costs incurred should the vehicle owner seek to re-claim the vehicle. Reimbursement shall be subject to review and approval by the Chief of Police or designee.

(c) A copy of Title 29-A M.R.S.A., Chapter 15, Subchapter III shall be issued to each licensee and shall be available to the public in the city clerk's office.
(Ord. No. 183-97, 1-22-97)

Sec. 28-127. Release of vehicles impounded pursuant to provisions for towing parked vehicles.

Whenever a vehicle has been removed and stored pursuant to police request, it shall not be released until the provisions of section 28-103(a), (b) or (c) concerning the payment of waiver fees and charges owed to the city have been complied with. 7.
(Ord. No. 183-97, 1-22-97)

Sec. 28-128. Solicitation of business.

No wrecker may respond to the scene of an accident or emergency for the purpose of towing vehicles unless specifically called there by the police or person involved in the accident or emergency. This section is intended to prohibit wrecker owners from soliciting business at the scenes of accidents and emergencies and shall not be construed to prohibit any wrecker from contracting with any person providing the wrecker owner, his or her agents and employees do not solicit towing contracts at the scene of accidents or emergencies.
(Ord. No. 183-97, 1-22-97)

Sec. 28-129. Removal of towed vehicle or parts thereof from wrecker's lot.

No vehicle or part or accessory thereof that has been towed by police request shall be removed from the possession or premises of the licensee or owner of the storage area, except in accordance with section 28-103. This shall apply to and include, without limitation, the owner of such vehicle. Nothing herein shall

prohibit the licensee from acting in accordance with this article. Upon written application of the owner of a vehicle being held by the licensee, the chief of police or authorized representative may make suitable arrangements for the retrieval of specified personal property of the registered owner if satisfied that there are exigent circumstances requiring retrieval prior to the owner reclaiming the vehicle. For purposes of this section, "personal effects" includes medications, medical equipment, clothing, mail, child safety seats and similar items. Except for child safety seats, items attached to the vehicle and business equipment, machinery and tools are not considered personal effects.

(Ord. No. 183-97, 1-22-97)

Sec. 28-130. Enforcement.

(a) Any violation of this division shall be punishable by a fine as provided in section 1-15.

(b) The chief of police or his designee may, prior to commencement of court action, issue a notice of violation to any person charged with a violation of this division. Said notice shall be in a form approved by the corporation counsel and shall provide a method by which a person charged with a violation of this division may waive court action with respect to the violation by payment of a specified fee within a stated period of time.

(Ord. No. 183-97, 1-22-97)

Sec. 28-131. Reserved.

Sec. 28-132. Reserved.

Sec. 28-133. Reserved.

Sec. 28-134. Reserved.

Sec. 28-135. Reserved.

DIVISION 2. LICENSE*

*Cross reference(s)--Licenses and permits generally, Ch. 15.

Sec. 28-136. Required.

(a) No towing or wrecking service shall tow any vehicle within the city without the express knowledge or consent of the

Maine Cities TOW Rates

September 5, 2017	Police Dept. Phone #	Charge For Tow	Storage/Release	Tow for Sweeping
City of Auburn	784-7332	\$150.00	First 24 hrs free then Dependant on wrecker	Yes
City of Augusta	626-2362 or 626-2370 #1	Day(8a-8p)\$65/Night\$75	\$25p/d(after 1st 24)	Seldom
City of Bangor	Union st tow 942-8663	65 day \$70 night	\$25p/d(after 1st 24)	Yes
City of Biddeford	282-5127	7am-5pm- \$90 5pm-7am- \$105	\$50p/d(after 1st24)/\$25(after hrs)	No
City of Lewiston	795-9002	See Auburn		Yes
City of Sanford	324-9170	Dependant on wrecker	Dependant on wrecker	No
City of So. Portland	799-5511	\$100 eff Jan. 2017	\$25p/d(after 1st24)/\$25(after hrs)	No
City of Westbrook	854-2531	Non-Accident \$85/Accident \$95 Dual Rear \$105	\$30p/d(after 1st24)/\$40Release	No
City of Portland		\$85.00	\$25p/d(after 1st24)	Yes



Memorandum

TO: Chair Thibodeau; Sustainability & Transportation Committee
FROM: Michael Murray, Assistant to the City Manager
CC: Jon Jennings, City Manager
Michael Sauschuck, Chief of Police
John Peverada, Parking Manager
SUBJECT: Proposed Towing Fee Increases
DATE: October 11, 2017

OBJECTIVE:

To review and make recommendations to the fee schedule for towing operators.

BACKGROUND:

The City of Portland regulates the fees paid to tow companies/operators for services provided to the City of Portland. Private towing companies are an integral component to safe streets in the city of Portland as they provide services to accidents, illegally parked vehicles, and assist in achieving snow ban compliance. Representatives of the towing companies have requested that the tow fees be increased as a result of increased costs since the fees were last adjusted.

On September 28, 2017, City staff, including representatives of the Portland Police Department, Portland Parking Division, and the City Manager's Office met with tow operators to discuss possible fee increases. Additionally, Portland Parking Division provided staff with a history of towing fee adjustments in the City of Portland, as well as survey results of parking fees paid by other Maine cities and various New England cities to tow company operators.

RECOMMENDATIONS:

After meeting with representatives of area tow companies, and reviewing the attached survey data, City staff recommends that the tow fees be adjusted as follows:

1. Non-accident tow: increase from \$85.00 to \$100.00; this fee was last adjusted in July, 2013.
2. Accident tow: increase from \$105.00 to \$125.00; this fee was last adjusted in July, 2013.



3. Storage of Vehicles: increase from \$25.00 to \$30.00; this fee was last adjusted in February, 2008.
4. After hours release: increase from \$25.00 to \$30.00; this fee was last adjusted in February, 2008.
5. Vehicle re-tows: increase from \$85.00 to \$100.00; this fee was last adjusted in July, 2013.
6. Hook up/Drop fee: increase from \$25.00 to \$30.00; this fee was last adjusted in 1994.
7. Additionally, City staff recommends that recovery charges be addressed in City Code. Recovery charges are incurred when a vehicle has left the roadway, is submerged, rolled over, or otherwise requires special equipment for retrieval before it can be towed. Staff recommends that a charge of \$80.00 be assessed in addition to the towing fee. If the vehicle recovery takes longer than one hour, a rate of \$80.00 per hour may be charged after the first hour.
8. Tow operators also requested reimbursement of administrative and legal costs incurred by tow companies during disposition of unclaimed or abandoned vehicles, as set out in Sec. 28-126, if the owner decides to re-claim the vehicle. Staff recommends that such costs be reimbursed only after documentation of expenses have been provided to and authorized by the Portland Police Department.
9. Tow companies also requested a change to after hour release language, to expand the hours from 5pm to 9 am weekdays, and to add Saturday from 7 am to 7pm to the current after hour schedule. The current after hour schedule is after 7:00 p.m. and prior to 7:00 a.m. seven days a week and from 7:00 a.m. to 7:00 p.m. on Sundays or on official City holidays. City staff recommends that no change be made to this schedule.
10. Tow operators also requested that consideration be given to allow wrecker companies to assess an additional fee for no shows for vehicle releases after hours. City staff does not recommend an additional fee.
11. Tow operators also requested a similar fee for vehicle owners who call after hours to retrieve personal possessions from the towed vehicle. City staff does not recommend an additional fee. However, City staff does recommend additional language be added to City Code to clarify what items are included as personal possessions. The proposed language, which mirrors current state statute, provides clarity as to what may be removed from a towed vehicle without reclaiming it.



For your review are the following attachments:

1. Proposed changes to Chapter 28 in red-line form;
- 2.** Survey of Maine City Tow Fees;
- 3.** Survey of New England City Tow Fees;
4. A History of Portland Tow Fees.

Out of State Tow Rates STATE TOW RATES

September 5, 2017

	Charge For City Authorized Tow	After Hours Pick Up Fee	Storage Fee	City Owned Tow Trucks	City Owned Impound Lot	Tow For Street Sweeping
New Bedford, MA (508)991-6336	\$108.00	not sure	\$37.50	No	No	temporary signs
Cambridge, MA (617)349-4713	\$100.00	No	\$37.50	No	No	Yes
Hartford, CT (860)527-6300	93..59	Dependent on Wrecker	1st 24hrs included in Tow Fee/After Varies	No	No	Yes
Lowell, MA (978) 937-3225	\$108.00	no	\$38	No	No	temporary signs
Manchester, NH (603)668-8711	\$110.00	\$25.00 after 5:00PM	\$30(after 1st 24)	No	No	temporary signs
* Worcester, MA (508)799-8687	\$108, Fuel cost \$4-5	No	\$38	No	No	Yes
Fall River, MA (508)676-8511	\$108, Fuel cost \$4-5	No	\$37.50	No	no	no
Springfield, MA (413)787-6363	\$108, Fuel cost \$4-5 CJ towing 413-543-9100	No	37.5	No	no	no
Boston, MA (617)635-4687	\$108, Fuel cost \$4-5	yes	\$37.50	Yes	Yes	no
PORTLAND, Maine	\$85.00	\$25	\$25.00	No	No	Yes

NOTE

State wide regualtion for Massachusetts, \$108.00 tow fee, \$3.00/mile charge after 5 miles, 6% fuel charge + \$35.50 per 24 hr for storage
<http://www.lawlib.state.ma.us/source/mass/cmr/>

TOWING Issues for Jan./Feb. 2005 Council Meeting

TOW RATE HISTORY

	Prior	1989	1994	2000	Feb. 2005*	Feb. 2008	July 2013
				Current	City Council	City Council	City Council
Day Tow	30	40	50	50	65	70	85
Night Tow	40	50	50	50	65	70	85
Snow Tow	40	50	50	50	65	70*	85
Accident Tow			50	60	75	75	95
"City Vehicle"*			25	25	Pay Market	Pay Market Rate	Pay Market Rate
Vhcl. Over with <i>Dual Rear Wheel</i>	?	?	70?	70?	90	90	105
Hooked Up/drop			25	25	25	25	25
2 nd /Retows		20	25	25	25	25	85
Storage/day after <i>24 hours</i>	4	10	10	15 after 24	20	25	25
After Hour Release <i>7:00 p.m.-7:00 a.m.</i>	15	15	15	15	20	25	25
All day Sunday				15	20	25	25
City Holidays		Same as Sundays			20	25	25

NOTES:

Items in bold = changed

OTHER Tow items amended/changed

1. **Hooked Up** definition expanded to mean wrecker has attached the vehicle to the wrecker by chains or by hook, or *some other similar physical connection that must be detached before the vehicle can move*. A flat bed touching the tires is not hooked up.

2. During Snow Ban if a wrecker driver shoves out vehicle prior to hooking up then a \$25 fee is due, regardless of whether the vehicle is hooked up, but if it is hooked up and shoveled the fee is still only \$25.

3. Rates for large Vehicles w/ dual wheels is \$105 eff July 25, 2013

4. If a wrecker tows 1 vehicle with a trailer attached then the fee is double

* **Goes into effect February 17, 2005** Snow Ban Tow will remain at \$50 for this season ending 6/30/05

*Snow Ban Tow will remain at \$65 for this season ending 6/30/08



BAYSIDE ADAPTS PHASE 1

Sewer & Stormwater System Data Gap Analysis



September 1, 2017
Project Number. 230429.00



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Appendix D	Areas Recently Surveyed





Acknowledgements

Bayside Adapts, Phase I was overseen by the New England Environmental Finance Center and supported by City staff from numerous departments.

Prepared for:
City of Portland, Maine



By:
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Special thanks to:
Bayside Area Working Group





BAYSIDE ADAPTS

How do we make our neighborhood more resilient to flooding?
Effective planning starts with good information.

Executive Summary





WORKING TOWARD A RESILIENT BAYSIDE

Flooding has been a problem in Portland's Bayside area for decades. The low-lying neighborhood is already susceptible to flooding during high tides. When coupled with heavy rain, these conditions worsen. The City and its partners have been working to address flooding in Bayside and are identifying the key information and tools necessary to address today's issues and to adapt to tomorrow's changing climate.

With the right tools, collaboration, and planning, the City can select the most cost-effective, community-enhancing adaptation alternatives. This document summarizes the additional data collection needs which will serve as the foundation for adaptation planning in Bayside. In-depth detail on these topics is presented in a 2017 report entitled Bayside Adapts Phase 1 – Sewer & Stormwater System Data Gap Analysis.

EFFECTIVE ADAPTATION PLANNING REQUIRES GOOD INFORMATION AND THE RIGHT MODELING TOOLS

Coastal urban flooding is caused by several factors which must be collectively considered to properly plan for, predict, and identify effective flood management options. Factors include storm and sewer system pipe capacity, tide level, and precipitation rates, amongst others. Computer-based modeling tools are often used to simulate and assess the combined effects of these key factors on flooding. Modeling tools need quality information to produce useful results. Obtaining the appropriate amount of information and building an accurate model is key to enhanced, effective, and cost-efficient adaptation planning in Bayside.

DO WE HAVE GOOD INFORMATION AND THE RIGHT MODEL TOOLS?

Good information and a model exist. The City has:

- ▶ Reasonably up-to-date information on the location of drainage and combined sewer pipes and structures (GIS data)
- ▶ High-resolution and recent surface elevation data
- ▶ Schematic drawings of Special Structures that currently control tide intrusion into the combined sewer
- ▶ Recent survey information covering most of the key sewer and combined sewer areas in Bayside and obtained as part of implementing the City's multi-million-dollar sewer infrastructure improvement program
- ▶ A hydraulic and hydrologic model of the major combined sewer drains (SWMM Model)

However, more information is required. The City needs:

- ▶ Compilation and extraction of recent survey information for integration into City GIS
- ▶ Additional model expansion for surface flooding prediction and adaptation decision support
- ▶ Targeted field surveys and condition assessments of critical drain pipes and structures

BAYSIDE'S SEWER AND STORMWATER SYSTEMS

Bayside's sewer and stormwater system is made up of over 20 miles of pipe, over 950 structures and has 7 primary outlets into the Back Cove.





WHAT WE KNOW ABOUT THE FUTURE

The contributors to flooding in Bayside are rainfall, sea level (tides), and the adequacy and functionality of the drainage system. The following table includes current projections of Portland-specific sea level and climate change information to assist with flood and adaptation planning.

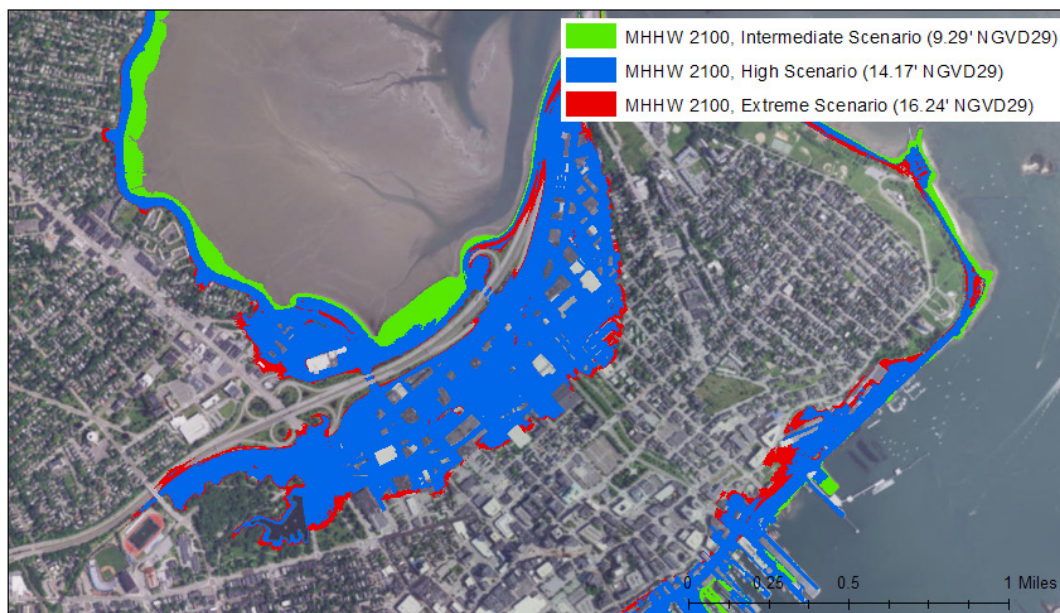
Year 2050		Year 2100	
	Rise in Sea Level		Rise in Sea Level
Commit to Manage	1.5 ft.	Commit to Manage	3.8 ft.
Prepare to Manage	3.4 ft.	Prepare to Manage	8.8 ft.
		Be Aware of	10.8 ft.

**Source: The 'Rise in Sea Level' values are the Relative Sea Level rise values for the Intermediate, High, and Extreme scenarios for Portland, ME reported by a NOAA publication titled "Global and Regional Sea Level Rise Scenarios for the United States" (Sweet et al, 2017).*

Commit to Manage represents the most statistically likely to occur scenario. *Prepare to Manage* represents a less likely to occur scenario, but more consequential event if not managed appropriately. *Be Aware of* represents the 'Extreme Scenario', a very low probability, but high consequence event. In the years to come, Portland will continue to evaluate these numbers against the latest climate science data to determine if the 'High' or 'Extreme' scenarios increase in probability, and whether adjustments are needed to these sea level rise projections.

In addition to identifying the sea level rise projections, Portland-specific storm surge and precipitation tables have also been researched to aid in future modeling and planning. These climate change tables, combined with enhanced sewer and drain system information, ground surface information, and other model inputs, will provide the necessary information for flood predication modeling and the selection of the most cost-effective and community enhancing adaptation alternatives. One way the City can use this information today is establishing new design standards for development based on the projected precipitation and sea level information.

DAILY HIGH TIDE LEVELS IN 2100



Note: Daily high water levels are predicted using a base water level elevation of Mean Higher High Water (MHHW) for the Relative Sea Level rise values reported for Portland by Sweet et al (2017). MHHW is a tidal datum established by NOAA that represents the average high-water level reached daily. The figure is for illustrative purposes only as it is derived using a "bathtub" GIS analysis; it does not account for tidal flooding through the current stormwater conveyance system. Dynamic storm drain modeling is necessary to provide an actual detailed depiction of likely inundation areas.





THE STEPS TOWARDS A SAFER AND FLOOD RESILIENT BAYSIDE





Section 1

Introduction & Background Information





1. INTRODUCTION & BACKGROUND INFORMATION

In the fall of 2016, the City of Portland issued a request for proposals for planning and engineering services to facilitate climate change adaptation planning in the Bayside Neighborhood. Known broadly as Bayside Adapts, the Sewer & Stormwater System Data Gap Analysis project was framed to specifically improve the City's understanding of flooding caused by intense rainfall, extreme tides and sea level rise in this low-lying neighborhood both now and in the future.

Numerous initiatives, studies and processes have analyzed and projected the coastal impact of storm surge and sea level rise in the northeast region. The information available is from many different sources and not necessarily analyzed specifically for the City of Portland. To improve the City's understanding of this information and be able to utilize it effectively, the project team of Woodard & Curran, RPS ASA and Jordan Environmental Engineering collaborated with the City to use a multi-disciplinary approach to bring together the big picture potential changes to our City's climate with an in-depth look at what information the City needs to improve their knowledge of the sewer and stormwater infrastructure assets. This information together will help position the City to initiate a follow-on process – Bayside Adapts, Phase II.

1.1 Project Goals

For the Bayside Adapts, Phase 1 project, the City identified seven key goals which include:

- Assess the understanding of sewer, combined sewer and stormwater drainage areas in the study area,
- Define the validity and extent of existing information on system connectivity, functionality, performance and capacity,
- Define the data necessary to accurately model system performance and capacity for a range of rainfall, tide and sea level rise scenarios,
- Interview key department staff for operational and maintenance knowledge pertinent to areas of persistent system failures,
- Identify approaches the City is considering to address stormwater/wastewater management and flooding in Bayside and to what degree those approaches may be effective,



Photo: Bayside Area Working Group Meeting, December 2016

- Analyze historic extreme rain, tide and storm surge events incorporating predictable damage and community disruption, and
- Identify new (if any) immediate priority actions to lessen flooding risks and impacts discovered during the project.

1.2 Climate Change Adaptation Planning in Portland

In the City of Portland's recent Comprehensive Plan update (2017), it is acknowledged that climate change will have significant impacts on the City and there is a desire to mitigate and adapt. During the community engagement piece of the project, the City heard from participants their concern about climate change which helped guide the formation of the plan's overall vision. Climate change has been identified specifically as an environmental challenge faced by the City that will have local, regional and potential global implications and will also require collaboration and coordination to adequately and appropriately adapt to. Prior to the comprehensive plan, numerous studies and initiatives have been undertaken to inform the City of Portland about the projected coastal impact of storm surge and sea level rise. Many regional assessments provide valuable climate change predictions. The information from these studies was utilized in this data gap analysis as a first step in helping the City focus its adaptation efforts. Available information includes:





Local Plans, Studies, Resources

- Ocean Gateway Infrastructure Planning (2005)
- Sustainable Portland Report (2007-2009)
- Maine Climate Change Adaptation Task Force (2009 – 2010)
- City Council Resolution on Sea Level Rise Adaptation (2011)
- Bayside Vulnerability Assessment (2011)
- Commercial Street/Waterfront Vulnerability Assessment (2013)
- Urban Land Institute – Urban Resiliency Panel (2014)
- City of Portland Comprehensive Plan Update (2017)
- Flooding Response Protocols – Internal Staff Process (2015 – 2016)

While not all of these projects focus specifically only on Bayside, understanding the body of knowledge that exists helped inform the discussion for this project and provided a comprehensive, detailed investigation of approaches being considered throughout the City. To further understand the body of research available, the project team also referenced other relevant existing work, which is listed in Section 7.0.

1.3 Climate Change Implications in Portland

Climate change adaptation planning is an issue with wide ranging impacts and it knows no physical, social or political boundaries. The Bayside neighborhood has a unique history in that much of it is filled tidal flats which have been modified substantially over time since 1870 (**see Figure 1**). Prior to the fill, Bayside was part of the Back Cove or tidal marsh. Bayside started to become upland area when it was partially filled with debris from the Great Fire of 1866. Subsequent filling of Bayside created more upland area, and transformed the landscape into a present day urban residential and industrial area of the City, home to warehouses, scrapyards, manufacturing and small businesses. Today, Bayside is seeing a significant interest and investment from commercial and residential developers as well as light industrial manufacturing uses and craft breweries. The residential nature of the neighborhood is another key factor in the need to determine next steps for improved flood control and climate change considerations.





Figure 1: Historic Fill in Bayside Neighborhood 1870 - 2003



During heavy rain events, particularly when they coincide with a high tide or astronomical high tide, parts of Bayside flood. The existing stormwater and combined sewer system in Bayside is stressed by these high tides, storm surge, and extreme precipitation events. During storm events with heavy precipitation, sewer, combined sewer and stormwater systems in Bayside can reach their capacity, resulting in wastewater discharges in the coastal receiving waters, which can be damaging to the environment and pose health risks. The potential for high precipitation events in low-lying coastal areas often coincides with storm surge events due to the characteristics of coastal storms. Understanding these events is an important aspect of scenario development. Understanding how the system responds to current and historical events is also key to predicting how it will respond to increasingly severe conditions in the future.

1.3.1 What is the City Currently Doing - CSO Abatement In Bayside

The City of Portland remains committed to Combined Sewer Overflow abatement within the Bayside neighborhood. Numerous projects have been completed, are ongoing, or are planned to separate stormwater from combined sewers. In addition, a major project (Back Cove South Combined Sewer Storage Conduit) that would temporarily store combined sewage and stormwater and then route this stored wastewater to the East End Wastewater Treatment Facility is in

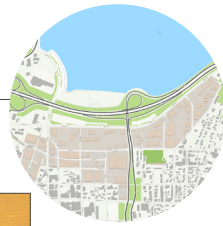
the design evaluation stage. While combined sewer overflow abatement is ultimately a stormwater management activity, the design objectives for these projects do not directly address flooding or flood control. The City is currently implementing improved tide inundation protection as a part of the installation of new stormwater drainage at Preble Street. Another mechanism the City is using to improve conditions is by requiring parcel developers to control stormwater runoff during redevelopment projects which will reduce the peak rate of runoff from an individual parcel.

1.4 The Data Gap Analysis

The City of Portland has many competing needs for operational and capital improvement budgets. It is challenging to identify and prioritize the funding and implementation of these projects. The decisions of investing to maintain and rehabilitate versus rebuild and redevelop are further complicated by considerations of climate change, which leaves coastal infrastructure with increased vulnerability. The exciting part of facing these complications is the potential for solutions that address not one, but multiple issues. This data gap analysis was prepared using a multi-disciplinary approach so that it can be applied widely, is repeatable, and is useful to address other needs.

While the City of Portland has already undertaken a tremendous amount of valuable work and developed related model improvements for the upland portions





of the Bayside drainage area, the influence of coastal water levels on the entire City of Portland, particularly Bayside, is having an impact that must be considered in future analyses of the system. One of the key issues for this project is understanding the influence of tides and storm surge on the stormwater system, now and into the future. To evaluate these impacts we have detailed how existing data and models currently used to manage the drainage system should be combined with tidal and storm surge predictions from ocean models to understand hydraulic limitations of the system. In this process we have flagged data gaps that must be filled before undertaking new modeling.

Conducting a technical data gap analysis of the sewer and stormwater drainage system will help the City to advance its understanding of the coastal influences and vulnerabilities (impacts) to the Bayside neighborhood, infrastructure, development, economic resources, cultural assets and natural systems, which is critical so decision-makers can continue to engage the public, identify funding, and move forward with informed adaptation planning and projects.

1.5 Collaboration With the Bayside Area Working Group

Woodard & Curran and our project partners RPS ASA and Jordan Environmental Engineering collaborated with the New England Environmental Finance Center (NEEFC) and the Bayside Area Working Group (BAWG); an essential component of public engagement during the Bayside Adapts planning effort.

The project team met with the NEEFC Project Manager and BAWG in March and June of 2017 to discuss the data gap analysis and receive feedback, in addition to attending other BAWG meetings to observe the public process. The BAWG was also involved in a Design Challenge which focused on developing concepts for adaptive approaches throughout Bayside to address rising sea levels. Illustrative design concepts were submitted from five applicants to help the community envision a viable future for Bayside and Woodard & Curran provided technical assistance for the event.





Section 2

The Sewer & Stormwater Systems in Bayside





2. BAYSIDE FLOODING AND DRAINAGE SYSTEM OVERVIEW

Frequent flooding in an urban environment is rarely caused by a single factor. Flood predicting and planning is complex as many key factors must be assessed. To provide a framework for this report, this Section provides an overview of basic definitions, a simple summary of Bayside's drainage system, and a synopsis of the challenges that complicate drainage and flood planning in this area of Portland. This Section also discusses the City's Combined Sewer Abatement (CSO) program and how it plays a role in the City's flood planning.

2.1 Drainage and Flood Planning

Flooding in urban areas is caused by several key hydrologic and hydraulic factors. These factors must be considered collectively to properly predict and plan for flooding.

Hydrologic factors influence how much and at what rate precipitation moves off the landscape as stormwater runoff. These factors include, but are not limited to, land use, rainfall intensity, rainfall duration and volume, soils and other factors. Hydrologic factors change as land use and climate change.

Hydraulic factors influence how water moves through pipes and channels. These factors include, but are not limited to, pipe size, pipe slope, configuration, structural condition, and whether a pipe is pressurized or not. Additionally, elements like tides and storm surge will greatly influence a pipe's hydraulics. How well and how fast a pipe system collects, redirects, conveys, stores, and ultimately discharges stormwater can greatly influence the flooding potential of the area.

2.1.1 Flood Planning is Complex – Requires Data and Modeling Tools

Hydrologic and hydraulic factors that are present in an area like Bayside combine to make planning a complicated task. Due to the complexity of the land use and infrastructure systems, areas of interest are typically modeled using computer-based tools that help predict the locations and extent of flooding. Modeling tools need the right input information to produce useful results. Obtaining an adequate amount of the “right” information is key to initiating flood planning.

Identifying information that influences hydrologic

and hydraulic factors for Bayside is the basis for this project. Where are the important data “gaps” that should be addressed to best adapt and enhance the area's resilience to flooding? **Sections 3, 4 and 5** provide an overview of drainage infrastructure, hydraulic and hydrologic information currently available and identify several gaps that will enhance future planning.

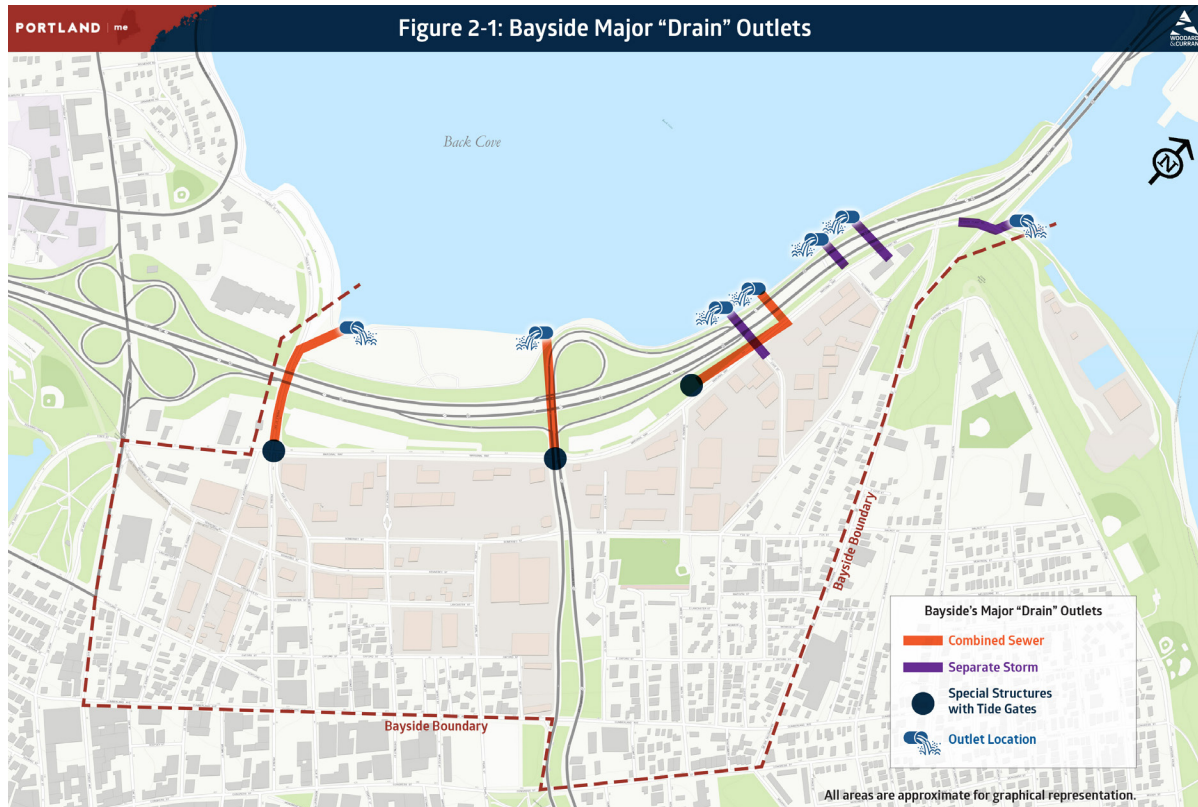
2.2 Bayside's Existing Drainage and Combined Sewer Infrastructure

For the purpose of this report, the combined sewer (pipes carrying both sewage and stormwater) and separate stormwater drainage system are called “drains” or the “drainage system”. Throughout Bayside, these systems are interconnected. As this is essentially a flooding adaptation project, enhancing the stormwater drainage system inclusive of consideration for combined sewers is critical to resiliency.

The drainage system in Bayside has five key components that are necessary to understand when thinking about improvements to the existing conditions and future planning, they include:

- **Primary Drainage Discharge Conduits** – There are seven primary conduits or pipes that provide drainage system relief to Bayside. These pipes outlet to the ocean via Back Cove (**see Figure 2-1**). The largest three pipes accommodate sewage overflows during intense rain events, as most of the Bayside area is serviced by combined sewer systems. The remaining four pipes are separated stormwater drains that are intended to only carry stormwater runoff. Overall, the combined sewer and separated stormwater infrastructure in the Bayside area is made up of over 19 miles of pipe and over 900 structures. **Figure 2-1** is only a simplified rendering of the seven primary drainage system outlet locations in the Bayside area.
- **Tidal Intrusion** – Incoming tides can send seawater back into coastal drainage systems. This complicates hydraulics and can create backups for stormwater and combined sewer systems. Each of the primary drainage conduits are subject to tidal intrusion. Tide gates are a type of infrastructure that restrict the flow of tides back into a drainage system, but tide gates alone cannot protect upstream areas from precipitation-based flooding.
- **Combined Sewer System and Special Structures** – For the three combined sewer systems, there are





“Special Structures” that, if functioning properly, provide control of sewage overflows. These Special Structures, unlike other structures such as a typical manhole, contain various flow control devices such as weirs, orifices, tide gates, etc. Therefore, these Special Structures play a significant role in the overall system function. Structures that are referred to in this Report as “Special Structures with Tide Gates” have tide control features that are intended to protect upstream combined sewer systems from tidal intrusion. Each of the three combined sewer pipe systems have a critically important but aging “Special Structure with Tide Gate”.

- **Separated Stormwater Drainage Systems** – The four fully separated stormwater drains are not currently protected from tidal intrusion, allowing inflow of ocean water during high tide. The City does not have full access or full responsibility over some of the separated stormwater drains. These drains are under Interstate-295 and are at least partially owned and operated by Maine DOT. Several additional stormwater drainage networks tie into the combined sewer conduits below the tide gates making them subject to tidal intrusion.

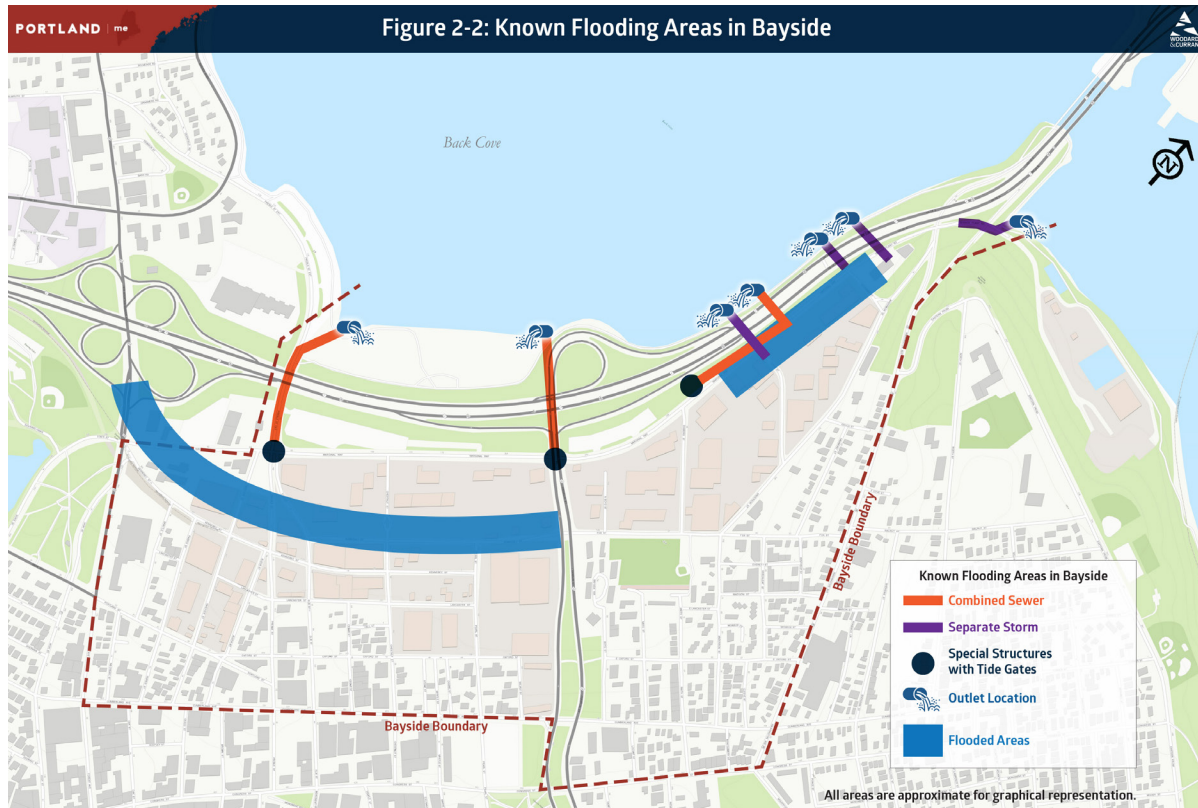
- **Known Flooding Areas in Bayside** – Illustrated in **Figure 2-2** are approximate areas in Bayside that flooded in 2016, based on the Flood Response Map provided by the City. These areas generally correspond to low-lying areas unprotected from tidal intrusion via separate stormwater drainage systems.

2.3 Computer-Based Modeling and the CSO Abatement Program

The stormwater drainage system in Bayside is complex which makes resolving flood and drainage issues challenging. To help manage the complexity and dynamic elements of the system, a computer-based tool is often used to model the entire system. Such software helps predict flooding and plan mitigation projects. The City is utilizing a computer-based model for assistance with decision-making on abatement of combined sewer overflows, as discussed in the **Section 3**.

The existing computer-based model uses the EPA Storm Water Management Model software, and is therefore referred to as the “SWMM model.” The model was built, and has been maintained by the Portland Water District, to support the City’s multi-million dollar Combined Sewer Overflow (CSO) abatement program. The existing model excludes the separated stormwater





drainage system because its primary intent is to address combined sewer overflows; it was not built with the intent of modeling local flooding. CSOs and flooding are linked because CSOs are caused by rainfall, and rainfall can cause or contribute to flooding.

2.4 Challenges Specific to the Bayside Area

Several challenges somewhat unique to Bayside should be considered during review of this report. These challenges are offered for context as several of these elements will complicate additional data collection and resiliency planning.

- The drainage system in the Bayside area was constructed over various periods of time that often coincide with the periods of fill, development, and urbanization in the area. The infrastructure is interconnected and not always well documented. Some areas may simply not be accessible for information gathering.
- Most of the drainage system is old with structural deficiencies, blockages and other impediments to hydraulics that are a function of condition defects which are challenging to assess and are changing in time.
- Portions of the drainage system, and particularly, the combined sewer system have and will continue to be modified due to increased development and efforts by the City to reduce Combined Sewer Overflows.
- I-295's location and ownership require coordination with a separate government entity MaineDOT with differing objectives for drainage system operations.





Section 3

Sewer & Stormwater System Data Gaps





3. SEWER & STORMWATER INFRASTRUCTURE DATA GAP ANALYSIS

Woodard & Curran worked with Jordan Environmental Engineering to conduct the following sewer and stormwater data gap analysis. Drainage infrastructure data and the existing SWMM model were reviewed to identify data “gaps” that may hinder adaptation planning in Bayside.

3.1 Summary of Infrastructure Data Gap Analysis Methodology

A variety of existing infrastructure and SWMM model data was provided to the project team by City staff and reviewed as part of this project. The review of City-provided data is discussed in **Section 3.2**. Upon completion of the initial review of the City’s data, the project team interviewed several key City Department of Public Works staff. The information obtained from the interview is discussed in **Section 3.3**. Woodard & Curran was also able to use the experience of our staff who have a long-standing relationship with the City and who have background knowledge of the City’s drainage and sewer infrastructure, particularly in Bayside. This knowledge was used extensively during this project.

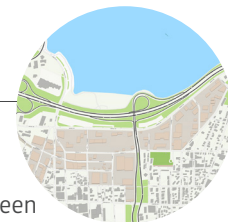
3.2 City-Provided Data

Table 3-1 below summarizes the information provided by the City for our review in this data gap analysis.

Table 3-1: Summary of City Provided Data to Support Gap Analysis

Dataset (Received from City)	Format	Date Received	Description (Refer to Section 3.2 for more detail)
Stormwater and Sewer Infrastructure Data	GIS Geodatabase, Map Package	March 13, 2017	- Geographic and attribute information on sanitary sewer, combined sewer, and separate storm drain infrastructure. See Appendix A for representation of GIS data. - Sewer and stormwater pipes recently inspected for structural and operational condition.
I&I Maps (Infiltration-Inflow Analysis maps)	PDF	2004	1970s & 1980s Infiltration-Inflow Analysis maps of Portland Sewer System. Refer to Appendix B for Bayside area I&I maps. - Approximate geographic locations and connectivity of pipes and structures. Including invert elevations. - Vertical datum: Anecdotally confirmed by City staff to be NGVD29. - Schematics of Special Structures in the drainage system. See Appendix B.
Surface Elevation Data (From 2015 LiDAR aerial survey)	Multiple: - GIS LiDAR (LAS) - GIS raster Digital Elevation Model (DEM)	March 28, 2017	- Detailed surface elevations for the entire Bayside area. - Vertical datum: NGVD29
SWMM Model	ASCII	March 17, 2017	Hydraulic and hydrologic computer model of the sewer and combined sewer system servicing Bayside.





In addition to the information provided for this project listed in **Table 3-1**, the project team also obtained and reviewed the following documents for additional infrastructure information relevant to the gap analysis.

- City's 2016 Flood Response Map.
- Listing of flood event reports that occurred from 2013 to 2016.
- A report titled, "Separation and Green Projects for the Back Cove South Storage Conduit", dated November 2014, and prepared by Wright-Pierce. The report documents the results of a recent study that identified possible separation and/or green projects that would benefit the performance of the Back Cove South storage conduit.

The following provides additional detail on the City-provided data noted in **Table 3-1**:

GIS Database - The City has a well-developed GIS (Geographic Information Systems) database of sanitary sewer, combined sewer, and separate storm drain infrastructure. The geographic features of the database are depicted in **Figure A-1** in Appendix A. The City's GIS data appears reasonably up-to-date and it shows the locations of pipes, inlets and other drainage and combined sewer infrastructure which can all be referred to as "drainage system assets."

The information contained within the database and associated with these "drainage system assets", called "attribute data", are not completely populated in the GIS. Attribute information contains items like pipe size, material, slope, elevation, etc. Attribute data may be available in other data sources, but have not yet been integrated into the GIS. A null analysis of the City GIS was conducted which quantified how much of key attribute data fields are currently unpopulated. The results of the null analysis is provided in Appendix A. Updated and accurate attribute data is important for asset management and for hydraulic modeling of the system – both of which play a key role in flood mitigation planning.

The City also provided a GIS file that shows all the Bayside area sewer and stormwater pipes that have been inspected for structural and operation deficiencies since 2011. The data provided from the City only shows which pipes have been inspected, it does not provide the inspection results or condition assessment reports. It has been assumed that these reports

are available for the segments of pipes that have been inspected.

The GIS database shows that the Bayside area, as delineated by the City and shown in Appendix A, has approximately 7.6 miles of stormwater pipe, 11.6 miles of combined sewer pipe, 1.1 miles of sewer pipe, 610 stormwater manholes and catch basins, and 365 sewer manholes. An additional 12 structures exist in the GIS under the label of "Sanitary Sewer Network Structures" (SSNS), but are referred to in this report as "Special Structures".

I&I Maps (Infiltration-Inflow Analysis Maps) - The City's I&I maps were developed in the 1970s and 1980s and depict the entire City of Portland sanitary sewer system, including combined sewer systems, but with limited information about separate storm drainage. I&I maps continue to provide generally helpful information because they show the approximate geographic connectivity of pipes and structures. In addition, I&I maps provide rim and invert elevation data, as well as schematics of important structures in the sewer system. The City's DPW staff have confirmed that the elevation data noted on the I&I maps are comparable to other survey data referenced to NGVD29; and therefore has considered these maps as referenced to NGVD29. Although the existing I&I maps are, in some cases, outdated, they are an especially important source of information wherever newer information is not available. It is our understanding that much of the City's GIS database and SWMM Model were constructed based on the I&I map data as their starting point, but have been largely updated as newer information was obtained. The four I&I Maps that cover the Bayside area are provided in Appendix B.

In addition to the typical components that make up a combined sewer system, the drainage system in the Bayside neighborhood also contains "Special Structures." As previously noted, the Special Structures, unlike other structures such as a typical manhole, contain various flow control devices such as weirs, orifices, tide gates, etc. and these structures play a significant role in the overall hydraulics of the stormwater drainage system. A summary document compiling both the I&I and GIS data available for each of Bayside's "Special Structures" was created and is provided in Appendix B. Note that the City's GIS refers to Special Structures as "Sanitary Sewer Network Structures" (SSNS).



Surface Elevation Data - Surface elevation data is another key piece of information used for flood planning. The City has detailed surface elevations for the entire Bayside area that was obtained from a 2015 aerial overflight LiDAR survey. The vertical datum of the data is NGVD29. Drainage infrastructure “rim” (street surface) elevations can be obtained from this surface elevation data due to its high resolution and accuracy. Also, the elevations of buildings and other major above ground structures can be extracted from these surface elevation data files, which will be needed for future flood modeling exercises.

Existing Bayside Hydraulic & Hydrologic Model - As previously noted, an extensive hydraulic and hydrologic model exists for the sewer and combined sewer system serving the Bayside neighborhood. The model is owned and managed by the Portland Water District, and was built in support of the City’s CSO abatement program. The model was first developed in the early 1990’s and has undergone numerous updates, as needed, for various CSO abatement projects.

The model is based on the EPA Storm Water Management Model software, version 5.x (SWMM5). The Bayside area portion of the City’s SWMM model is called the Northeast Pump Station (NEPS) model. The existing model of the Bayside area includes selected sanitary sewer and combined sewer pipes (conduits) that are hydraulically connected to the Northeast Pump Station, which is one of the two pump stations that delivers flow to the East End wastewater treatment plant.

Separate stormwater drainage system pipes are excluded from the SWMM model because the primary intent of the model is combined sewer abatement, not flood management. The City is currently investigating and designing CSO abatement options for the Bayside area which has resulted in a recently updated version of the model for the Bayside area. However, the model not been completely calibrated and verified, particularly for flooding events. The target calibration and validation of the model is focused on the 1-inch 24-hour rainfall event and is not focused on higher precipitation depth or precipitation intensity events.

The current model does not have a geographic interface, but a schematic representation of the pipes and structures that are currently included in the Bayside model was developed by Woodard & Curran for this purposes of this report. The “Existing SWMM Model Schematic” figure is provided in Appendix C.

3.3 Stakeholder Interviews

An interview with City staff was conducted in April 2017, and is summarized in **Table 3-2**. The interview was conducted to better understand recently surveyed areas that are not represented in GIS, planned construction projects, maintenance activities on Special Structures, SWMM model updates and general confirmation of the functionality and connectivity of the drainage infrastructure in Bayside.

Table 3-2: Summary of April 2017 Interview with City Staff

Date	Staff Interviewed	Meeting Minutes
April 21, 2017	City (3): - Brad Roland - Justin Pellerin - Doug Roncarati	- Recent infrastructure surveys have been completed as part of City’s roadway reconstruction and CSO abatement efforts. The City staff provided approximate locations of recently surveyed areas in Bayside. (See Appendix D) - Condition information is available for most of the sanitary and combined sewer. - City expressed that the following has been a source of concern: - Lack of information on DOT-owned stormwater infrastructure, including condition. - Servicing and maintenance needs for tide gates vary from year to year. City labor resources are often limited. More maintenance may be needed for tide gates and Special Structures. - Uncertainty on the functionality of existing tide gates. Structures may require updates to incorporate newer technologies/updates. - The SWMM model is managed by the Portland Water District, not the City. - The SWMM model as constructed is not a fully useful tool for flood planning. The SWMM model does not incorporate separate stormwater drainage systems and modeling, calibration and validation is done with the main goal of CSO abatement, not flood mitigation.





The following provides additional detail on the information noted in **Table 3-1**:

Recently Surveyed Areas in Bayside – Recent, ground-based surveys of much of the drain, sewer and combined sewer infrastructure exists for the Bayside area due to the City’s aggressive roadway reconstruction and CSO abatement efforts. City staff also identified that several City projects are anticipated to move forward with design and construction in the near future and these projects will also be preceded by extensive surveying. The areas with recent or upcoming survey information are shown in the figure in Appendix D.

Condition Assessment Data – The City conducts regular inspections of their combined and sanitary sewer infrastructure following the recommendations of their Sewer Capacity, Management, Operation, and Maintenance (CMOM) Plans. Additionally, the City is in the middle of an ongoing sewer infiltration and inflow reduction study, which includes a multi-year flow and pipe condition data collection effort. Based on discussions with City staff during our interview process, it is likely that much of the Bayside sanitary sewer and combined sewer have undergone recent condition inspections as part of these aforementioned efforts. Condition inspection data includes video of pipe and manhole assets and generally include infrastructure attribute information in addition to identifying structural defects and operational defects (clogging, root intrusion, etc).

Very limited condition assessment data is available for separated storm pipes. Given tidal intrusion in the separate storm drain, the inspection data may be poor due to partial tidal inundation of the pipes at the time of inspection.

Maintenance, Ownership and Functionality of Infrastructure – The Bayside area includes infrastructure owned by the Maine Department of Transportation (DOT). The maintenance and condition status of DOT infrastructure is often unknown to the City. The City does not have free access or responsibility over DOT infrastructure. Staff indicated the necessity to increase collaboration with DOT, as it will be needed for flood planning in Bayside.

The City also expressed the need for increased frequency of tide gate maintenance. City labor resources are often not sufficient to meet the regular maintenance

requirements of tide gates, as these structures need to be periodically inspected and/or cleaned after significant tidal cycles or precipitation events. Maintenance of these structures is complicated by their location in busy intersections, such as the intersection of Preble Street and Marginal Way and the intersection of Franklin and Marginal Way.

There is also uncertainty regarding the current and future functionality of the aging tide gates. City staff have expressed interest in upgrading or replacing the tide gates with newer technologies to reduce maintenance and increase reliability.

3.4 Identified Data Gaps

Upon a review of City-provided data and the information collected from interviews with City staff, Woodard & Curran has identified data gaps that should be filled for the City to improve flood and adaptation planning. The gaps are categorized as “infrastructure-related” and “modeling-related,” however, they are all closely linked. Infrastructure-related gaps may be resolved by review of existing survey and inspection reports, additional infrastructure surveys, condition assessments, and collaboration with DOT. Modeling-related gaps can be resolved by closing infrastructure data gaps, migrating data to a single repository, such as City GIS, and updating the model to accommodate additional planning objectives, which will require commitments to dedicated staff and/or consultants, software advancements, and calibration.

3.4.1 Infrastructure-Related Gaps

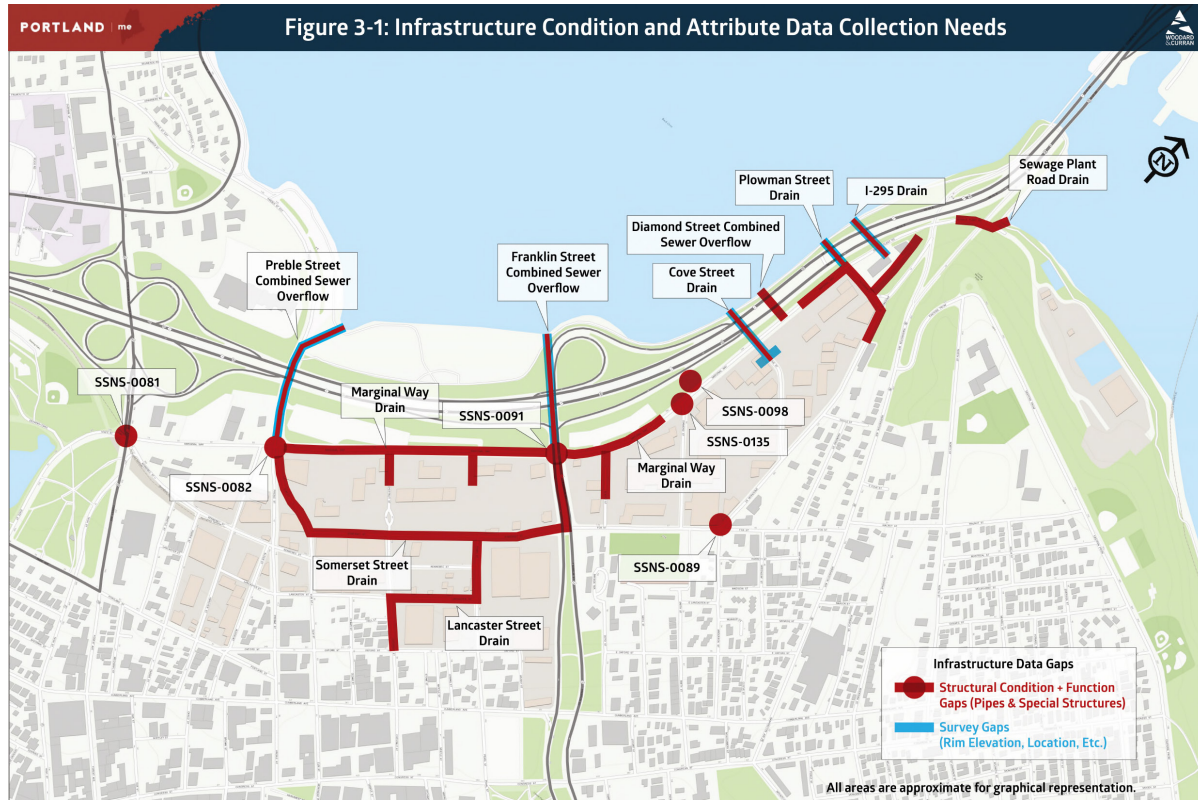
Table 3-3 provides a summary listing of the important flood-planning data and resources that the City has available, as well as the infrastructure data and maintenance gaps that have been identified. No data gaps were identified pertaining to surface elevations. Detailed surface elevations for the entire area of Bayside were obtained via recent aerial overflights (2015 LiDAR Survey) and the data is high quality. **Figure 3-1** provides graphical representation of infrastructure-related data gaps.

**Table 3-3: Summary of Infrastructure Data Gaps**

Existing Data	Data Gaps	Refer to:
City's GIS Database Gaps		
- Reasonably up to date Geographic Information System (GIS) data shows the locations of pipes, inlets and other drainage and combined sewer infrastructure. - The associated information (size-shape-depth,etc) with these drainage system assets, although not completely populated in the GIS, largely exists in surveys or other locations. - The City currently utilizes ESRI's Local Government Information Model (LGIM) for attribute data schema.	- Recent survey data has not been integrated into the GIS. - Important attribute data, although largely available, is not completely populated in the GIS. - The database organization under LGIM must be able to accommodate future data collection for Bayside adaptation planning.	Figure: Available Sewer and Stormwater Infrastructure GIS Data, Appendix A Table: Null Analysis of GIS Attribute Data, Appendix A
City Infrastructure Data Gaps: Surveys		
Extensive ground-based survey data for most of the key drain, sewer and combined sewer infrastructure exist in the area due to the City's CSO abatement and roadway reconstruction efforts.	Recent survey data does not exist for some critical drainage infrastructure and may require additional field survey. Approximately 3,000 linear feet of this infrastructure have been identified for survey.	Figure: Areas Recently Surveyed, Appendix D Figure: Infrastructure Condition and Attribute Data Collection Needs, Figure 3-1
City Infrastructure Data Gaps: Condition Assessments		
Condition assessment data (since 2011) is available for approximately half of the sewer and combined sewer system.	Limited condition information is available for separate stormwater drainage. Approximately 35,000 linear feet of separate stormwater drainage is within the study area and condition information may be unknown.	Figure: Infrastructure Condition and Attribute Data Collection Needs, Figure 3-1



Existing Data	Data Gaps	Refer to:
City Infrastructure Data Gaps: Condition, Form & Function of Special Structures		
Schematics for Special Structures are available in I&I maps, and potentially available from recent CSO storage conduit planning and design efforts (not received or verified by Woodard & Curran)	- I&I maps and schematics were developed in the 1970s and 1980s and may not be accurate given recent reconstruction. - Special Structures in Bayside have not been recently assessed for condition and functionality.	Figure: I&I Maps covering Bayside, Appendix B Figures/Tables: Summary of Special Structures, Appendix B Figure: Infrastructure Condition and Attribute Data Collection Needs, Figure 3-1
Maine DOT Infrastructure Gaps		
DOT owned or operated drainage infrastructure locations are mapped in GIS.	- Attribute data, condition and location of drainage infrastructure needs to be verified with input from DOT. - Collaboration and partnership between the City and DOT regarding maintenance and rehabilitation of drains that pass under I-295.	Figure: Infrastructure Condition and Attribute Data Collection Needs, Figure 3-1



3.4.2 SWMM Model-Related Gaps

The key SWMM model gaps identified in this study are summarized in **Table 3-4** below. **Figure 3-2** provides graphical representation of model-related data gaps. An overview of the model fundamentals and limitations is discussed below:

Overview on How the Existing Model Works

As previously mentioned in **Section 3.2**, the portion of the existing SWMM model that covers the Bayside area includes selected sanitary sewers, combined sewers and storm drains that are hydraulically connected to the Northeast Pump Station. The SWMM model can be thought of as a network of pipes and nodes. Some nodes represent simple pipe junctions, while other nodes represent Special Structures or other sewer point features. The data files required to run the model consist of a combination of hydraulic parameters and hydrologic data, including information on infrastructure, precipitation, groundwater, tides, and other factors.

The existing SWMM model utilizes long-term and actual precipitation, tide, and groundwater input data to run simulations. It is not an event-based model. To

ensure that the results are reliable, the model needs to be calibrated and validated with actual pipe flow during simulated events to match results with simulated flows. Although the software currently being used does not have a geographic interface, a schematic representation of the pipes and structures that are incorporated in the existing model was developed by Woodard & Curran for this purposes of this Study. The “Existing SWMM Model Schematic” figure is provided in Appendix D. Upon running the model, the EPA SWMM5 software can identify which structures (at modeled nodes) will overflow onto the street surface.

Model Gaps:

Model Components – The primary intent of the existing model is combined sewer abatement and the model has never been modified with the specific intent of modeling local flooding. The model does not currently contain much of the separate storm-water drainage system that may be influencing local flooding.

Within the Bayside area that is likely to be subject to flooding, the sanitary and combined sewers required to model flood scenarios are for the most part already included in the model. The one sanitary and combined





sewer area that does not have enough detail within the SWMM model is the intersection of Forest Ave, Kennebec Street, and Brattle Street, which has been highlighted in **Figure 3-2**.

Data Sources – The portion of the model that describes the combined sewer pipe network and the Special Structures was originally constructed using information from the I&I maps, developed in the 1970s and 1980s. The source of most of the infrastructure data (manhole inverts, pipe lengths, etc.) within the existing Bayside model is not documented on a point-by-point basis. Historically, there was a very limited effort to identify source information or changes to the model and embed it into the model. Most source and change data has been lost during various model updates.

Data Accuracy – Data was intentionally input into the model incorrectly because, at the time, the software was less advanced and required limited manual manipulation for calibration. For example, the manhole and special structure rim elevations along Somerset Street and Lancaster Street are set several feet above the actual street elevation. These elevations made sense for the original model, in that prior to SWMM5, the SWMM model math engine had some numerical instabilities associated with surcharging manholes. To get accurate CSO volume estimates at the overflow weirs (the original objective of the model), the rim elevations for the nodes likely to surcharge were set artificially high to prevent them from surcharging. The numerical methods used in the current version of the SWMM5 math engine are superior to those used in the original model, therefore, the concerns related numerical instabilities and surcharging no longer exist.

Model Calibration and Validation – To accurately calculate which nodes will surcharge (i.e., which manholes will overflow and result in local flooding), the model needs to be calibrated, and the calibration needs to be verified. Calibration/validation requires depth and velocity data from key locations within the pipe network. For example, Wright-Pierce and the City of Portland used a network of 27 monitors at 23 locations to collect data to calibrate and verify the SWMM model for flows within the Bayside area. These monitors collected data from October 2013 to January 2015. Wright-Pierce used this data to calibrate the hydrologic parameters for the catchments within the Bayside area. The focus of the calibra-

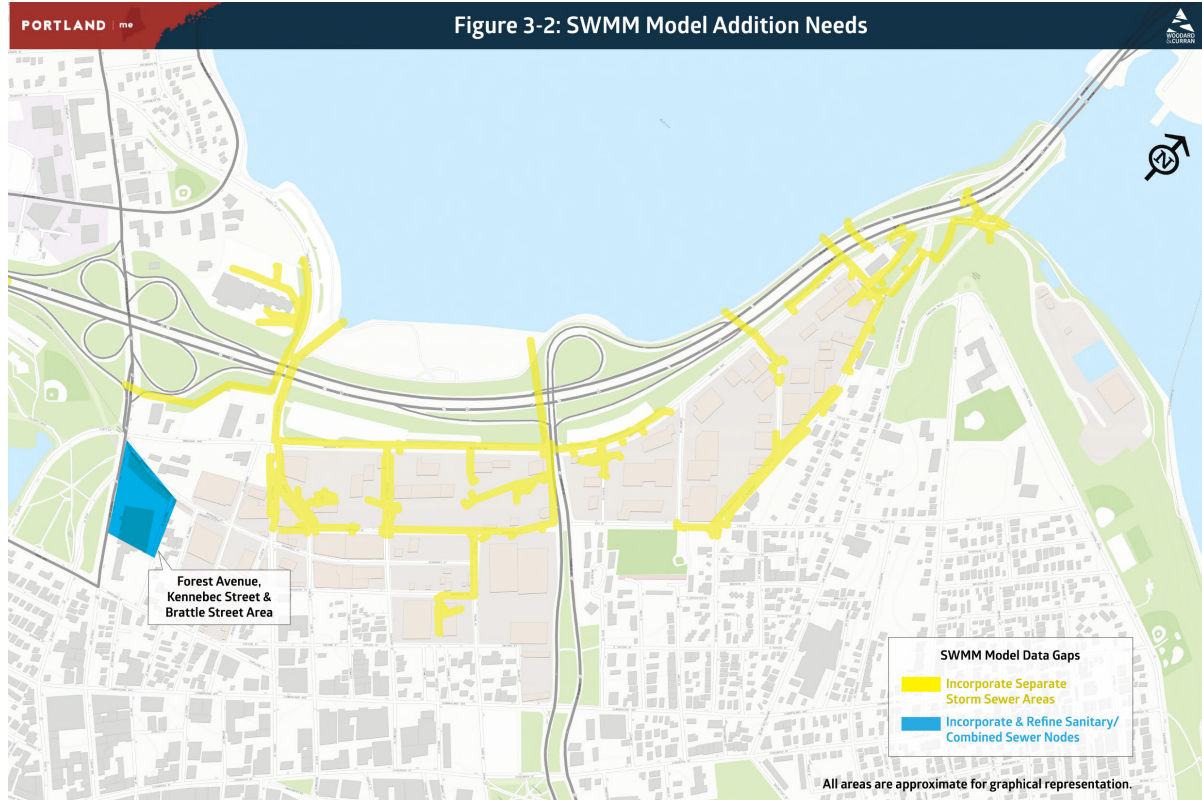
tion were flow rates generated by a 1-inch 24-hour rainstorm for both the metered locations and at the Preble Street and Franklin Street combined sewer overflow weirs.

Model Capabilities – The model, when run in the SWMM5 environment, is only capable of predicting which nodes (drainage structures) surcharge. It is not capable of predicting the extent of flooding (depth and coverage area). From a practical standpoint, a surcharged node is a manhole or special structure that is causing some degree of local flooding. From a modeling standpoint, a surcharged node is identified when the local hydraulic grade-line has an elevation that is greater than the manhole's or special structure's rim elevation. In the Bayside area, a node's hydraulic grade-line elevation is a function of the CSO piping network, the tide elevation in Back Cove, and during rain events, a combination of total rainfall, rainfall intensity, and the operational status of the Franklin Street and Northeast pump stations. The hydraulic grade-line is the elevation that the water would rise to if it was contained within a very tall manhole. The depth and extent of flooding can be determined from the local hydraulic grade-line and a surface elevation model.



**Table 3-4: Summary of SWMM Model Gaps**

Description of Existing Data	Description of Gap
Model Components	
· Within the Bayside area that is likely to be subject to flooding, the sanitary and combined sewer pipe systems that would be required to model the flooding are for the most part already included in the SWMM model.	· The model lacks many separate pipe systems in Bayside that are likely to contribute to local flooding. · Figure 3-2 provides an illustration of general areas that contain separate stormwater system infrastructure. It is estimated that up to 10,000 linear feet of separate stormwater drainage pipe and nodes would need to be included in an updated model; much of which has recently surveyed.
Data Sources	
· Data sources for Special Structures and model junction nodes are outdated and uncertain.	· Special Structures condition, form and function identified in Figure 3-1 are likely outdated given data sources from 1961.
Data Accuracy	
· The accuracy of most data in the model is assumed to be good given numerous updates and calibrated flows for small precipitation events.	· Selected rim elevation infrastructure data was historically input incorrectly to account for calibration needs.
Model Calibration and Validation	
· The model has been calibrated and validated for combined sewer overflow abatement design criteria. The design storm of interest in the 1" 24-hour event.	· Calibration and validation for a range of storm events and flow conditions that are focused on flood, tide and storm surge condition design criteria.
Model Capabilities	
· SWMM5 environment is a common and extensively utilized hydraulic evaluation and simulation model.	· SWMM5 does not account for surface flooding evaluation but can be updated and integrated with other modules that can account for surface flooding.





Section 4

Sea Level Rise & Climate Change Evaluation



4. SEA LEVEL RISE AND CLIMATE CHANGE EVALUATION

In the following sections describing sea level rise, storm surge, and precipitation, a scenario-based approach is taken when defining ranges of potential changes. Planning for a series of potential scenarios is important for managing uncertainty and ensuring continuity of critical systems. Such an approach is valuable when planning at the municipal level where mid-range projections are important for nearer-term planning needs. This approach is also prudent because it considers a broader range of outcomes that address the widening uncertainty in predictions, including those scenarios that are low-probability but high-consequence and may be important for planning of long-life critical infrastructure upgrades or construction. Use of a scenario based approach is consistent with both national and international best practices and with the recent Urban Land Institute study on strategies for creating resilient waterfronts in Portland and South Portland (ULI, 2014), which recognizes that recommendations must account for both uncertainty in future projections and risk tolerance.

4.1 Sea Level Rise

A recent review of sea level rise (SLR) literature conducted by NOAA (Sweet et al, 2017) provides a full range of global and regional SLR scenarios based on both current scientific literature and various future greenhouse gas (GHG) emissions scenarios. These GHG scenarios are known as Representative Concentration Pathways (RCPs) (van Vuuren et al., 2011) and were used in the Intergovernmental Panel on Climate Change's Fifth Assessment Report (IPCC, 2013) to represent possible future GHG concentrations. Sweet et al. (2017) use three RCPs :

- 1. RCP 2.6:** strong GHG mitigation resulting in net-negative emissions at the end of the 21st century; likely increases in global mean temperature of 1.9 to 2.3 degrees Celsius in the period from 2081 to 2100 relative to the period from 1850 to 1900 (IPCC, 2013)
- 2. RCP 4.5:** moderate GHG mitigation resulting in a stabilization of emissions by 2050, a subsequent decline in emissions, and likely increases in global mean temperature of 2.0 to 3.6 degrees Celsius in the period from 2081 to 2100 relative to the period from 1850 to 1900 (IPCC, 2013)
- 3. RCP 8.5:** often referred to as a 'business as usual'

scenario with continued intensive use of fossil fuels and likely increases in global mean temperature of 3.2 to 5.4 degrees Celsius in the period from 2081 to 2100 relative to the period from 1850 to 1900 (IPCC, 2013)

Based on recent literature, NOAA concluded that global projections of SLR in the range of 2.0 to 2.7 meters by 2100 are not only physically plausible, but becoming more likely given new research on Antarctic ice-sheet instabilities. As such, NOAA has revised its extreme upper-bound SLR scenario for 2100 to 2.5 m, which is an increase of 0.5 m from the previous extreme scenario used in the third National Climate Assessment (Mellilo et al., 2014). The lower-bound scenario was also increased from 0.1 m to 0.3 m based on analysis of recent water level observations and review of new climate model results (Sweet et al., 2017). Several intermediate scenarios were defined between the upper and lower bounds, for a total of six global mean sea level (GMSL) rise scenarios:

- 1. Low: 0.3 m**
- 2. Intermediate Low: 0.5 m**
- 3. Intermediate: 1 m**
- 4. Intermediate High: 1.5 m**
- 5. High: 2.0 m**
- 6. Extreme: 2.5 m**

While the range of GMSL scenarios provides a starting point for defining sea level rise scenarios for the City of Portland, it must be adjusted for regional factors and then reviewed relative to the City's planning horizons and risk tolerance. Regional factors are discussed in **Section 4.1.1** below. It is also important to note that these scenarios are relative to the year 2000 (a non-standard 1991-2009 epoch) instead of 1992 (the National Tidal Datum Epoch of 1983-2001). Since most of the U.S., including Portland, uses the National Tidal Datum Epoch an adjustment is necessary. Details of this adjustment are also provided in **Section 4.1.1**.

In consideration of risk tolerance and following the guidance provided by Sweet et al. (2017), the SLR scenarios presented for Portland strive to account for both "what is most likely to occur" as well as a "how bad can things get". Thinking in these terms will allow the City to prepare for the most probable outcome, while also ensuring that there is a general awareness of lower-probability, but higher consequence events. Sweet





et al. (2017) provide guidance for choosing scenarios by associating probabilities of exceedance for each GMSL scenario. For example, there is a 94% to 100% chance that by 2100 GMSL will have increased more than 0.3 m (the low scenario) but only a 0.05% to 0.1% chance that it will have increased more than 2.5 m (the extreme scenario). It is important to note that recent research on the Antarctic ice sheet could significantly increase the probabilities of higher-end scenarios and attention should be paid to the literature on this subject. A summary of the GMSL scenarios and probability of exceedance for each is shown in **Table 4-1**. Each scenario is assigned a range of probabilities, based on the three emissions scenarios used in the study.

Table 4-1: Global Mean Sea Level Rise Scenarios for 2100 with corresponding exceedance probabilities (Sweet et al., 2017)

Scenario	GMSL (m)	Probability of Exceedance
Low	0.3	94-100%
Intermediate Low	0.5	49-96%
Intermediate	1	2-17%
Intermediate High	1.5	0.4 to 1.3%
High	2	0.1 to 0.3%
Extreme	2.5	0.05 to 0.1%

4.1.1 Regional Sea Level Rise Estimates for the City of Portland

Regional factors that influence GMSL projections include:

- Shifts in regional oceanographic processes (e.g., circulation patterns)
- Changes to the Earth's gravitation field and rotation
- Vertical land movement (subsidence or uplift)

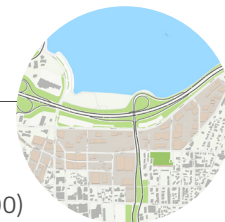
When adjusted for regional factors, Sweet et al. (2017) found that the relative sea level (RSL) rise along the Northeast Atlantic coast is expected to exceed global projections significantly. This is illustrated by recent observations of sea level trends. Over the last several decades the rate of regional sea level rise in the Northeast has outpaced the global rate and Portland has seen the largest change in sea levels in the eastern

U.S. (Goddard et al. 2015); this regional acceleration in sea level rise is likely attributable to changes in the Gulf Stream (Yin and Goddard, 2013; Ezer, 2013; Kopp, 2013; Kopp et al., 2015). These changes include both an offshore shift and weakening north of Cape Hatteras (Ezer et al., 2014).

In addition to changing oceanographic processes, the impacts of Antarctic and Greenland Ice Sheet and glacial and ice cap melting are amplified along most U.S. coastline due to static-equilibrium processes. Finally, non-climatic contributions such as the regional influence of vertical land movement (VLM) also play an important role. In the Northeast, subsidence is occurring at a rate of 2 to 5 mm/yr (Sweet et al. 2017).

To facilitate use of the GMSL rise scenarios regionally, NOAA (Sweet et al., 2017) has derived regional relative sea level (RSL) rise projections from the GMSL scenarios on a 1-degree grid covering U.S. coastlines as well as





for tide gauges around the country, including Portland, Maine (Station 8418150). RSL rise scenarios for 2050 and 2100 in Portland are summarized in **Table 4-2**. As expected due to regional factors, the Portland-specific RSL values are higher on average than the global sea level rise scenarios presented in **Table 4-1** from Sweet et al., 2017. **Table 4-2** also shows the projected mean sea level for 2050 and 2100 relative to NGVD29 (the City's preferred vertical datum).

The following steps were necessary to perform this conversion to NGVD29:

1. Convert the RSL values from a reference year of 2000 (1991 to 2009 epoch) to a reference year of 1992 (National Tidal Datum Epoch) by calculating the difference between average MSL for 1983-2001 and 1991-2009 at the Portland Tide Station (8418150) and adding it to the RSL value relative to 2000. This difference in Portland is 0.014 m (0.046 ft.).
2. Convert the RSL (1992) rise values to MSL relative to NAVD88 using the datum offsets available from the Portland Tide Station (8418150). At this location NAVD88 is 0.095 m (0.312 ft.) above MSL.
3. Convert the MSL (1992) values from NAVD88 to NGVD29 using the values available from the National Geodetic Survey for Portland Tide Station (8418150). At this location NAVD88 is 0.222 m (0.728 ft.) above NGVD29.
4. Thus, for Portland, to convert from RSL change (2000) as reported by Sweet et al. (2017) to MSL relative to NGVD29 one must add 0.014 m, subtract

0.095 m, and add 0.222 m to the RSL change (2000) values for a total offset of 0.14 m (0.46 ft.) between RSL (2000) and mean sea level relative to NGVD29 (1992).

Sea level rise curves (in ft.) for the 2000 to 2100 period are shown in **Figure 4-1**, represented as projected mean sea level relative to NGVD29. The curves clearly indicate that the projections are not linear and that differences in sea level scenarios become larger over time.

Based on the probabilities of exceedance defined for the GMSL rise scenarios, scenarios that have exceedance probabilities for 2100 significantly lower than 50% are used to narrow the range of possible scenarios. Thus, we define "What is most likely to occur" as the intermediate scenario (probability of exceedance 2-17%) and "How bad can things get" as the extreme scenario (probability of exceedance 0.05 to 0.1% - a low probability and high consequence event).

As such, we recommend that Portland commit to managing the intermediate mean sea level of 1.9 ft. (NGVD29), but be prepared to manage the extreme mean sea level of 3.8 ft. (NGVD29) in 2050. In the latter half of the century scenario planning is more complicated because the four sea level rise scenarios bounded by the intermediate to extreme envelope in 2050 deviate from each other significantly between 2050 and 2100; the range increases from 1.9 ft. in 2050 to 7.0 ft. in 2100 (**Figure 4-1, Table 4-2**). Our recommendations for the 2100 planning horizon are that Portland commit to managing the intermediate mean sea level of 4.3 ft. (NGVD29) by 2100, be prepared to manage the

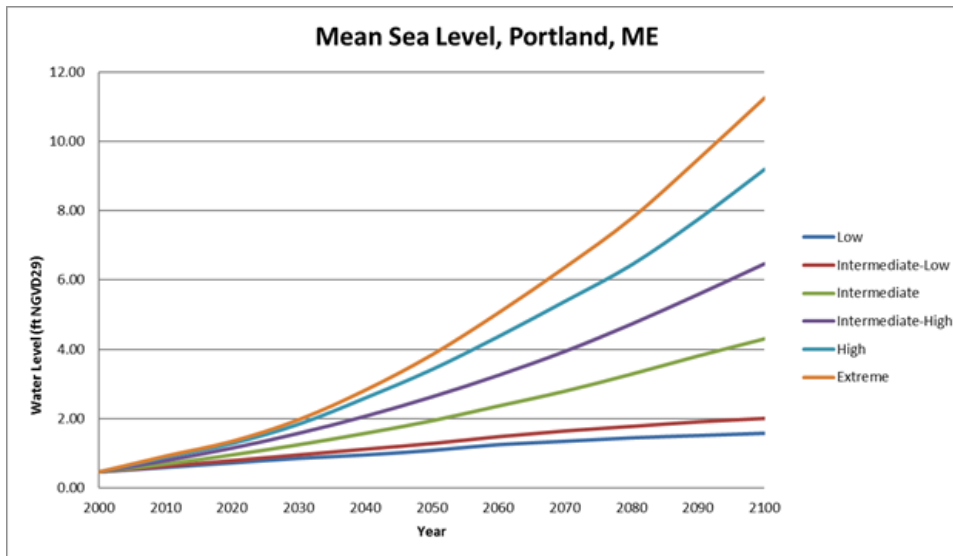
Table 4-2: Summary of Sea Level Rise Scenarios for 2050 and 2100, Portland, Maine

Scenario	2050: RSL, ft. / Mean Sea Level, ft. relative to NGVD29	2100: RSL, ft. / Mean Sea Level, ft. relative to NGVD29
Low	0.62 / 1.08	1.12 / 1.58
Intermediate Low	0.82 / 1.28	1.53 / 2.00
Intermediate	1.48 / 1.94 – commit to manage	3.84 / 4.30 – commit to manage
Intermediate High	2.16 / 2.63	6.00 / 6.46
High	2.95 / 3.41	8.72 / 9.19 – prepare for
Extreme	3.38 / 3.84 – prepare for	10.79 / 11.25 – be aware of
<i>Note: The first value is the RSL rise in ft., as originally reported by Sweet et al (2017). The second value is the RSL converted to Mean Sea Level relative to NGVD29 following the methodology presented in Sweet et al., (2017).</i>		





Figure 4-1: Predicted MSL elevations from 2000 to 2100 for Portland, Maine



Note: The predicted elevations in Figure 4-1 are in feet and relative to NGVD29 for all RSL rise scenarios.

high mean sea level of 9.2 ft. (NGVD29), and be aware of and monitoring for any indication that mean sea levels could approach the extreme scenario of 11.3 ft. (NGVD29).

Figure 4-2 illustrates what daily high water levels may look like in 2050 and 2100 for the range of scenarios chosen. Daily high water levels are predicted using a base water level elevation of Mean Higher High Water (MHHW) for the RSL rise values reported for Portland by Sweet et al. (2017). MHHW is the average of the higher high water elevation of each tidal day observed over the National Tidal Datum Epoch (NOAA, 2017) and thus represents the high-water level reached daily. To generate the projected daily high water levels for 2050

and 2100, the process followed in Steps 1 through 4 above was repeated for MHHW to determine MHHW elevations for 2050 and 2100 relative to NGVD29. The total offset between RSL (2000) and MHHW (1992) relative to NGVD29 is 5.45 ft. **Table 4-3** shows the MHHW elevations relative to NGVD29 for the recommended 2050 and 2100 scenarios.

To create the maps, a GIS analysis was performed, using high resolution elevation data (2015 City of Portland, Maine LiDAR). This figure is a GIS-based 'bathtub' style analysis, which assumes a static base water level elevation (MHHW relative to NGVD29) from the Portland, ME tide station (8418150) for all of Portland, and should be used for illustrative purposes only as it does

Table 4-3: Summary of MHHW Elevations Under Various Sea Level Rise Scenarios for 2050 and 2100 in Portland, Maine

Scenario	2050: RSL (ft.) / MHHW, ft. relative to NGVD29	2100: RSL (ft.) / MHHW, ft. relative to NGVD29
Intermediate	1.48 / 6.93 – commit to manage	3.84 / 9.29 – commit to manage
Intermediate High	2.16 / 7.61	6.00 / 11.45
High	2.95 / 8.40	8.72 / 14.17 – prepare for
Extreme	3.38 / 8.83 – prepare for	10.79 / 16.24 – be aware of

Note: The first value is the RSL rise in ft., as originally reported by Sweet et al., (2017). The second value is the RSL converted to MHHW relative to NGVD29 following the methodology presented in Sweet et al., (2017).



Figure 4-2: Maps of Predicted Daily Inundation Extent in Portland, Maine in 2050 and 2100



Note: The maps in Figure 4-2 are using a base water level elevation of MHHW in 2050 (top) and 2100 (bottom) for recommended RSL rise scenarios. These figures represent an illustrative “bathtub” GIS analysis. A dynamic storm drain modeling exercise is necessary to provide an actual detailed depiction likely of inundation areas.

not include tidal flooding through the current stormwater conveyance system. The availability of detailed maps for each sea level rise scenario is discussed in **Section 5.2**.

The influence of RSL rise on storm surge is presented in **Section 4.2**. However, even in the absence of storm events, sea level rise can play an important role in the frequency of nuisance flooding. NOAA's National Weather Service (NWS) has defined a series of thresholds for minor, moderate, and major flooding at the Portland, ME Tide Station (8418150); these are 7.5, 8.5, and 9.5 ft. relative to NGVD29 respectively. The minor, moderate, and major flooding thresholds are used

by the NWS when issuing coastal flood statements. Coastal flood advisories are issued when minor or nuisance coastal flooding is occurring or imminent. Minor flooding causes little to no risk of property damage, however there is some public threat or inconvenience. Coastal flood watches are issued when moderate to major coastal flooding is possible, potentially posing a serious risk to life and property. Coastal flood warnings are issued when moderate to major coastal flooding is occurring or imminent, posing a serious risk to life and property. Moderate flooding causes some inundation of structures and roads and potential evacuations of people and property to higher elevations. Major flooding causes extensive inundation of structures and roads



and may require significant evacuations of people and property to higher elevations.

Table 4-4 and **Table 4-5** show predicted water levels, relative to NGVD29, for today's minor, moderate, and major flood thresholds, as well as MHHW and the highest predicted annual tide for 2050 and 2100 for the various RSL scenarios in 2050 and 2100. **Table 4-4** shows that by 2050 the minor flood elevation will be exceeded daily under the intermediate-high scenario and the moderate flood level will be exceeded daily under the extreme scenario. Also by 2050, the predicted highest annual tide will exceed the moderate flood elevation for all scenarios and will exceed the major flood threshold for the high and extreme scenarios. **Table 4-5** shows that by 2100 the moderate flood threshold is exceeded daily by the intermediate scenario and the major flood threshold is exceeded daily by the intermediate-high through extreme scenarios.

Table 4-4: Water Levels in 2050 for Various Tidal Datums and NWS Flood Thresholds at the NOAA Portland Station (8418150)

	Scenario (RLS Rise in 2050: converted to 1983-2001 Epoch)			
	Intermediate (1.55 ft.)	Intermediate-High (2.23 ft.)	High (3.02 ft.)	Extreme (3.45 ft.)
Water Level National Tidal Epoch (ft. NGVD29)				
MHHW: 5.38	6.93	7.61	8.40	8.83
Highest Annual Tide (2050): 7.13	8.67	9.36	10.15	10.57

Table 4-5: Water levels in 2100 for various tidal datums and NWS flood thresholds at the NOAA Portland Station (8418150)

	Scenario (RSL Rise in 2100: 1991-2009 Epoch)			
	Intermediate (3.93 ft.)	Intermediate-High (6.07 ft.)	High (8.79 ft.)	Extreme (10.86 ft.)
Water Level National Tidal Epoch (ft. NGVD29)				
MHHW: 5.38	9.29	11.45	14.17	16.24
Highest Annual Tide (2100): 7.26	11.16	13.33	16.05	18.12



As sea levels increase, flood thresholds are likely to be exceeded more frequently. An analysis of historical water levels at the Portland Tide Station (8418150) from 1912 to 2016 illustrates this increasing frequency for Portland. **Figure 4-3** shows the number of flood days per year for the entire period of record (1912-2016) at the Portland Tide Station (8418150). Flood days per year is defined as the number of days where the verified hourly water level exceeds the NWS minor flood threshold of 7.5 ft. NGVD29 for at least one hour. The trendline (red circles) shows that the number of flood days per year has increased over time. As sea level rise rates continue to accelerate through the 21st century, the frequency of flood days is also expected to increase.

Figure 4-3: Flood Days Per Year at the Portland, Maine Tide Station (8418150)

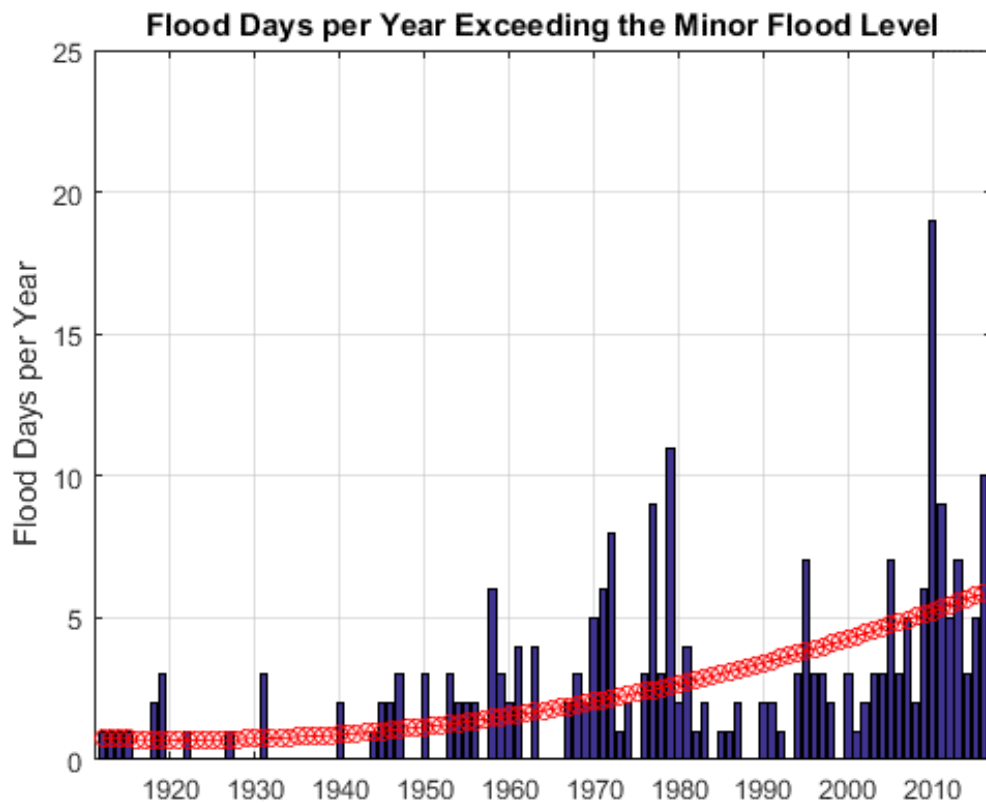


Figure 4-4 shows the same RSL curves as **Figure 4-1** but using MHHW (relative to NGVD29) as the base water level. The figure also shows the NWS flood thresholds, illustrating when each scenario is expected to cause daily flooding in the Portland region. Furthermore, the monthly historic MHHW values from 1980 through 2000 are plotted on the graph to show how these future changes compare to the past. By 2050 the intermediate-high, high, and extreme scenarios all exceed the minor flood threshold and the extreme scenario exceeds the moderate flood threshold. By 2100 all four recommended scenarios exceed the moderate flood threshold and the intermediate-high, high, and extreme scenarios exceed the major threshold. **Table 4-6** summarizes the decade in which each NWS flood threshold (minor, moderate, and major) is expected

to be exceeded at least once per day for each of the recommended scenarios.

4.2 Storm Surge

Storm surge elevations for various recurrence intervals have been extracted from the North Atlantic Comprehensive Coast Study (NACCS). The NACCS was a 2015 initiative of the U.S. Army Corps of Engineers (USACE) to provide a risk management framework and improve resilience of coastal communities by supporting management of risk to vulnerable populations, property, ecosystems, and infrastructure. As part of NACCS, the USACE carried out state-of-the-art atmospheric, wave, and storm surge modeling to characterize storm hazards in the North Atlantic region. Coupled numerical





Figure 4-4: Predicted MHHW Elevations from 2000 to 2100 in ft. Relative to NGVD29 in Portland, Maine for all RSL Rise Scenarios

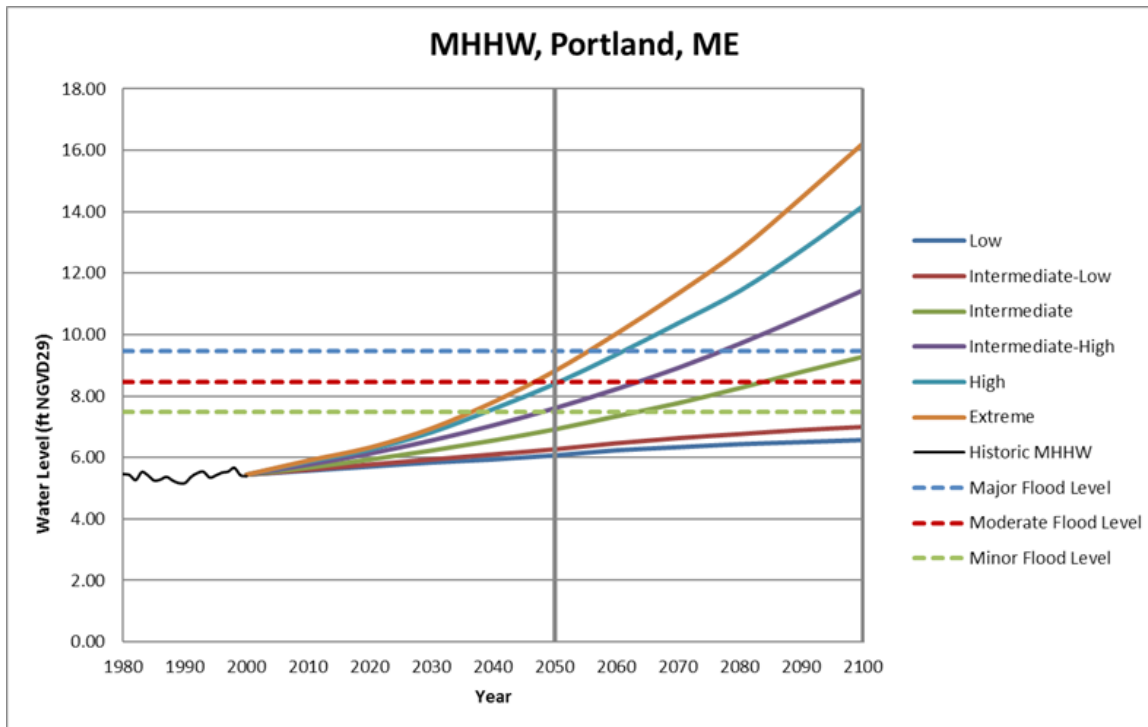


Table 4-6: National Weather Service Flood Warning Thresholds for the Portland, ME NOAA CO-OPS Station (8418150)

		Decade of Daily Exceedance			
NWS Threshold	Water Level	Intermediate (3.93 ft.)	Intermediate-High (6.07 ft.)	High (8.79 ft.)	Extreme (10.86 ft.)
(ft. NGVD29)	Intermediate	Intermediate-High	High	Extreme	16.24
Minor Flooding	7.5	2060	2040	2030	2030
Moderate Flooding	8.5	2080	2060	2050	2040
Major Flooding	9.5	2100	2070	2060	2050

Note: Table 4-6 includes the decade in which those thresholds are expected to be exceeded daily under each of the recommended planning scenarios.





models simulated winds, waves, and water levels along the coast based on 1,050 synthetic tropical storms and 100 historical extratropical storms. The results from each storm simulation were added to 96 random tide phases. These tides are linearly added to the base water level for each storm (Cialone et al., 2015). The result is a large catalog of storm surge, wave heights, and extremal statistics derived from the model runs and stored at high-resolution model output stations along the coast, including several in the Portland, Maine region, as shown in **Figure 4-5**.

While extreme water levels, based on a statistical analysis of historic observations, are also available for the Portland Tide Station (8418150), the NACCS dataset was utilized for this study as it provides the highest resolution and the most recently available modeled data regarding storm-driven water levels. It also provides results at several locations around Portland, including an output point at the entrance to Back Cove, providing insight into the spatial variability of extreme water levels in the region. **Table 4-7** provides a comparison of the 100-year return period water from NACCS station 7221 at the entrance to Back Cove, NACCS station 7047 near the Maine State Pier and the Portland, Maine CO-OPs Tide Station (8418150). The NACCS values represent the mean 100-year water level elevation derived from 1,150 storms modeled and

added to each of the 96 randomly selected tide phases for a total of 110,400 water level results (Cialone et al., 2015). The value reported for the Portland Tide Station (8418150) is the mean 100-year storm elevation reported by NOAA for 2016 (NOAA, 2017b).

The NACCS output point for the Maine State Pier is very close to the Portland Tide Station and the 100-year water level elevations for both datasets are very similar. However, the NACCS modeling results show that the 100-year storm elevation for the entrance to Back Cove is almost 2 feet higher than that along the Portland waterfront. This difference, would not have been apparent from the tide gage data and is an important consideration when planning for storm surge in the Bayside neighborhood.

Table 4-8 summarizes the 10-year, 20-year, 100-year, and 500-year return period water levels at the two NACCS stations and shows how those are expected to change by 2050 under each of the four predicted MSL scenarios defined in **Section 4.1**. **Table 4-6** shows how the NACCS results for station 7221 and 7047 are expected to change by 2100 under each of the four MSL scenarios defined in **Section 4.1**. **Figure 4-6** provides the same MSL curves as **Figure 4-1** relative to the 100-year stormwater level from 2000 to 2100 at both stations.

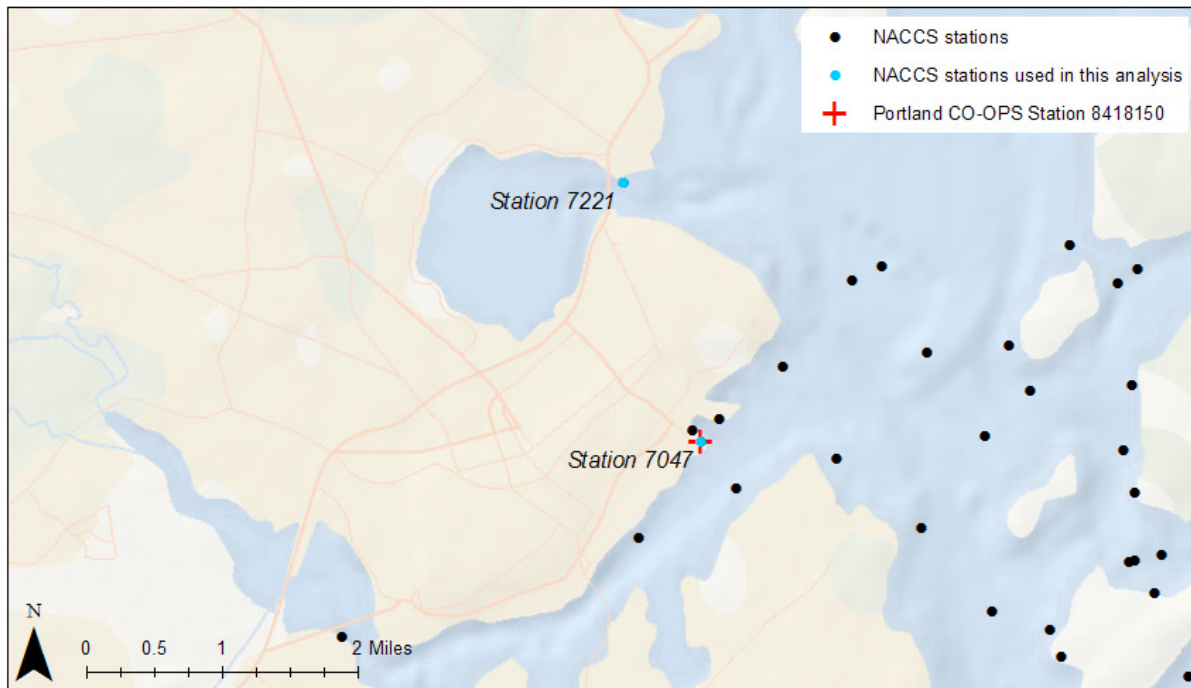
Table 4-7: Comparison of the 100-year return period water level for the Back Cove Entrance and Maine State Pier NACCS stations and the Portland Tide Station (8418150)

Location	100-Year Return Period Water Level (ft. NGVD29)
NACCS Back Cove Station (Station 7221)	11.13
NACCS Maine State Pier Station (Station 7047)	9.32
Portland Tide Station (8418150)	9.53





Figure 4-5: NACCS Stations in the Portland, Maine Region



Note: NACCS Station 7221 at the entrance to Back Cove and Station 7047 at the Maine State Pier are highlighted in blue. Each NACCS station provides data on storm surge, wave heights, and extremal statistics. Portland CO-OPS Station 8418150, also located at the Maine State Pier, is depicted by a red cross.

As shown by **Table 4-8** and **Table 4-9**, the storm surge water levels for various return periods are higher at the entrance to Back Cove (Station 7221) when compared to the other side of the Portland peninsula (Maine State Pier - Station 7047). This difference varies based on the return period. For the 10-year water level the difference is 0.2 ft.; for the 500-year water level the difference increases to 1.9 ft.

Table 4-8 and **Table 4-9** also show how the water levels associated with each return period for Back Cove and the Maine State Pier change with each scenario over time. To obtain storm surge values under each of the four MSL scenarios by 2050, under the intermediate scenario at Back Cove, today's 100-year water level (~11.1 ft. NGVD29) is nearly a 20-year water level (meaning it is likely to occur five times as frequently) and under the intermediate-high scenario it is nearly a 10-year water level (meaning it is likely to occur ten times as frequently). By 2100 the 100-year water level is expected to occur more frequently than every 10 years under every scenario. For context, the Blizzard of 1978, during which water levels reached 9.6 ft. NGVD29, the highest values ever recorded in Portland by almost 0.9 ft., is representative of the 100-year water level in Portland.

Similarly, by 2050, under the intermediate-high scenario the 500-year water level (~11.8 ft NGVD29) is nearly a 20-year water level and under the high scenario it is nearly a 10-year water level. By 2100 the 500-year water level is also expected to occur more frequently than every 10 years for every scenario.

These conclusions assume that sea level rise and storm surge can simply be added together. The validity of this assumption varies as the actual effect of sea level rise on storm surge is non-linear in some locations, depending on local coastal geomorphology. These non-linear interactions may pose a greater hazard in some locations (Tajalli Bakhsh et al., 2017). Whether there are significant non-linear interactions between sea level rise and storm surge should be further investigated and strategies for filling this data gap are provided in **Section 5.3.2**.

The NACCS results do not provide any insight into storm surge conditions within Back Cove. How the surge might be exacerbated or mitigated by the constriction at the entrance to the cove is another gap that should be further investigated.





Table 4-8: Summary of Extreme Water Levels from the NACCS Study combined with MSL scenarios for 2050.

NACCS Station	Water Level Return Period	Storm Surge Water Level (ft.) ¹	Storm Surge Water Level + 2050 Intermediate MSL of 1.94 (ft. NGVD29)	Storm Surge Water Level + 2050 Intermediate-High MSL of 2.63 (ft. NGVD29)	Storm Surge Water Level + 2050 High MSL of 3.41 (ft. NGVD29)	Storm Surge Water Level + 2050 Extreme MSL of 3.84 (ft. NGVD29)
7221 Back Cove	10-yr	8.04	9.97	10.66	11.45	11.88
	20-yr	8.73	10.66	11.35	12.14	12.57
	100-yr	10.73	12.67	13.35	14.14	14.57
	500-yr	11.45	13.39	14.08	14.86	15.29
7047 Maine State Pier	10-yr	7.81	9.75	10.43	11.22	11.65
	20-yr	8.17	10.11	10.79	11.58	12.01
	100-yr	8.89	10.83	11.52	12.30	12.73
	500-yr	9.95	11.48	12.17	12.96	13.39

¹Relative to mean sea level





Table 4-9: Summary of Extreme Water Levels from the NACCS Study combined with MSL scenarios for 2100.

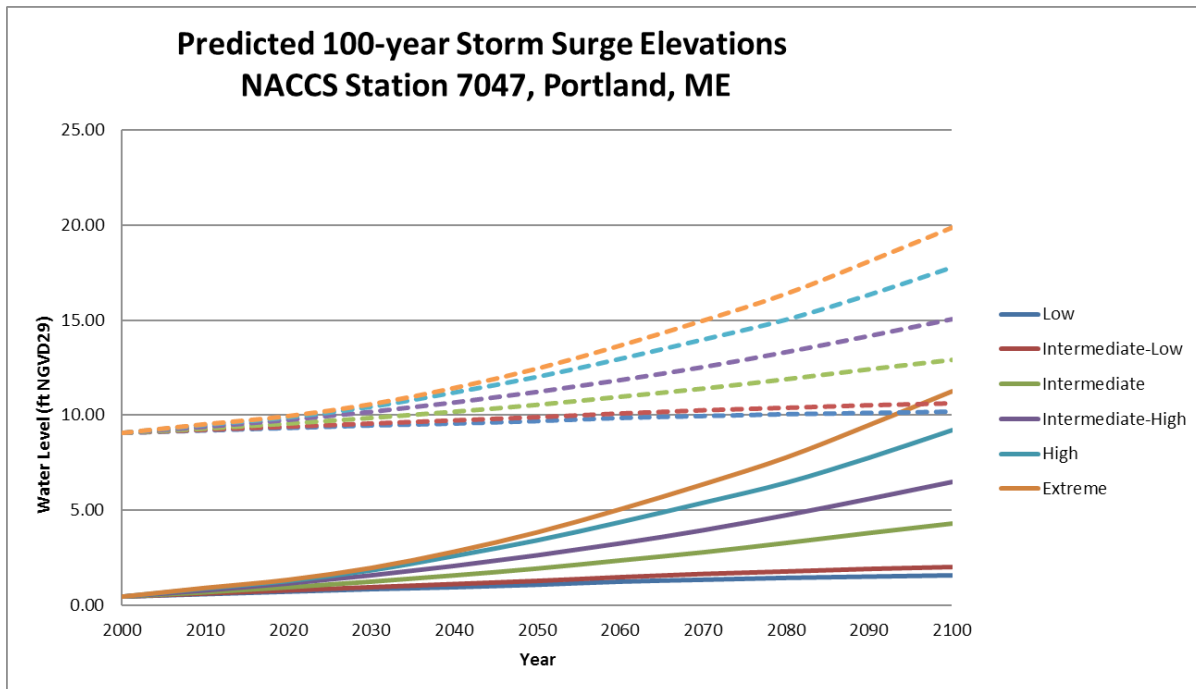
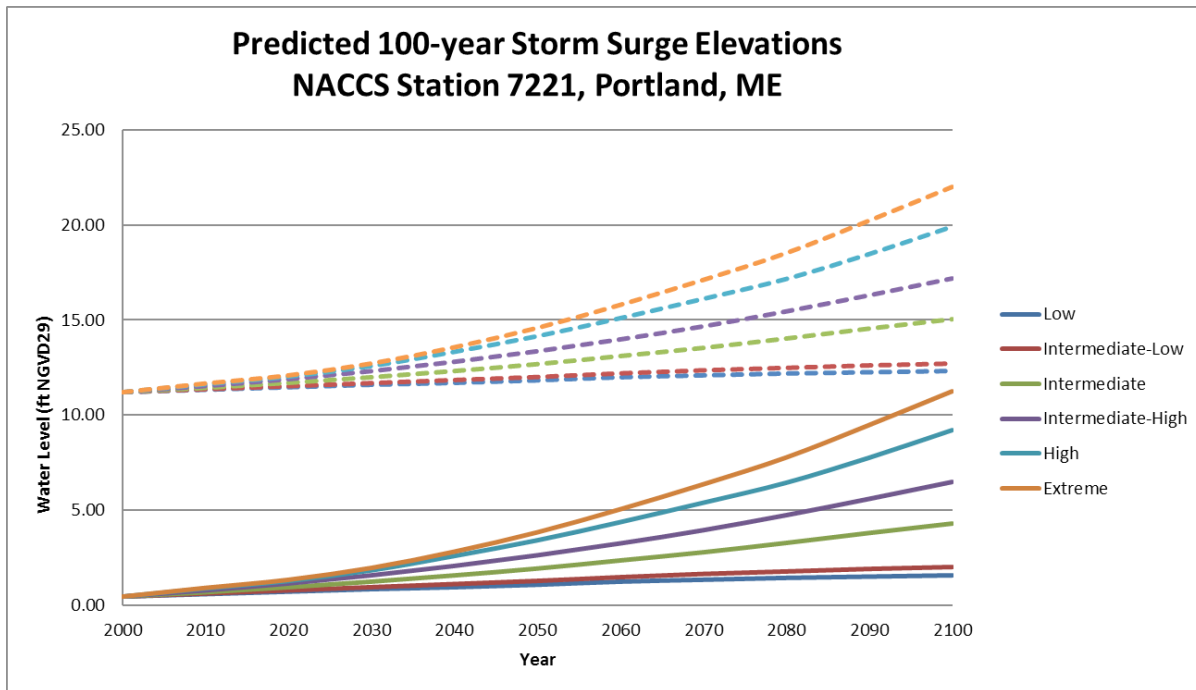
NACCS Station	Water Level Return Period	Storm Surge Water Level (ft.) ¹	Storm Surge Water Level + 2100 Intermediate MSL of 4.3 (ft. NGVD29)	Storm Surge Water Level + 2100 Intermediate-High MSL of 6.46 (ft. NGVD29)	Storm Surge Water Level + 2100 High MSL of 9.19 (ft. NGVD29)	Storm Surge Water Level + 2100 Extreme MSL of 11.25 (ft. NGVD29)
7221 Back Cove	10-yr	8.04	12.34	14.50	17.22	19.29
	20-yr	8.73	13.03	15.19	17.91	19.98
	100-yr	10.73	15.03	17.19	19.91	21.98
	500-yr	11.45	15.75	17.91	20.64	22.70
7047 Maine State Pier	10-yr	7.81	12.11	14.27	16.99	19.06
	20-yr	8.17	12.47	14.63	17.35	19.42
	100-yr	8.89	13.19	15.35	18.08	20.14
	500-yr	9.55	13.85	16.01	18.73	20.80

¹Relative to mean sea level





Figure 4-6: MSL scenarios (solid lines) for the entrance to Back Cove (NACCS Station 7221) (top) and Maine State Pier (NACCS Station 7047) (bottom)



Note: Figure 4-6 shows how the 100-year water level height (dashed lines) changes in magnitude under each scenario.



4.3 Precipitation

As part of this study precipitation characteristics and literature pertaining to present and projected precipitation changes were assessed. The aspects of precipitation important to stormwater management include the characteristics of the design storm, which for the City has been stated to be the 24-hr precipitation event with a 25-yr recurrence interval, and the peak intensity of precipitation on a short-term basis. This analysis has been performed to estimate the present and potential future values of these metrics as well as updated sources for provision of data/approach. First a summary of present precipitation characteristics is presented, then the basis and values to be used in the future are established. An assessment of known flooding events is presented in **Section 5.1**.

4.3.1 Analysis of existing precipitation characteristics

Stormwater management requires an understanding of precipitation characteristics, namely the frequency, duration, intensity and distribution of precipitation. Typically engineers design systems for a given design storm which is a theoretical representation of the precipitation distribution and total for a given statistical significance; in this case the City designs for the 24-hr precipitation that recurs at a 25-yr interval, which can be thought of as the event that has a 4% chance of occurring in any given year. The precipitation distribution throughout the event along with the watershed characteristics dictate the runoff volumes to various components of the stormwater system.

4.3.1.1 Precipitation Event Totals Statistics

A review of data sources (NOAA TP-40, NOAA Atlas 14, NRCS/NRCC) that provide precipitation totals/duration combinations for different recurrence intervals was performed. A sample of the comparison for the 1-hr precipitation and 24-hr precipitation totals at various recurrence intervals is shown in **Figure 4-7** and **Figure 4-8**. Evident in these figures is that there is variability across the sources with the trend in conservatism changing depending on recurrence interval.

Figure 4-7: Summary of Precipitation Totals (in.) for the 1-hr Duration at Various Recurrence Intervals

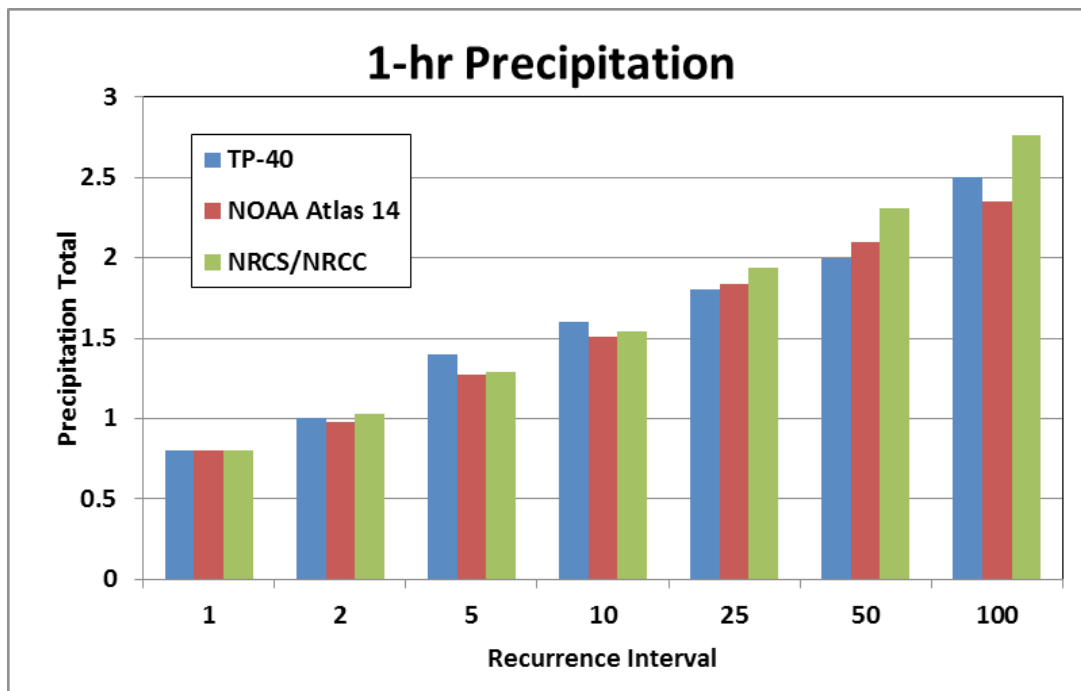
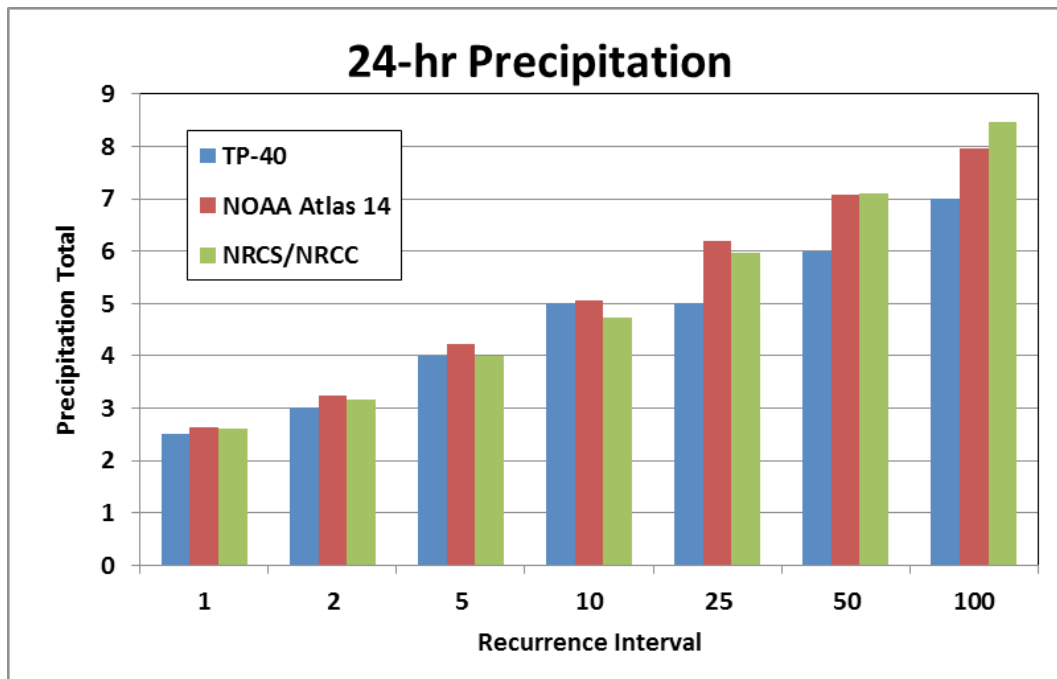




Figure 4-8: Summary of Precipitation Totals (in.) for the 24-hr Duration at Various Recurrence Intervals



The uncertainty of the 24-hour precipitation event totals for various recurrence intervals was also investigated for the NOAA Atlas 14 data (**Figure 4-9**) and the NRCC data (**Figure 4-10**); TP-40 does not provide uncertainties. This shows that the uncertainty is slightly greater for the NOAA Atlas 14 data and that furthermore the uncertainty can be a relatively high particularly for less frequent events. **Figure 4-9** illustrates that a 24-hr total of 6 inches could be associated with any event ranging from a 10-yr to a 100-yr recurrence interval.

Figure 4-9: Illustration of Uncertainty Associated With the NOAA Atlas-14 24-hr Precipitation Totals at Various Recurrence Intervals

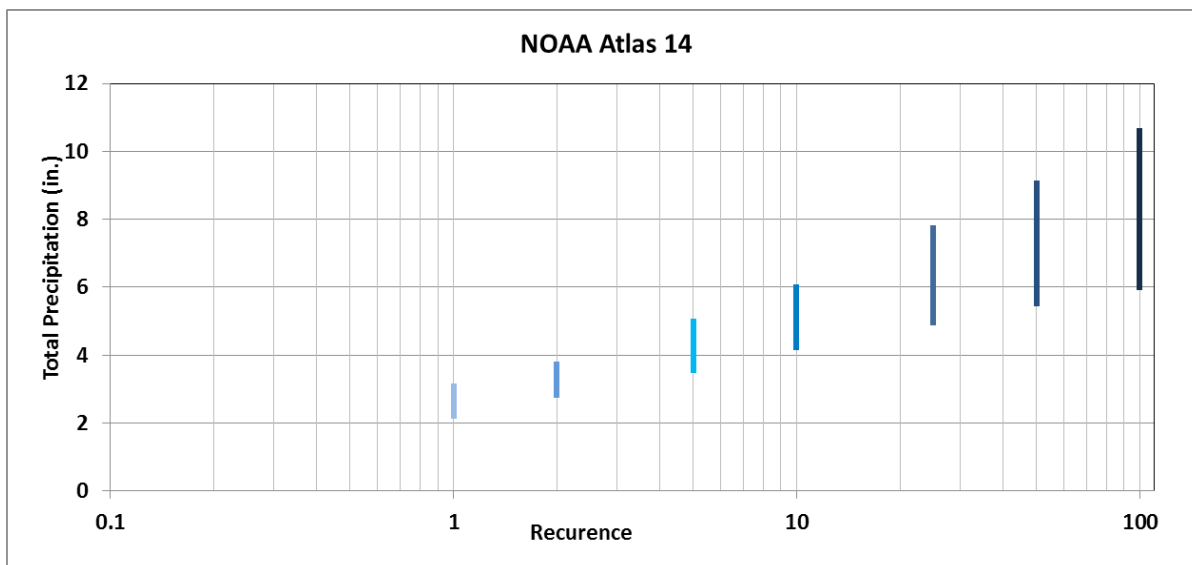
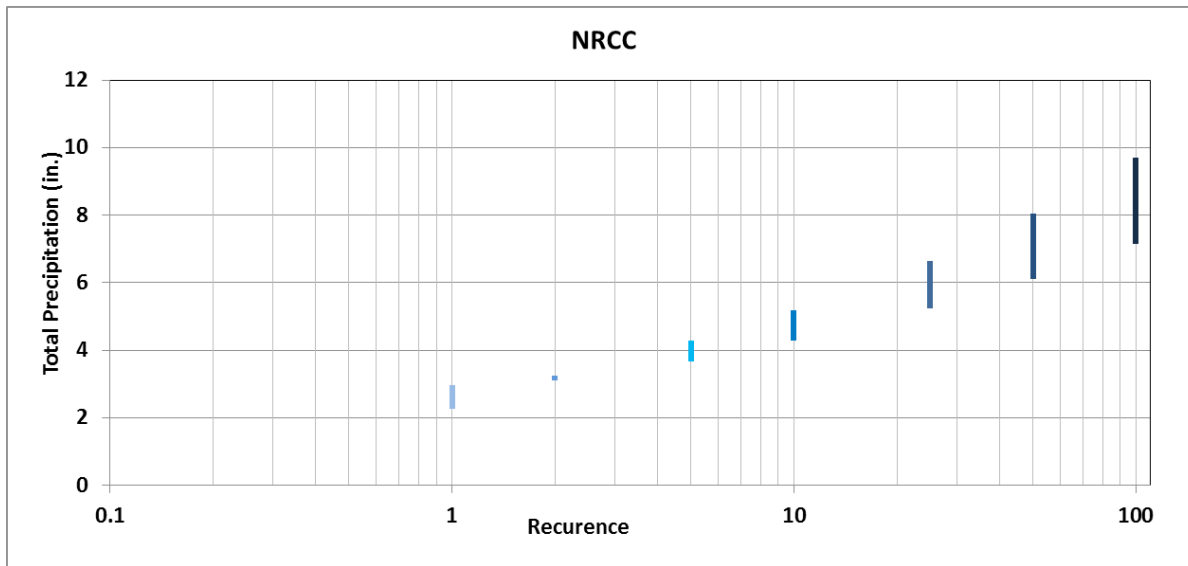




Figure 4-10: Illustration of Uncertainty Associated With NRCC 24-hr Precipitation Totals at Various Recurrence Intervals



4.3.1.2 Precipitation Event Distributions and Intensity

Another important component of precipitation characteristics is the distribution during an event. Historically most planning was done using the NRCS Type III distribution in this region. The NOAA 14 Atlas has updated distributions for some parts of the country, however to date have not yet updated the distributions to be used in Maine though those will be coming. In the interim the Northeast Regional Climate Center has computed distributions for the northeast and have made available a tool that provides site specific distributions. **Figure 4-11** and **Figure 4-12** provide illustrations of the new NRCC and the historic NRCS distributions for the 24-hr precipitation events represented by cumulative and incremental fraction respectively; note that the NRCC data is specific for a 25-yr event and the distribution changes slightly depending on the recurrence interval of the event. These distributions are based on 6-minute time steps so the incremental fraction shows the time history of 6-minute totals throughout the event. The distributions are similar, however the NRCC new distri-

bution has a slightly narrower but peakier pattern. It is suggested that the City move towards assuming the New NRCC distributions for use in studies or planning related to stormwater.

The intensity of precipitation is also a useful metric relative to stormwater management. A summary of the peak intensity during the design storm using various sources of total precipitation (TP-40, NOAA Atlas 14, and NRCS/NRCC) and distributions (Historic Type III and New NRCC) are presented in **Table 4-10**. It can be seen from this table that while the new NRCC distribution produces the greatest 6-minute intensity, the historic NRCS Type III distribution produces the greatest hourly intensity. Further it can be seen that for this design event that the peak hourly intensity varies by almost a half inch depending on the source used to define the event total precipitation. It is recommended that the City use the NOAA Atlas 14 value for planning purposes relative to the 25-yr 24-hr design storm.



Figure 4-11: Comparison of Historic and New Precipitation (in.) Distributions (cumulative)

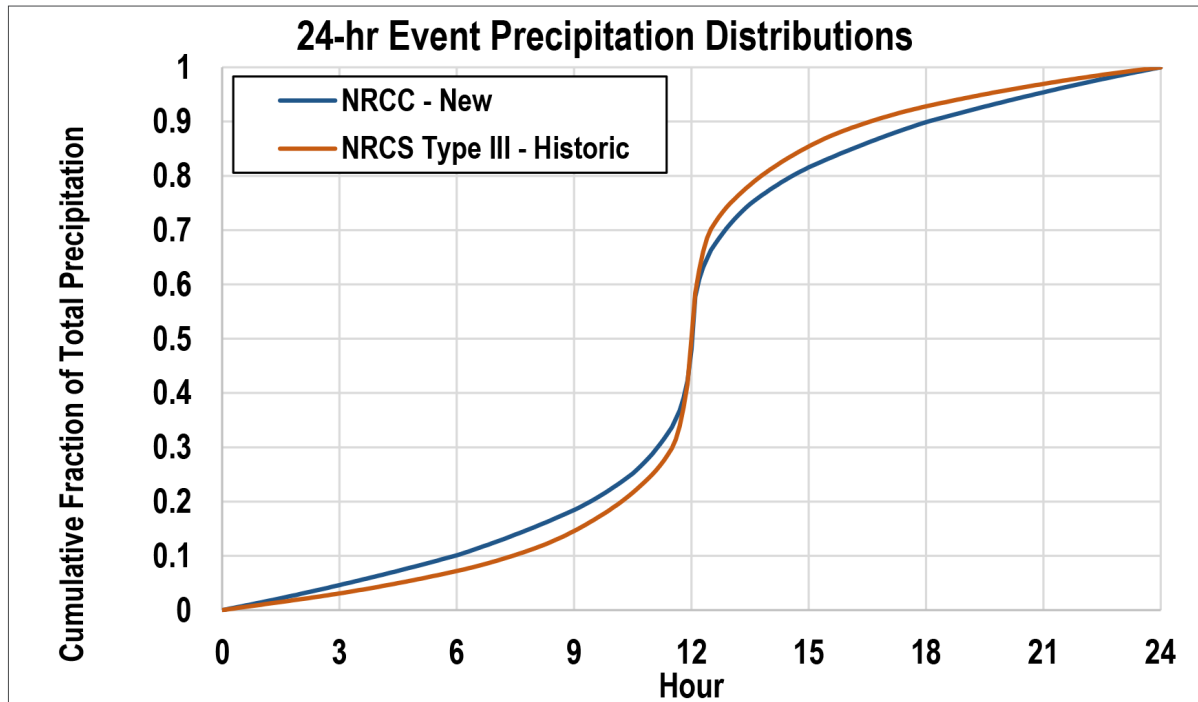


Figure 4-12: Comparison of Historic and New Precipitation (in.) Distributions (incremental)

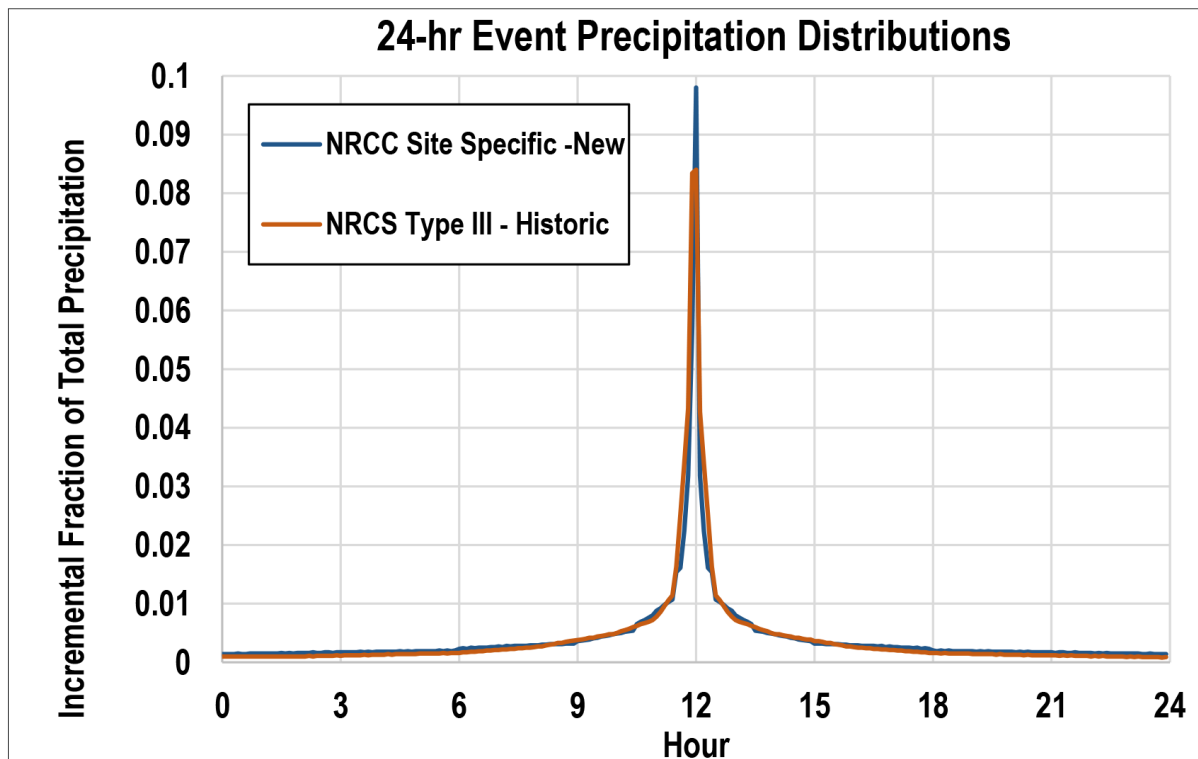




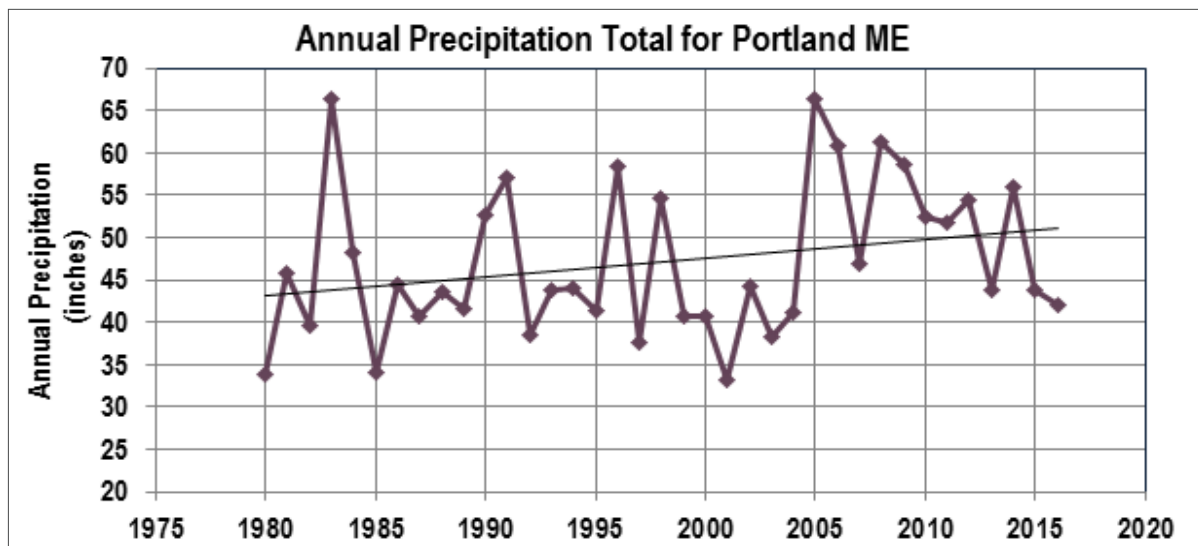
Table 4-10: Summary of Peak 6-minute and Hourly Intensity During the 25-yr 24-hr Precipitation Event

Description	RI	Entire Event Duration	TP40	NOAA ATLAS 14	NRCC
Total Precipitation (in.)	25-yr.	24-hr.	5.00	6.19	5.97
Peak 6-min Using NRCC- New (in./6 min)	25-yr.	24-hr.	0.49	0.61	0.59
Peak 6-min Using NRCS- Historic (in./6 min)	25-yr.	24-hr.	0.42	0.52	0.50
Peak Hourly - Using NRCC New (in./hr.)	25-yr.	24-hr.	1.63	2.02	1.95
Peak Hourly - Using NRCS - Historic (in./hr.)	25-yr.	24-hr.	2.02	2.50	2.41

4.3.1.3 Precipitation Annual Totals

The annual total precipitation has been analyzed for the period of 1980 – 2016; a plot of the annual totals is illustrated in **Figure 4-13**. The average annual precipitation from this period is 47.11 inches with a minimum of 33.12 inches and a maximum of 66.4 inches. A linear trendline fit to the data is also shown in **Figure 4-13**. This trendline is sloped upwards, indicating a trend of increasing annual totals.

Figure 4-13: Annual Precipitation Totals from 1980-2016



Source: (source: <http://www.nrcc.cornell.edu/wxstation/nowdata.html>)



4.3.2 Establishment of Future Conditions

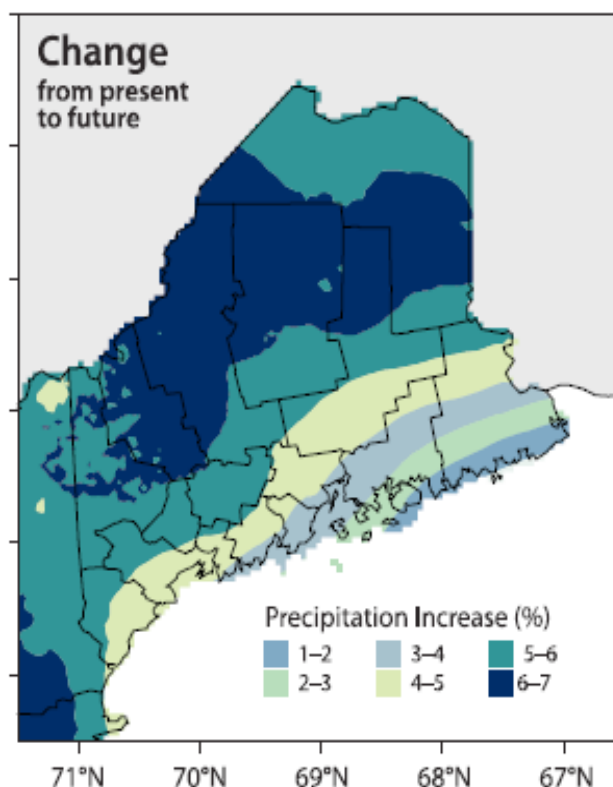
The preceding sections described the sources of precipitation statistics and values associated with the assumed design storm. This section provides insight to projected future conditions and makes recommendations for values to be used in future design scenarios.

Climate change is anticipated to change both the average annual precipitation and the peak intensity on a short-term basis (e.g., 6 minute or hourly). The objective of this analysis is to be able to project the future design storm characteristics and peak intensities in two future timeframes, a mid-term (2050) and long-term (2100). Multiple sources were investigated including the Casco Bay Estuary Program report on Climate Change Trends (CBEP, 2015), the University of Maine Maine's Climate Future (Fernandez, 2015), and the Climate Solutions New England (CSNE) Climate Assessments for New England.

4.3.2.1 Future Design Storm Totals

To develop the future design storm totals, literature that provides projected values or rates was investigated. The CBEP climate change report and website content provide a summary of the past precipitation trends and summarize that based on historic data and showed that the increase from 1895 to 2014 was 0.5 inches (0.0042 in./yr) in Maine while more recent data shows a more rapid increase of 1.92 inches from 1960-2014 (0.0349 in./yr). Further the study suggests that the annual average will continue to increase, and points to the University of Maine (UMaine) report for this topic. The UMaine report provides the same historic hindcast and additionally provides a projection that states the annual average will continue to rise between 5-10% between now and 2050. A reproduction of the map presented in that report is provided in **Figure 4-14** which shows that the Portland region falls within the 4-5 % predicted increase range. This study also discusses how the number of extreme events have been and are expected to continue to increase.

Figure 4-14: Projected Precipitation Increase from 2015 to 2050 (Fernandez et al., 2015)





The CSNE report provided the most comprehensive set of quantitative metrics regarding increase in average annual precipitation, and therefore was chosen as the source for providing future projections for the Bayside project. This study provides projections for the change in annual precipitation for various timeframes and emission scenarios. The study presents the historic annual average as 46.6 in. based on data from 1980-2009, which was consistent with the analysis of the annual data provided in **Section 4.3.1.3**. The study projects the change in the averages for medium term and long term periods for a low and a high emission scenario. Based on these incremental changes, the projected average annual totals were calculated for each timeframe/emission scenario and summarized as shown in **Table 4-11**. The percent change in average annual precipitation was also calculated for each timeframe/emission scenario as summarized in **Table 4-12**; in all cases the percent change is relative to the historic average

annual precipitation total of 46.6 inches. Also shown is the average total annual precipitation. Additionally, the average percent change was calculated by averaging the values for the low and high emission scenario for each timeframe. For the purposes of the present study it is proposed to use these averages to scale the precipitation totals to establish the future conditions of each precipitation event. The historic and scaled values for various duration storms is provided in **Table 4-13**. The design event (25-yr 24-hr) is highlighted in this table. The 24-hr event statistics were also plot and shown on two different x-axis extents (**Figure 4-15** and **Figure 4-16**) with two different reference lines to illustrate where the historic total crosses the future curves. These figures show how for the 24-hr event the historic 25-yr. event is expected to be equivalent to the 16-yr in 2050 and 13-yr in 2100 and similarly how the historic 100-yr. 24 hr. event is expected to be equivalent to the 52-yr in 2050 and 42-yr in 2100.

Table 4-11: Summary of Projected Average Annual Precipitation for the 2050 and 2100 Representative Scenarios.

Representative Scenario	Range	Low Emission Annual Total (inches)	High Emission Annual Total (inches)
2050	Mid-Term 2040-2069	51.7	52.7
2100	Long-Term 2070-2099	53	56.3

Table 4-12: Summary of Projected Percent Change in Average Annual Precipitation for the 2050 and 2100 Representative Scenarios.

Representative Scenario	Range	Low Emission Annual Total Percent Change (%)	High Emission Annual Total Percent Change (%)	Average Percent Change (%)	Average Total Annual Precipitation (in)
2050	Mid-Term 2040-2069	10.9	13.1	12	52.2
2100	Long-Term 2070-2099	13.7	20.8	17.3	54.7



Table 4-13: Summary of Historic and Suggested Future Precipitation Totals (in.) for Various Durations

3-hr Precipitation (in.)			
ARI (yrs.)	Historic	Mid Term	Long Term
		2050	2100
1	1.36	1.52	1.59
2	1.67	1.87	1.96
5	2.16	2.42	2.53
10	2.56	2.87	3.00
25	3.13	3.51	3.67
50	3.56	3.99	4.17
100	3.99	4.47	4.68

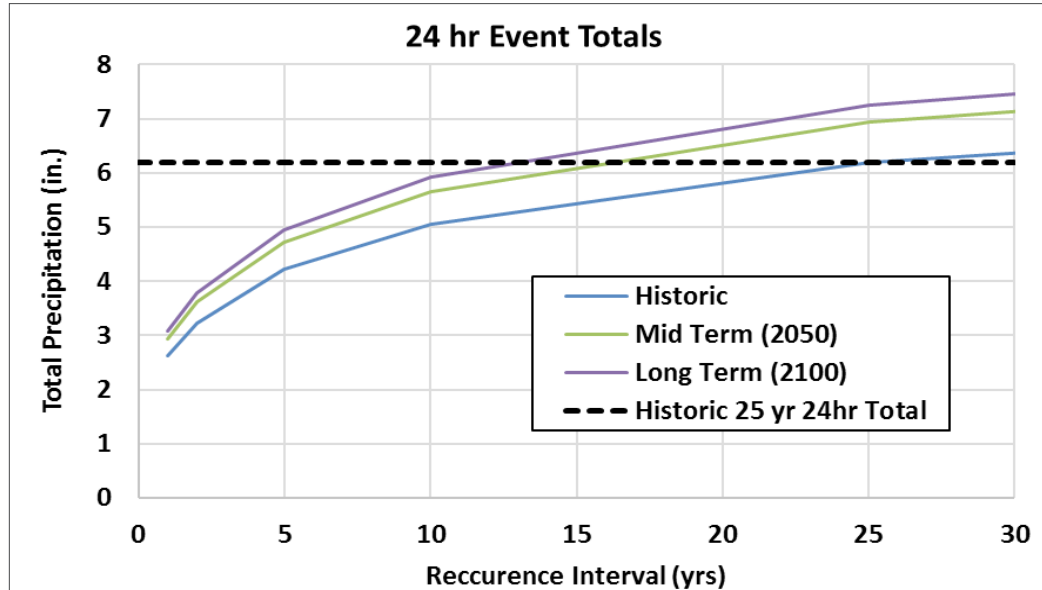
6-hr Precipitation (in.)			
ARI (yrs.)	Historic	Mid Term	Long Term
		2050	2100
1	1.8	2.02	2.11
2	2.2	2.46	2.58
5	2.84	3.18	3.33
10	3.38	3.79	3.96
25	4.12	4.61	4.83
50	4.68	5.24	5.49
100	5.25	5.88	6.16

12-hr Precipitation (in.)			
ARI (yrs.)	Historic	Mid Term	Long Term
		2050	2100
1	2.26	2.53	2.65
2	2.75	3.08	3.22
5	3.56	3.99	4.17
10	4.23	4.74	4.96
25	5.15	5.77	6.04
50	5.86	6.56	6.87
100	6.58	7.37	7.72

24-hr Precipitation (in.)			
ARI (yrs.)	Historic	Mid Term	Long Term
		2050	2100
1	2.62	2.93	3.07
2	3.23	3.62	3.79
5	4.22	4.73	4.95
10	5.05	5.66	5.92
25	6.19	6.93	7.26
50	7.07	7.92	8.29
100	7.95	8.90	9.32

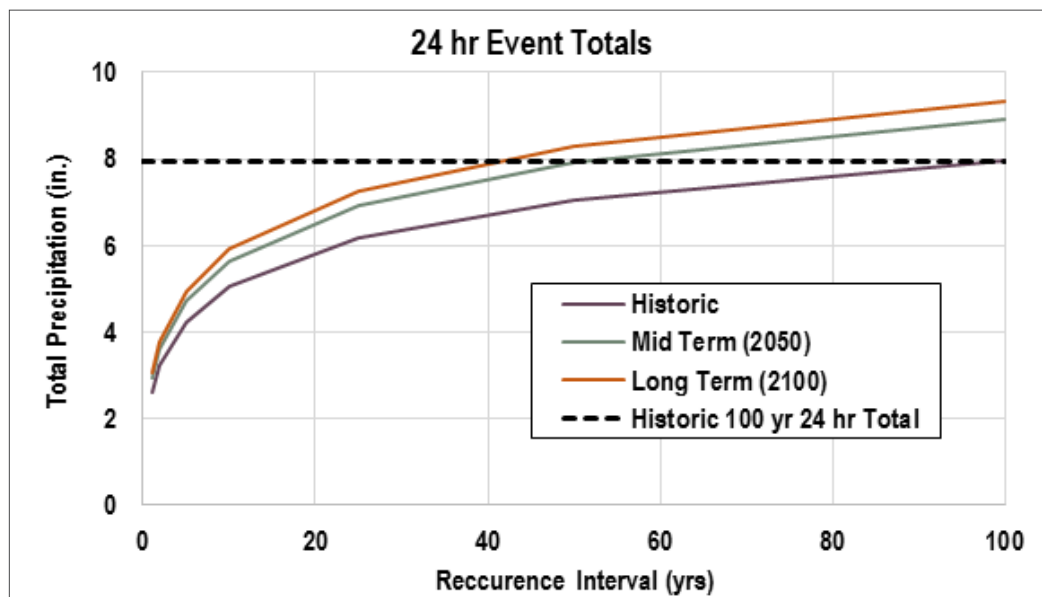


Figure 4-15: 24-hr Event Recurrence Interval Totals for Historic and Future Timeframes



Note: X-axis zoomed to 30-year timeframe

Figure 4-16: 24-hr Event Recurrence Interval Totals for Historic and Future Timeframes



Note: X-axis extended to 100-year timeframe

4.3.2.2 Future Increases to Precipitation Intensity

The studies reviewed were consistent in suggesting that the precipitation intensity will increase in the future, however few quantitative metrics are available. Most of the literature focuses on the increase in the number of events as opposed to the increase in actual intensity. The projected increase in event totals indicates that intensity will increase throughout the event. The peak 6-minute and hourly precipitation totals were calculated for the future timeframes and are summarized along with historic values in **Table 4-14**. These calculations are based on the NOAA Atlas 14 totals and the NRCC distribution.



Table 4-14: Summary of Peak 6-Minute and Hourly Intensity During the 25-yr 24-hr Precipitation Event for Historic, Mid-Term (2050) and Long Term (2100) Timeframes

Description	RI	Entire Event Duration	Historic	Mid Term (2050)	Long Term (2100)
Total Precipitation (in.)	25-yr.	24-hr.	6.19	6.93	7.26
Peak 6-min Using NRCC-New (in./6 min)	25-yr.	24-hr.	0.61	0.68	0.71
Peak Hourly - Using NRCC New (in./hr.)	25-yr.	24-hr.	2.02	2.26	2.37

4.3.2.3 Precipitation Summary

An analysis of the historic precipitation characteristics, historic analysis approaches to precipitation and future projected precipitation characteristics was performed. The following bullet points provide a summary of major findings.

- The city infrastructure is intended to withstand the 25-yr 24-hr precipitation event.
- Historically total precipitation for design events was obtained from TP-40 and the distribution was based on NRCS Type III curves.
- Newer sources of precipitation statistics and a new approach to precipitation distribution are presently available and recommended for future use since the take in to account more recent precipitation trends.
- It is suggested that the NOAA Atlas-14 recurrence interval statistics are used along with the NRCC precipitation distribution to define design storm characteristics.
- Future design storm totals were estimated by averaging the low emission and high emission scenarios annual total values for both a midterm (2050) and long term (2100) timeframe. The average increase from the present total of 46.6 in. was 12% (52.2 in.) for 2050 and 17.3% (54.7 in.) for long term.
- The design storm total based on NOAA Atlas 114 will increase from historic value of 6.19 in. to 6.93 in. by 2050 and 7.26 in. by 2100.
- The peak 6-minute precipitation will increase from 0.61 in. to 0.68 in. by 2050 and 0.71 in. by 2100.
- The peak hourly precipitation will increase from 2.02 in. to 2.26 in. by 2050 and 2.37 in. by 2100.
- The historic precipitation total for the design storm (24-hr 25-yr.) is equivalent to the precipitation total for a 16-yr event in 2050 and a 13-yr. event in 2100.
- The historic precipitation total for the design storm (24-hr 100-yr.) is equivalent to the precipitation total for a 52-yr. event in 2050 and a 42-yr. event in 2100.
- The uncertainties in precipitation recurrence interval totals is high and can rival the magnitude of the storm.



Section 5

Sea Level Rise and Climate Change Findings





5. IMPACTS TO BAYSIDE & DATA GAPS

5.1 Analysis of Known Flooding Events

The Bayside neighborhood has stormwater infrastructure that conveys runoff to the coastal waters through a system of catch basins, pipes/culverts, and pumping stations. The system is taxed during extreme events, which can result in drainage issues. These issues may be exacerbated for certain coastal conditions such as unusually high tides or storm surges when the waters rise enough to create a hydraulic connection between the coastal waters and the drainage system; this condition can diminish the capacity of the conveyance system. To understand if Bayside flooding is a function of the coastal water surface elevation or the precipitation or the combination of both, a review of the reported flood events was performed. The total daily precipitation and water surface elevation for each day of report flooding is shown in **Table 5-1**. Reported events are sparse and nothing conclusive regarding precipitation alone as the source of flooding problems can be learned from this data set.

Table 5-1: Summary of Reported Flooding Events and Associated Daily Precipitation Sum and Highest Water Elevation

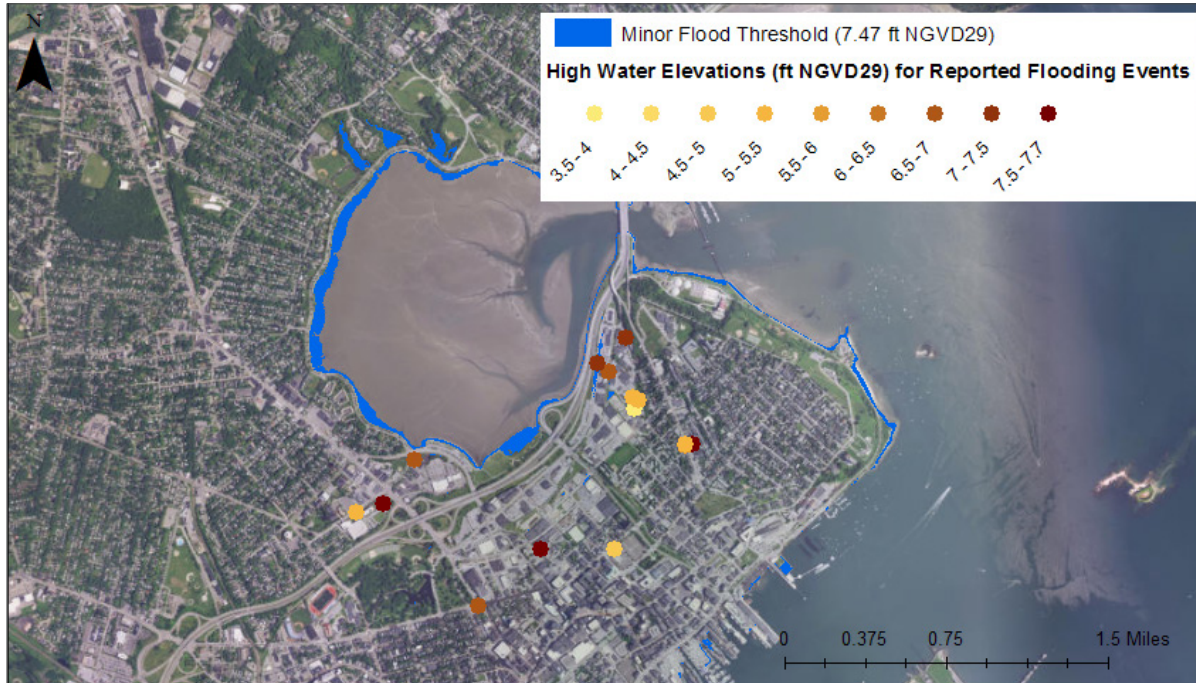
Event Year	Event Date	Precipitation Total (inches)	Precipitation Notes	Observed Highest Water Elevation (ft. NGVD29)	Predicted Highest Water Elevation (ft. NGVD29)
2013	5/9/2013	0.7		5.8	5.7
2013	6/24/2013	Trace		7.6	7.3
2014	6/13/2014	2.32		6.9	6.5
2014	9/1/2014	1.29	day before	5.3	5.0
2015	4/21/2015	0		7.7	6.8
2015	9/30/2015	5.56		7.6	7.1
2015	10/1/2015	0		6.8	6.9
2015	10/28/2015	0.97		6.8	7.3
2016	3/11/2016	0.13		7.2	6.7
2016	3/31/2016	0		4.0	4.3
2016	4/26/2016	0.4	also 2+ in. snow	5.2	5.0
2016	5/7/2016	Trace		7.3	7.2
2016	5/28/2016	0		5.2	5.2
2016	5/29/2016	0		5.1	5.1
2016	6/15/2016	0		4.9	4.6





Figure 5-1 shows a map of the minor flood threshold (7.5 ft. NGVD29, as described in **Section 4.1.1**) along with the locations of the reported flooding events color coded by the high-water elevation from the date of the reported flood event. Most the reported flood events occurred with high water elevations less than the minor flood threshold. Given that these flood events are occurring at or below the coastal minor flood threshold, further investigation is needed to determine the causation of each of these flood events particularly those occurring when observed coastal water levels are well below the minor flood threshold and no rain has been reported. The lack of information as to the origin of these events should be considered a data gap.

Figure 5-1: Map of Minor Flood Threshold Compared to Reported Flooding Events and the Respective High Water Elevation





5.2 Sea Level Rise

5.2.1 Sea Level Rise Impacts

Sea level rise causes permanent inundation along the coast. In Maine, this will lead to loss of salt marches, beach erosion, and increased flooding due to storm surge (Fernandez, 2015; Whitman et al., 2013). Previous studies of Bayside have shown that a one to three-foot increase in sea level will impact existing infrastructure in the neighborhood including properties and roads along Marginal Way, Somerset Street, Preble Street, and Back Cove Park (Bohlen et al., 2013).

While the scenarios presented in **Section 4.1** and summarized in **Table 5-2** provide water level elevations for planning purposes, it is necessary to map potential areas of inundation to understand impacts.

Table 5-2: Summary of Predicted Daily Inundation Elevations

Scenario	2050: MHHW, ft. relative to NGVD29	2100: MHHW, ft. relative to NGVD29
Intermediate	6.93	9.29
Intermediate High	7.61	11.45
High	8.40	14.17
Extreme	8.83	16.24

Note: Expressed as MHHW relative to ft. NGVD29 for 2050 and 2100

While mapping each of the scenarios is outside the scope of this study, there are several sources of existing inundation maps that provide insight into the impacts of these scenarios, these include:

- Climate Central: Surging Sea's Risk Zone Map
- NOAA Sea Level Rise Viewer
- Maine Geological Survey (MGS) – Sea Level Rise/Storm Surge Viewer
- Sea Level Rise and Casco Bay's Wetlands: A Look at Potential Impacts – Portland Edition
- Maine Geological Survey (MGS) – Adapting to Sea Level Rise in South Portland
- Natural Resource Council of Maine Inundation Maps: Maps of Maine Communities Affected by Sea-level Rise

Table 5-3 includes a detailed summary of these studies including the sea level rise scenarios included and the base water level used for mapping. The maps available from each of these studies have been matched to the scenarios recommended above to show extent and depth of potential inundation where possible and to identify data gaps.



**Table 5-3: Summary of Resources that Provide Inundation Mapping for the Portland Region**

Existing Data	Year	Sea Level Rise Scenarios	Base Water Level	Source
Climate Central: Surging Sea's	2015	1 ft.; 2 ft.; 3 ft.; 4 ft.; 5 ft.; 6 ft.; 7 ft.; 8 ft.; 9 ft.; 10 ft., 11.2 ft.	Local MHHW	http://sealevel.climatecentral.org/
NOAA Sea Level Rise Viewer	Rolling updates	1 ft.; 2 ft.; 3 ft.; 4 ft.; 5 ft.; 6 ft.;	Local MHHW	https://coast.noaa.gov/digitalcoast/tools/slr
MGS Sea Level Rise/Storm Surge	2015	1 ft.; 2 ft.; 3.3 ft.; 6 ft.	2015 HAT	http://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml
Sea Level Rise and Casco Bay's Wetlands: Portland Edition	2011; updated in 2013	1 ft.; 3 ft.	1998 FEMA SWEL	https://www.cascobayestuary.org/wp-content/uploads/2014/06/2013_cbep_slr_report_portland.pdf.pdf
Adapting to Sea Level Rise in South Portland (MGS)	2012	1.97 ft. (0.6 m); 3.28 ft. (1 m); 5.91 ft. (1.8 m)	HAT; FEMA 100-year SWEL	http://www.capeelizabeth.com/planning_board/2013/10-01-2013/SPO%20approved%20final%20report.pdf
Natural Resources Council of Maine	2006	3.3 ft. (1 m); 19.7 ft. (6 m)	Unknown	http://www.nrcm.org/projects/climate/global-warming-air-pollution/sea-level-rise-maine/





Each of the resources listed in Table 5-3 is reviewed for relevance to the recommended scenarios in more detail below. While some are outdated or use low-resolution national elevation datasets, they do provide a screening level indication of potential inundation due to sea level rise.

Climate Central – Surging Seas Risk Zone Map Web Viewer

Climate Central's Surging Seas web viewer is a comprehensive national data viewer that allows the public to view the inland extent of sea level rise on top of a base water level of local MHHW. The exact value of MHHW used in each location is not published. Sea level rise scenarios varying from 1 to 10 ft. are provided. The data, although available for download as a static image or KML, is not available for download in GIS format. In Portland, assuming a local MHHW of 5.38 ft. NGVD29, the surging seas scenarios are equivalent to the following:

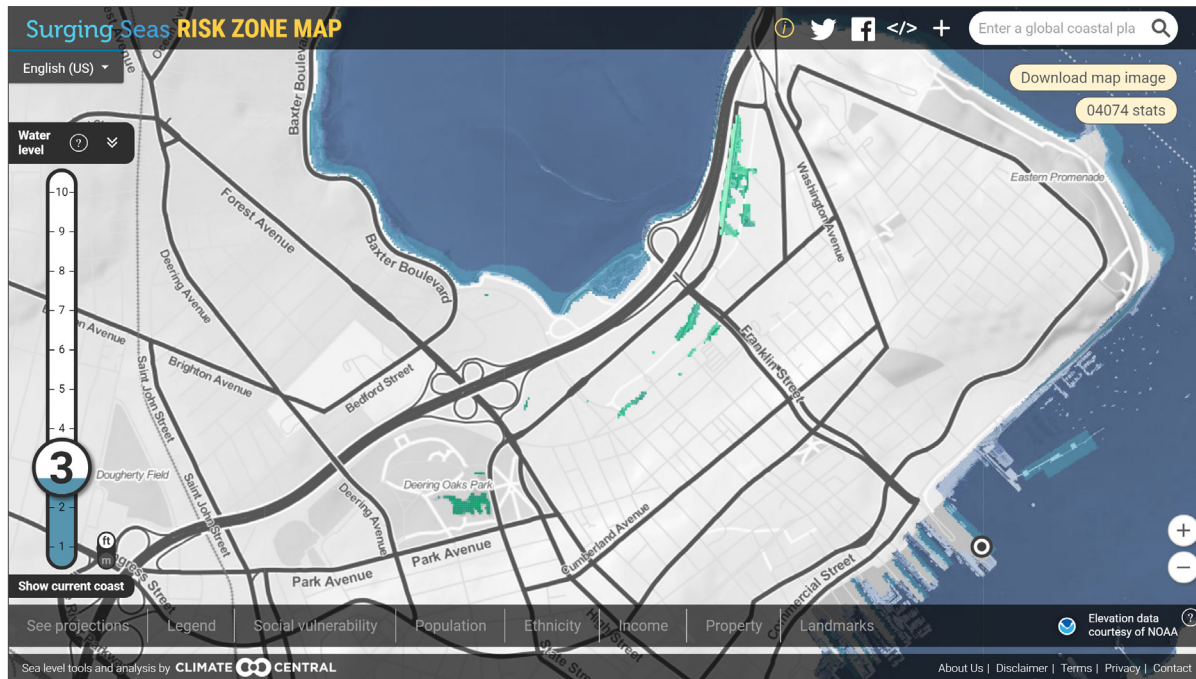
- **1 ft. above MHHW = 6.4 ft. NGVD29 (5.4 ft. NGVD29 + 1 ft. SLR):** This layer can be used to visualize what the 2050 intermediate (6.93 ft. NGVD29) scenario would inundate. This layer is about 0.5 ft. lower than the 2050 intermediate scenario.
- **2 ft. above MHHW = 7.4 ft. NGVD29 (5.4 ft. NGVD29 + 2 ft. SLR):** This layer can be used to visualize what the 2050 intermediate-high (7.61 ft. NGVD29) scenario would inundate. This layer is about 0.2 ft. lower than the 2050 intermediate-high scenario.
- **3 ft. above MHHW = 8.4 ft. NGVD29 (5.4 ft. NGVD29 + 3 ft. SLR):** This layer can be used to visualize what the 2050 high (8.4 ft. NGVD29) and 2050 extreme (8.83 ft. NGVD29) scenarios would inundate. This layer is equivalent to the 2050 high scenario and 0.43 ft. lower than the 2050 extreme scenario.
- **4 ft. above MHHW = 9.4 ft. NGVD29 (5.4 ft. NGVD29 + 4 ft. SLR):** This layer can be used to visualize what the 2100 intermediate (9.3 ft. NGVD29) scenario would inundate. This layer is 0.1 ft. higher than the 2100 intermediate scenario.
- **5 ft. above MHHW = 10.4 ft. NGVD29 (5.4 ft. NGVD29 + 5 ft. SLR):** N/A – this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.
- **6 ft. above MHHW = 11.4 ft. NGVD29 (5.4 ft. NGVD29 + 6 ft. SLR):** This layer can be used to visualize what the 2100 intermediate-high (11.45 ft. NGVD29) scenario would inundate.
- **7 ft. above MHHW = 12.4 ft. NGVD29 (5.4 ft. NGVD29 + 7 ft. SLR):** N/A – this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.
- **8 ft. above MHHW = 13.4 ft. NGVD29 (5.4 ft. NGVD29 + 8 ft. SLR):** N/A– this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.
- **9 ft. above MHHW = 14.4 ft. NGVD29 (5.4 ft. NGVD29 + 9 ft. SLR):** This layer can be used to visualize what the 2100 high (14.17 ft. NGVD29) scenario would inundate. This layer is 0.23 ft. higher than the 2100 high scenario.
- **10 ft. above MHHW = 15.4 ft. NGVD29 (5.4 ft. NGVD29 + 10 ft. SLR):** N/A– this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.
- **11.2 ft. above MHHW = 16.6 ft. NGVD29 (5.4 ft. NGVD29 + 11.2 ft. SLR):** this scenario was developed recently by Climate Central to represent the extreme sea level rise scenario provided in Sweet et al., (2017). It corresponds to the 83rd percentile of the GMSL rise projections provided by Sweet et al., (2017) and is thus slightly higher than the recommendations provided here, which correspond to the mean. This layer can be used to visualize what the 2100 extreme (16.24 ft. NGVD29) scenario would inundate. This layer is 0.36 ft. higher than the 2100 extreme scenario.

An example map of inundation for 3 ft. of sea level rise is shown in **Figure 5-2**; this sea level rise projection corresponds to the 2050 high scenario of 8.4 ft. NGVD29 and is approximately 0.5 ft. lower than the 2050 extreme scenario of 8.83 ft. NGVD29. The map shows permanent inundation along the coastline as well as some areas of inundated land that are isolated from the coast but could be susceptible to flooding via the drainage system.





Figure 5-2: Example of the Surging Sea's Web Viewer



Note: Figure 5-2 is showing 3 ft. of sea level rise on a base water level of MHHW (8.4 ft. NGVD29), which is equivalent to the 2050 high scenario and about 0.5 ft. lower than the 2050 extreme scenario. Blue overlay indicates inundated land. Green overlay indicates inundated land that is isolated from the coast.

NOAA Sea Level Rise Viewer

The NOAA Sea Level Rise web viewer is a comprehensive national data viewer that allows the public to view the inland extent of sea level rise on top of the base water level of the local MHHW. Sea level rise scenarios varying from 0 to 6 ft. are provided. These data layers are also available to download in GIS format. In Portland, assuming a local MHHW of 5.38 ft. NGVD29, these values are equivalent to the following:

- **0 ft. above MHHW = 5.4 ft. NGVD29 (5.4 ft. NGVD29 + 0 ft. SLR):** N/A – this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.
- **1 ft. above MHHW = 6.4 ft. NGVD29 (5.4 ft. NGVD29 + 1 ft. SLR):** This layer can be used to visualize what the 2050 intermediate scenario (6.93 ft. NGVD29) would inundate. This layer is 0.54 ft. lower than the 2050 intermediate scenario.
- **2 ft. above MHHW = 7.4 ft. NGVD29 (5.4 ft. NGVD29 + 2 ft. SLR):** This layer can be used to visualize what the 2050 intermediate-high (7.61 ft. NGVD29) scenario would inundate. This layer is 0.21 ft. lower than the 2050 intermediate-high scenario.
- **3 ft. above MHHW = 8.4 ft. NGVD29 (5.4 ft. NGVD29 + 3 ft. SLR):** This layer can be used to visualize what the 2050 high (8.4 ft. NGVD29) and 2050 extreme (8.83 ft. NGVD29) scenarios would inundate. This layer is equivalent to the 2050 high scenario and 0.43 ft. lower than the 2050 extreme scenario.
- **4 ft. above MHHW = 9.4 ft. NGVD29 (5.4 ft. NGVD29 + 4 ft. SLR):** This layer can be used to visualize what the 2100 intermediate (9.3 ft. NGVD29) scenario would inundate. This layer is 0.1 ft. higher than the 2100 intermediate scenario.
- **5 ft. above MHHW = 10.4 ft. NGVD29 (5.4 ft. NGVD29 + 5 ft. SLR):** N/A – this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.

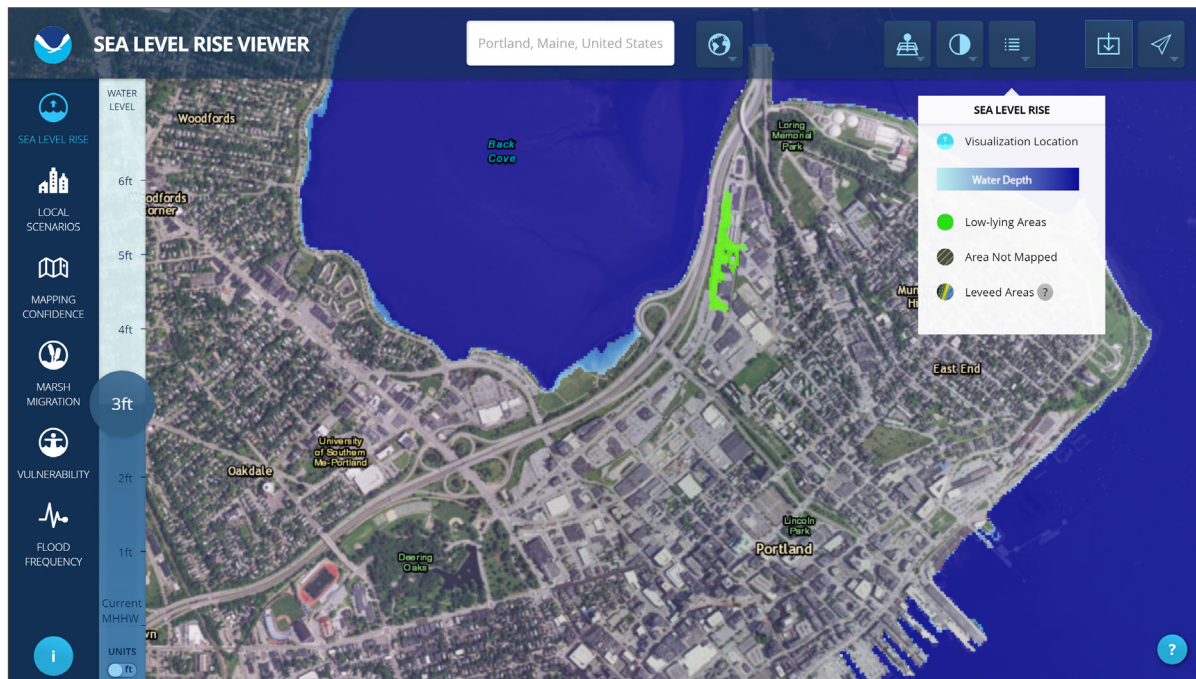




- **6 ft. above MHHW = 11.4 ft. NGVD29 (5.4 ft. NGVD29 + 6 ft. SLR):** This layer can be used to visualize what the 2100 intermediate-high (11.45 ft. NGVD29) scenario would inundate. This layer is 0.05 ft. lower than the 2100 intermediate-high scenario.

An example map of inundation for 3 ft. of sea level rise is shown in **Figure 5-3**; this sea level rise projection corresponds to the 2050 high scenario of 8.4 ft. NGVD29 and is approximately 0.5 ft. lower than the 2050 extreme scenario of 8.83 ft. NGVD29. The map shows permanent inundation along the coastline as well as some areas of inundated land that are isolated from the coast but could be susceptible to flooding via the drainage system. The NOAA inundation map shows slightly less inundation than the corresponding Climate Central Surging Seas Map shown in **Figure 5-2**.

Figure 5-3: Example of the NOAA Sea Level Rise Viewer



Note: Figure 5-3 is showing 3 ft. of sea level rise on a base water level of MHHW (8.4 ft. NGVD29), which is equivalent to the 2050 high scenario and about 0.5 ft. lower than the 2050 extreme scenario. Blue overlay indicates inundated land. Green overlay indicates inundated land that is isolated from the coast

Maine Geological Survey – Sea Level Rise/Storm Surge Web Viewer

The MGS Sea Level Rise/Storm Surge Viewer allows the public to view the inland extent of sea level rise on top of the base water level of the 2015 Highest Annual Tide, which varies along the coast of Maine and was determined using tide tables for each of the NOAA CO-OPS stations. At the Portland Maine CO-OPS Tide Station (8418150) the highest annual tide occurred on October 28th and reached an elevation of 7.3 ft NGVD 29. Sea level rise scenarios varying from 0 to 6 ft. are provided. These data layers are also available to download in GIS format. In Portland, assuming a local MHHW of 7.3 ft. NGVD29, these values are equivalent to the following:

- **0 ft. above HAT = 7.3 ft. NGVD29 (7.3 ft. NGVD29 + 0 ft. SLR):** This layer can be used to visualize what the 2050 intermediate-high (7.6 ft. NGVD29) scenario would inundate. This layer is 0.3 ft. lower than the 2050 intermediate-high scenario.
- **1 ft. above HAT = 8.3 ft. NGVD29 (7.3 ft. NGVD29 + 1 ft. SLR):** This layer can be used to visualize what the 2050 high (8.4 ft. NGVD29) and extreme (8.83 ft. NGVD29) scenarios would inundate. This layer is 0.1 and 0.5 ft. lower than the 2050 high and extreme scenarios, respectively.

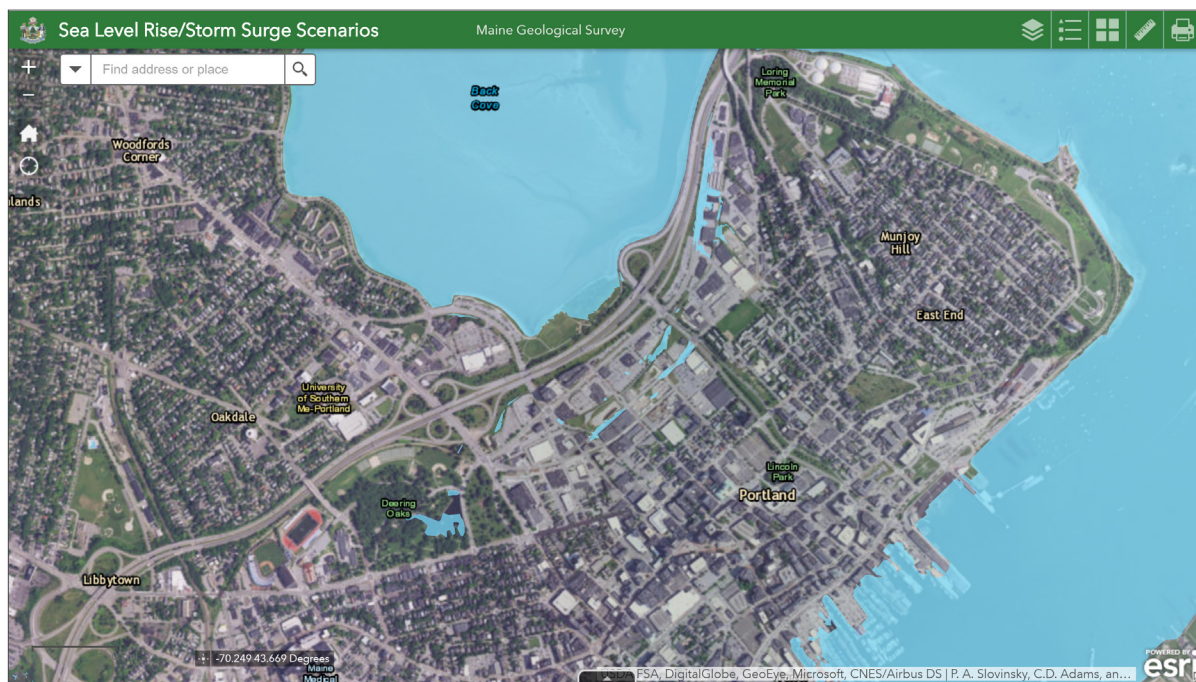




- **3.3 ft. above HAT = 10.6 ft. NGVD29 (7.3 ft. NGVD29 + 3.3 ft. SLR):** N/A– this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.
- **6 ft. above HAT = 13.3 ft. NGVD29 (7.3 ft. NGVD29 + 6 ft. SLR):** N/A– this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.

An example map of inundation for 1 ft. of sea level rise is shown in **Figure 5-4**; this sea level rise projection corresponds to the 2050 high scenario of 8.4 ft. NGVD29 and is approximately 0.5 ft. lower than the 2050 extreme scenario of 8.83 ft. NGVD29. The map shows permanent inundation along the coastline as well as some areas of inundated land that are isolated from the coast but could be susceptible to flooding via the drainage system. The MGS inundation map shows slightly more inundation than the corresponding NOAA Sea Level Rise Viewer Map shown in **Figure 5-3** and approximately equivalent inundation to the corresponding Climate Central Surging Seas Map shown in **Figure 5-2**.

Figure 5-4: Example of the Maine Geological Survey Sea Level Rise/Storm Surge Scenarios Viewer



Note: Figure 5-4 is showing 1 ft. of sea level rise on a base water level of the 2015 highest annual tide (8.3 ft. NGVD29), which is equivalent to the 2050 high scenario and about 0.5 ft. lower than the 2050 extreme scenario. Blue overlay indicates inundated land.

Sea Level Rise and Casco Bay's Wetlands: A Look at Potential Impacts – Portland Edition

The maps in the 2013 Portland edition of *Sea Level Rise and Casco Bay's Wetlands: A Look at Potential Impacts* provides inland extents of 1 ft. and 3 ft. of SLR using a starting base water level elevation of 9.63 ft. NGVD29, which is the 100-year stillwater elevation (SWEL) from the 1998 FEMA Flood Insurance Study. This value is approximately the same as the current 100-year water level reported in Section 4.2 above. The scenarios presented in this study are equivalent to the following:

- **1 ft. above 1998 FEMA SWEL = 10.63 ft. NGVD29 (9.63 ft. NGVD29 + 1 ft. SLR):** N/A– this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.
- **3 ft. above the 1998 FEMA SWEL = 12.63 ft. NGVD29 (9.63 ft. NGVD29 + 3 ft. SLR):** N/A– this scenario is not within 0.5 ft. of any of the recommended daily inundation scenarios.



Additional Studies

Two additional studies were evaluated but are ultimately not recommended for evaluating the impact of sea level rise scenarios in Bayside. The "Adapting to Sea Level Rise in South Portland" report estimated impacts to infrastructure based for various sea level rise scenarios using base water levels of the 2012 HAT and the FEMA 100-year SWEL (1978 storm elevation). The maps provided are for the greater Portland region and are difficult to interpret at a Bayside-specific level.

The Natural Resource Council of Maine also provides inundation maps for Portland for sea level rise scenarios of 3.3 ft. and 19.7 ft. These maps are more than 10 years old and the base flood elevation is unknown so they cannot be used to estimate sea level rise impacts in the Bayside neighborhood.

5.2.2 Sea Level Rise Data Gaps

The resources described in **Section 5.2.1** provide insight into potential inundation due to sea level rise for the scenarios recommended in **Section 4.1**. Climate Central's Surging Seas Viewer has inundation maps for water level scenarios within 0.5 ft. of each of sea level rise scenarios recommended by this study. Inundated areas were identified through a GIS analysis of elevation data at 5-meter resolution. The data is available for download as KML, however the KML lacks the necessary geographic reference information for converting to shapefile and use in further spatial analysis. NOAA's Sea Level Rise viewer provides inundation maps for all scenarios recommended by this study except for the 2100 high and extreme scenarios. These maps appear to indicate slightly smaller inundation areas than Climate Central for most scenarios, particularly for areas of inundation isolated from the coast. As with the Climate Central viewer, inundated areas were identified through a GIS analysis of elevation data at 5-meter resolution. The data is available for download and as web-based map services. The MGS Sea Level Rise and Storm Surge Scenario Viewer provides inundation maps representative of the 2050 intermediate-high, high, and extreme scenarios and the 2100 high scenario. As with the Climate Central and NOAA viewers, inundated areas were identified through a GIS analysis of LiDAR data, though the resolution is not reported. Of the three studies the NOAA viewer is the only one that provides an indication of depth.

Figure 5-5 shows a comparison of similar water levels from the NOAA Sea Level Rise Viewer and the MGS Sea Level Rise/Storm Surge Viewer. Corresponding data was not available from Surging Sea's Risk Zone Map Viewer at the time of this study. The MGS results, which represent a slightly higher water level than the NOAA results, indicate more inland flooding for this scenario. Isolated low-lying areas have not been removed since it is already well known that some of these locations may become hydraulically connected to the coast under certain tidal conditions.





Figure 5-5: Comparison of Inundation Extent Layers from NOAA SLR Viewer and the MGS SLR/Storm Surge Viewer



While all three studies are useful in predicting the extent of potential inundation, they are all simple GIS analyses of elevation data and none account for the local drainage features around the Bayside neighborhood. As it is well known that ‘sunny-day’ inland flooding (isolated from the coast) is already occurring in Bayside, it is important to account for underground pathways that contribute to inland flooding. As discussed in **Section 2.2** of this Report, there are seven drainage/combined sewer conduits in the Bayside area. All seven are at least partially unprotected by tide gates. As sea level rise continues to exacerbate tidal flooding it is critical to determine the elevation of each discharge pipe and understand how water can backflow through the system and flood inland areas.

5.3 Storm Surge

5.3.1 Storm Surge Impacts

The storm surge scenarios in **Section 4.2** provide water level elevations for various return period storms, extracted from the NACCS database, under various sea level rise scenarios at two points in the Portland region. A summary of the ranges of potential storm surge water levels for various return periods at the entrance to Back Cove (NACCS Station 7221) for 2050 and 2100 is provided in **Table 5-4**. The ranges represent how storm surge would change under the intermediate through extreme sea level rise scenarios in 2050 and 2100.

Table 5-4: Range of Potential Extreme Water Levels at the Entrance to Back Cove for 2050 and 2100

NACCS Station	Water Level Return Period	NACCS Storm Surge Water Level (ft. NGVD29)	Potential Storm Surge Water Levels 2050 (ft. NGVD29)	Potential Storm Surge Water Levels 2100 (ft. NGVD29)
7221 Back Cove	10-yr	8.44	9.97 - 11.88	12.34 - 19.29
	20-yr	9.13	10.66 - 12.57	13.03 - 19.98
	100-yr	11.13	12.67 - 14.57	15.03 - 21.98
	500-yr	11.85	14.08 - 15.29	15.75 - 22.70



Mapping storm surge inundation is more complex than mapping sea level rise inundation because storm surge elevations for a single event vary along the coast due to local dynamics and geomorphology. Typical GIS analyses of elevation data use static water level elevations and do not account for this spatial variation. While **Table 5-5** provides a summary of the existing mapping resources that correspond to the NACCS Station 7221 storm surge water level predictions, these maps should be used with caution as they do not account for the spatial variability of storm surge. Using them to predict potential inundation also assumes that sea level rise can simply be added to storm surge elevations, which may not be the case in the Portland region, as discussed in **Section 4.2**.

To illustrate the impact of the spatial variability of storm surge elevations around Portland, **Figure 5-6** and **Figure 5-7** were generated for this study using a custom python script developed by RPS to interpolate water level elevations between the NACCS output points, providing a continuous and spatially varying water level surface. The continuous water level surface was then used with the 2015 LiDAR data to show areas of potential inundation. These figures show the predicted extent of inundation for the 100-year event in 2050 for the intermediate and extreme sea level rise scenarios and 2100 for the intermediate and high sea level rise scenarios. While this approach to mapping storm surge helps to account for spatial variability, it still assumes that sea level rise can be added linearly to storm surge elevations. Even under the most extreme of these scenarios, it still appears that most of the inundation in Bayside is coming from Back Cove indicating that mitigation of this inundation can be carried out on a fairly local scale.

Figure 5-6: Inundation from the NACCS Mean 100-year Storm Surge Water Level for the 2050 Intermediate (top) and Extreme (bottom) Scenarios





Figure 5-7: Inundation from the NACCS Mean 100-year Storm Surge Water Level for the 2100 Intermediate (top) and High (bottom) Scenarios





Table 5-5: Summary of Storm Surge Water Levels for Various Return Periods and Sea Level Rise Scenarios and the Existing Map Resources that Correspond Most Closely

Existing Data Sources				
Storm Surge Scenario	Time-Frame	SLR Scenario	Water Level (ft. NGVD29)	Refer to Corresponding Map
10-year	2050	Intermediate	9.97	Climate Central - 4 ft. NOAA SLR Viewer - 4 ft.
10-year	2050	Intermediate-High	10.66	Climate Central - 5 ft. NOAA SLR Viewer - 5 ft. MGS - 3.3 ft.
10-year	2050	High	11.45	Climate Central - 6 ft. NOAA SLR Viewer - 6 ft.
10-year	2050	Extreme	11.88	Climate Central - 6 ft. NOAA SLR Viewer - 6 ft.
10-year	2100	Intermediate	12.34	Climate Central - 7 ft.
10-year	2100	Intermediate-High	14.50	Climate Central - 9 ft.
10-year	2100	High	17.22	N/A
10-year	2100	Extreme	19.29	N/A
20-year	2050	Intermediate	10.66	Climate Central - 5 ft. NOAA SLR Viewer - 5 ft. MGS - 3.3 ft.
20-year	2050	Intermediate-High	11.35	Climate Central - 6 ft. NOAA SLR Viewer - 6 ft.
20-year	2050	High	12.14	Climate Central - 7 ft.
20-year	2050	Extreme	12.57	Climate Central - 7 ft.
20-year	2100	Intermediate	13.03	Climate Central - 8 ft. MGS - 6 ft.
20-year	2100	Intermediate-High	15.19	Climate Central - 10 ft.
20-year	2100	High	17.91	N/A
20-year	2100	Extreme	19.98	N/A
100-year	2050	Intermediate	12.67	Climate Central - 7 ft.
100-year	2050	Intermediate-High	13.35	Climate Central - 8 ft. MGS - 6 ft.
100-year	2050	High	14.14	Climate Central - 9 ft.
100-year	2050	Extreme	14.57	Climate Central - 9 ft.
100-year	2100	Intermediate	15.03	Climate Central - 10 ft.
100-year	2100	Intermediate-High	17.19	N/A
100-year	2100	High	19.91	N/A
100-year	2100	Extreme	21.98	N/A
500-year	2050	Intermediate	13.39	Climate Central - 8 ft. MGS - 6 ft.
500-year	2050	Intermediate-High	14.08	Climate Central - 9 ft.
500-year	2050	High	14.86	Climate Central - 9 ft.
500-year	2050	Extreme	15.29	Climate Central - 10 ft.
500-year	2100	Intermediate	15.75	Climate Central - 10 ft.
500-year	2100	Intermediate-High	17.91	N/A
500-year	2100	High	20.64	N/A
500-year	2100	Extreme	22.70	N/A





5.3.2 Storm Surge Data Gaps

Historic high water marks from the Blizzard of 1978 (representative of a 100-year storm) show that there was little spatial variability in storm surge water elevations throughout the City of Portland. However, the water levels extracted from the NACCS database, see **Section 4.2**, show spatial variation of nearly 2 ft. between Back Cove and the opposite side of the Portland Peninsula. This uncertainty of spatial variability in Portland is an important data gap that should be investigated.

As discussed in **Section 4.2**, the storm surge predictions for 2050 and 2100 are simple linear additions of the predicted mean sea level scenarios for those periods and the NACCS storm surge elevations. For the Portland region, the validity of this assumption should be further investigated. Two potential sources of information include the NACCS study results and published SLOSH model results for the Penobscot Bay Basin, which covers the Portland Region.

The NACCS study included a set of scenarios that modeled a static water level adjustment of 1.0 m to simulate a potential future GMSL rise scenario. While this adjustment for sea level rise doesn't cover the range of scenarios recommended in **Section 4.1**, a review of these NACCS results would indicate whether the storm surge water levels increase linearly when using a higher base water level elevation. For example, if the NACCS storm surge values at the entrance to Back Cove are approximately 1.0 m higher for the sea level rise scenarios than the base scenarios the assumption that sea level rise can be added to storm

surge elevations to predict future extreme water levels for Bayside is correct. If not, further analysis is needed to determine how sea level rise will impact future storm surge elevations in the region. This analysis would require numerical modeling of storm surge in the region using base water level elevations that include sea level rise. Unfortunately, the set of NACCS results that includes sea level rise is not currently available for public use and thus represent a data gap. NOAA SLOSH model results with varying base water level are available for the Portland region. The NOAA SLOSH MOMs (Maximum of Maximum Envelope of Water) are provided for two base water level elevations, mean tide and high tide, and four hurricane categories, 1 through 4. The high tide simulations simply add five feet to the mean tide elevation and can be used as a simple proxy for sea level rise. The SLOSH results at the entrance to Back Cove, summarized in **Table 5-6**, indicate variations of between 2.6 and 5.2 ft. for the mean vs high scenarios. These results indicate that for the lower surge elevations, the assumption that that sea level rise can be added to storm surge is reasonable, but for higher surge elevation, non-linear effects appear to decrease the impact of a higher base water level. It should be noted that SLOSH is run on a much coarser resolution grid (approximately 1.5 nautical miles in the Portland region) than the NACCS model. Also, the data examined only accounts for storm surge resulting from hypothetical hurricanes, where as the top 10 water levels recorded at the Portland Tide Gage (8418150) occur during the months of November through April (NOAA, 2017c) and are likely the result of extra-tropical events.

Table 5-6: SLOSH Model Results for the Penobscot Bay v2 Basin, cell 96, 6 (entrance to Back Cove)

SLOSH Scenario	Surge at Mean Tide (ft. NGVD29)	Surge at High Tide (+ 5 ft.) (ft. NGVD29)	Difference (ft.)
Category 1	7.0	12.2	5.2
Category 2	12.8	17.9	5.1
Category 3	19.0	22.9	3.9
Category 4	24.3	26.9	2.6

Note: Table 5-6 shows the difference between base water levels representing mean and high tide.





Though the SLOSH model results indicate that linear addition of sea level rise to storm surge may not be a valid assumption, because SLOSH does not account for typical (extra-tropical) storm surges in the region, and because the model is low resolution we recommend verifying the validity of this assumption with the NACCS study sea level rise scenarios when they become publicly available. Alternatives to waiting for additional NACCS results to become available include obtaining the detailed storm surge modeling results from the 2016 Casco Bay Region Climate Change Resiliency Assessment, which modeled storm surge under three different sea level rise scenarios. There is also an ongoing study of regional resiliency in the Northeast, spearheaded by the Northeast Regional Association Coastal Ocean Observing System and in collaboration with researchers from the University of Maine, that includes numerical modeling of storm surge for Maine. The results of this study are not publicly available yet.

5.4 Precipitation

5.4.1 Precipitation Impacts

The impacts due to precipitation will vary due to the characteristics of the precipitation event. The main impact of precipitation is the potential for flooding. The flooding could occur anywhere though would be most predominant in the lower lying regions, particularly those adjacent to stormwater collection basins. Depending on the precipitation event, another possible impact is Combined Sewer Overflows. These impacts are present today and are predicted to occur more frequently and with a greater magnitude (e.g., larger area with flood depths >0.5 ft. or more CSOs triggered).

While precipitation alone can cause problems, it is likely that combined events of storm surge will be accompanied by relatively large precipitation totals. Similarly, as sea level rises the coincidence of precipitation events with high waters will increase. When these events occur, the drainage system is compromised and increased upland flooding can be expected. A recent study performed by Argonne National Laboratory (Yan et al., 2016) evaluated combined events with a 2D hydrodynamic model in the Back-Cove Area in Portland. The study was focused on identifying differences in the spatially and temporally varied precipitation distributions between radar based sources and rain gauge sources and to evaluate their impact on urban flooding. The study simulated two historic events, April 16, 2007 and September 30, 2015 with Flo-2D. The model application included a depiction of topography, ground cover (roughness), buildings, streets, the stormwater system (piping, inlets, outlets, storage, pumps), hydraulic structures, streamflow and precipitation, for which as mentioned two versions of precipitation were simulated for each event (radar and gauge), and variable coastal water surface elevation based on observations at the NOAA Buoy. **Table 5-7** summarizes the precipitation total and high water as stated in the Argonne report; note that the high water was not referenced to a vertical datum. The model outputs included total precipitation volume in the study area as measured by acre-ft, delineation of inundated areas and the depth of flood flow as well as flooding velocity. The flow depth and velocity were also used to determine the hazard level as either low, medium or high. **Figure 5-8** through **Figure 5-11** present maps of flow depth and flow hazard for the two events (using results from driven by radar based precipitation) respectively. What can be seen when comparing the two predictions is that the footprint of inundation is larger for the September 30th event, which is likely due to the precipitation in the presence of a compromised drainage system. As a point of reference, the September 30th event is close to the present design storm (25-yr 24-hr present P total =6.19 in.) precipitation total, though not quite as large and the April 16th event is more like a precipitation total of a 2-yr recurrence interval (2-yr 24-hr present P total =3.23 in.). The recurrence interval of the associated surge was not provided in the study, and the omission of the vertical datum provides uncertainty. For both simulations, a larger inundation area and greater inundation depth would be expected if the precipitation was increased or possibly if the surge was increased; alternatively, a smaller inundation footprint and depth would be expected if the precipitation decreased or the surge decreased; additional model simulations would be needed to quantify such trends.



Table 5-7: Precipitation Total and High Water from Argonne Simulations.

	Precipitation in.	High Water* ft.
April 16, 2007	3.36	13.3
September 30, 2015	5.56	8.3

**source report did not reference vertical datum*

Figure 5-8: Map of Flood Flow Depth from Radar Precipitation Driven Flo-2D Simulation of April 16, 2007 Event (Figure 5.7 from Yan et al. 2016)

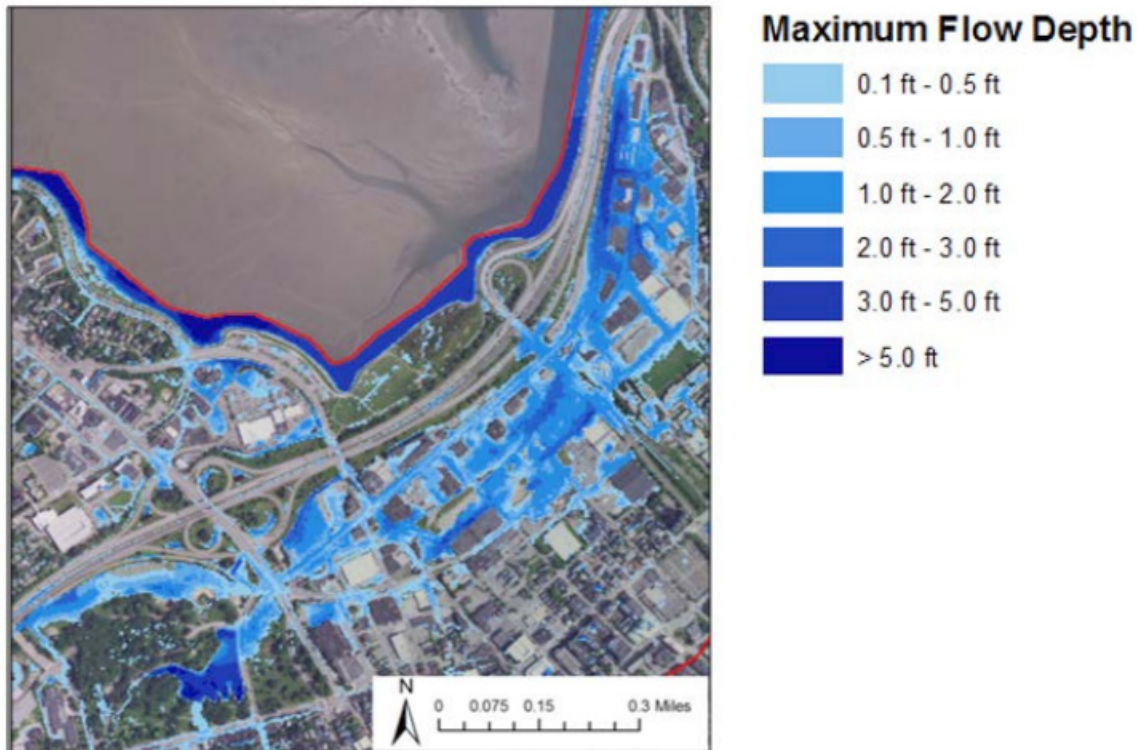




Figure 5-9: Map of Flood Flow Depth from Radar Precipitation Driven Flo-2D Simulation of September 30, 2015 Event (Figure 5.8 from Yan et al. 2016)

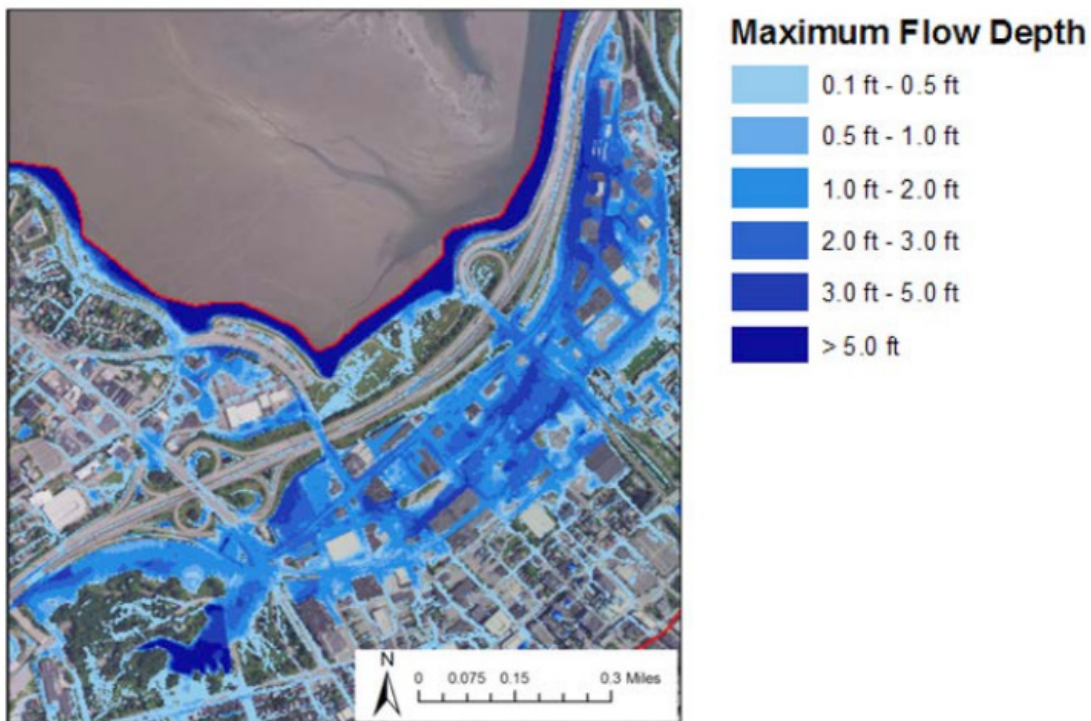


Figure 5-10: Map of Flood Hazard from Radar Precipitation Driven Flo-2D Simulation of April 16, 2007 Event (Figure 5.7 from Yan et al. 2016)

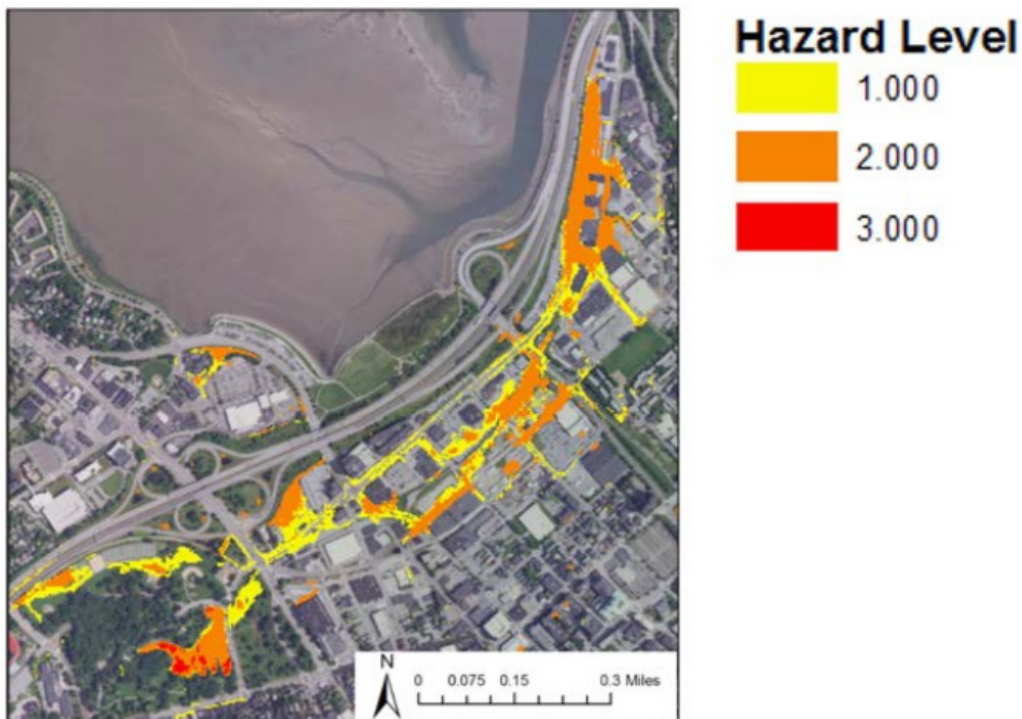
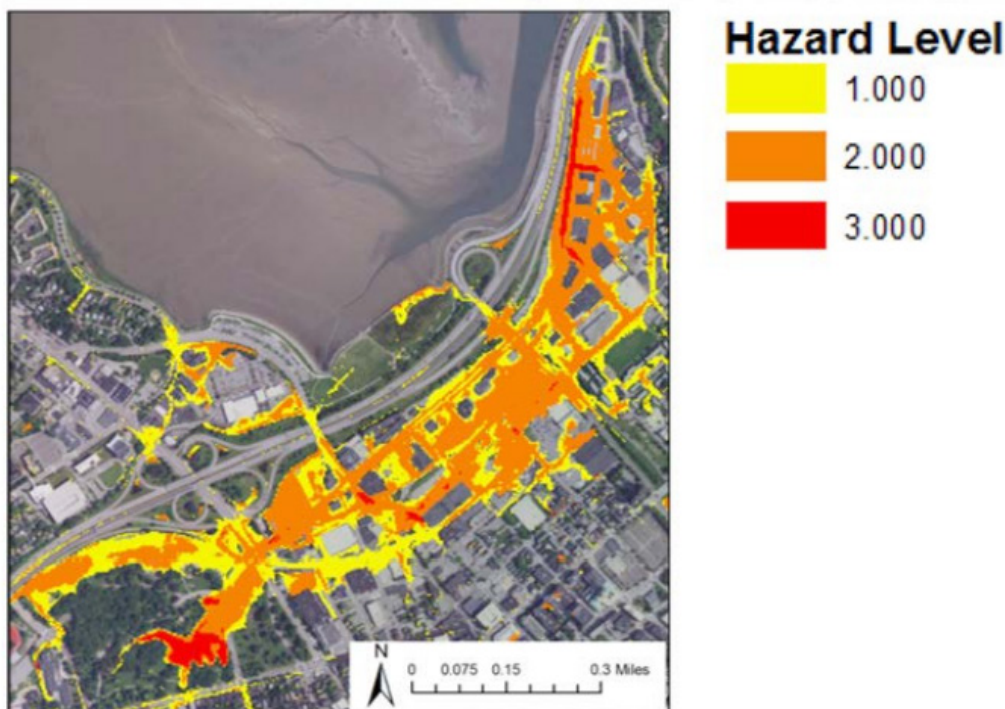




Figure 5-11: Map of Flood Hazard from Radar Precipitation Driven Flo-2D Simulation of September 30, 2015 event (Figure 5.7 from Yan et al. 2016)



5.4.2 Precipitation Data Gaps

The City is interested in understanding any data gaps relative to precipitation. Based on the literature there are means to estimate the future recurrence intervals and distributions to produce future design storm conditions. In that sense, such data is not a data gap, however it is recommended that the literature and numbers be updated continuously.

It is not understood if precipitation events alone are presently causing flooding problems, meaning precipitation events that do not coincide with high tides/submerged outfalls that may diminish the conveyance capacity. Therefore, the precipitation based flooding triggers are considered a data gap. Ideally a model or analysis of different design storms that mapped associated flood depths and identified components of the conveyance system that were at capacity would provide the type of information needed for planning.

Lastly it is understood that flooding can occur when there are storm surges or high tides. It is known that this flooding is exacerbated when it coincides with precipitation. The factors that will influence the degree of this problem are related to understanding the behavior of coastal waters relative to the stormwater system, specifically it is suggested that the invert elevation of all outfalls that have the potential to be submerged be obtained and that an inventory of internal tide gates be performed. Also, it would be useful to have a model or analysis of different design storms with variations of high tide and storm surge to produce maps of associated flood depths and to evaluate potential mitigation measures.



Section 6

Recommendations





1

Compile and Extract Existing Data for Integration into City GIS

The City's multi-year, multi-million dollar investments into maintaining their sewer systems and abating CSOs has generated a significant amount of high accuracy data, which will be used to populate their GIS and help inform future modeling and adaptation planning exercises in Bayside. This recommendation will integrate existing data into the City's GIS database as the sole repository for infrastructure needed for Bayside Adaptation planning.

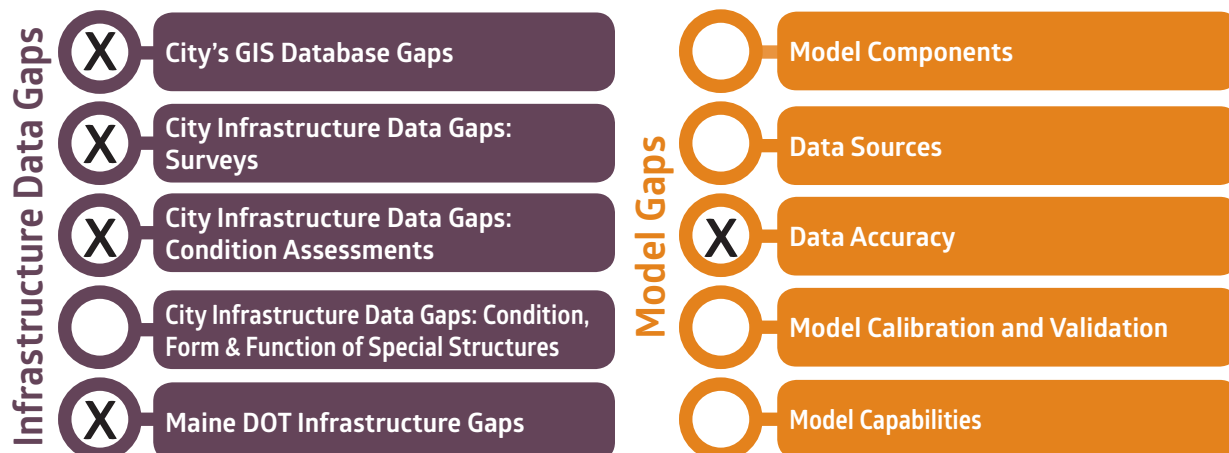
Specific tasks include:

- ▶ Confirmation of key infrastructure attributes that must be obtained for future use in Bayside modeling and adaptation planning and confirmation that the City's ESRI Local Government Information Model will accommodate selected model data input. It is recommended that this task include working meetings between technical engineering and modeling consultants, City GIS and Public Works staff, Maine DOT and Portland Water District (Project Team). The Project Team shall develop an approach for data source control and documentation (metadata) for all new data collection. Near-term utility construction or reconstruction projects should be considered during working meetings and those locations avoided for data collection migration.
- ▶ Obtain existing utility surveys from City, MaineDOT and PWD (as necessary).
Extract data and migrate into GIS.
- ▶ Obtain existing survey data (10k LF), extract and migrate into GIS
- ▶ Obtain existing structural condition reports, review for adequacy and ensure association of condition defect ratings (both structural and operational) with current GIS assets.
- ▶ Extract manhole and catch basin rim elevation from LiDAR and incorporate into GIS.
- ▶ Summarize new data availability in GIS and present to Bayside Project Team.

Budget Cost: \$50,000

Key Assumptions: City to ensure engagement with Maine DOT and PWD.

Data Gaps Resolved





2

Targeted Field Data Collection Program

This recommendation will identify, obtain, and integrate additional infrastructure data necessary for Bayside Adaptation planning and model development. This recommendation also includes an assessment of tide control devices to further inform the City's ongoing efforts to maintain and replace tide control infrastructure.

Specific tasks include:

- ▶ Identify additional, targeted data collection needs for the SWMM model updates that have not been resolved during Recommendation 1. This task requires engagement of the modeling consultant to inform final selection of specific stormwater drainage infrastructure to be utilized in the SWMM model.
- ▶ Initiate survey and/or condition assessment on segments of stormwater drainage infrastructure that will be utilized in the future SWMM Model and primary drainage conduits under I-295. All pipe and structures should be cleaned prior to initiation of assessment. All infrastructure must be assessed during low tide cycle only.
- ▶ Conduct cleaning maintenance on areas to be surveyed/inspected including Special Structures with Tide Gates.
- ▶ Survey (3,000 LF) and Clean and TV Inspect (10k - 35k LF)
- ▶ Initiate condition assessment on three Special Structures with Tide Gates. This assessment will include structural condition and operational/mechanical functionality assessment with City DPW staff. This task should include visual leak testing during high tide cycle and development of updated schematics of each of the Special Structures.
- ▶ Review video logs (from condition assessment) and conduct spot inspection for assessment of unprotected separate stormwater infrastructure for tide control retrofit opportunities. Develop recommendations.
- ▶ Incorporate new survey and condition assessment data into GIS.
- ▶ Present findings of survey, condition assessment and tide control retrofit opportunities to Bayside Team.

Budget Cost: \$135,000

Key Assumptions: City will provide police detail and traffic control for survey and condition assessments, as determined necessary.

Data Gaps Resolved

Infrastructure Data Gaps

- ☒ City's GIS Database Gaps
- ☒ City Infrastructure Data Gaps: Surveys
- ☒ City Infrastructure Data Gaps: Condition Assessments
- ☒ City Infrastructure Data Gaps: Condition, Form & Function of Special Structures
- ☒ Maine DOT Infrastructure Gaps

Model Gaps

- ☐ Model Components
- ☒ Data Sources
- ☐ Data Accuracy
- ☐ Model Calibration and Validation
- ☐ Model Capabilities





3

Explore Additional Model Capabilities / Options for Adaptation Planning

Hydrologic/hydraulic models in conjunction with GIS models, are used for the following flood abatement related activities:

- Flood predictions: The model can calculate the depth and area of flooding, including the combined effects of high tides, tidal surges, rainfall and snowmelt. With a fully developed and calibrated model, flood predictions can be made based on a series of likely and worst case scenarios.
- Detailed design: The model can be used to test a variety of design options and predict the level of abatement a design option will potentially result in.
- Operational optimization: A fully developed and calibrated model, along with live flow monitoring data, can be used in "real-time" to provide short term predictions of impending flooding. Also, in areas where flood abatement involves the use of active controls (flood gates, pump stations, etc.), the models can be used to help optimize the implementation of these controls.

This recommendation will consider and identify the appropriate modeling software necessary for Bayside Adaptation planning. The SWMM model is a solid foundation for future flood planning and there are several module additions to SWMM (InfoSWMM, InfoSWMM2D) that will simulate surface flooding. Alternatively, there are other software products being utilized for flood modeling that may also be considered.

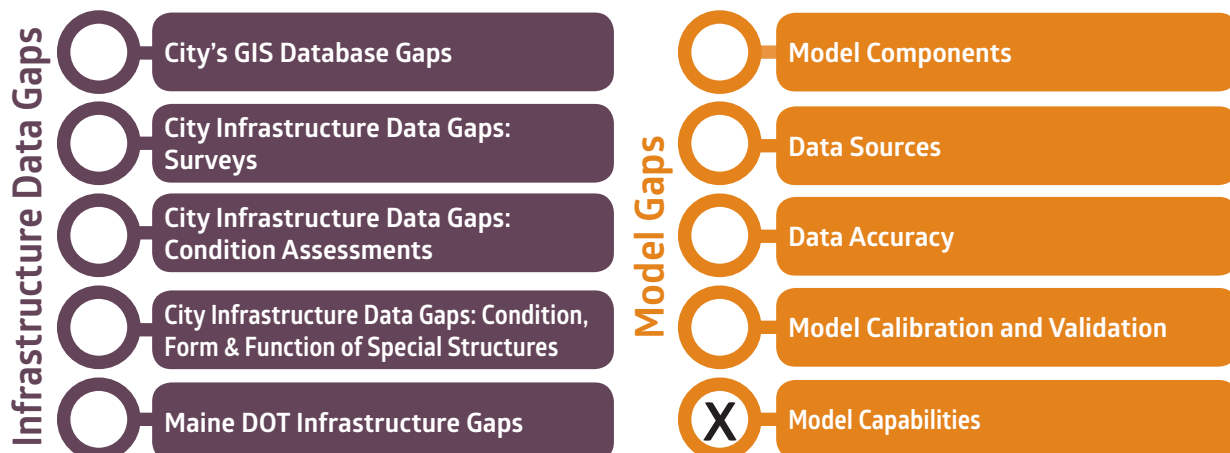
Specific tasks include:

- Project Team to engage Bayside Working Group to identify guiding principles and adaptation strategies of most interest to inform modeling needs.
- Develop Request for Information from various modeling software providers to provide presentation and overview of how their product could be utilized for future Bayside Adaptation planning and potential costs for procurement and development of the model.
- Select and procure model software and services of a modeler.

Budget Cost: TBD at later date, upon completion of recommendations #1 and #2

Key Assumptions: Adaptation planning and principles are developed with sufficient definition to inform model selection decisions

Data Gaps Resolved





4

Update / Calibrate / Validate Model(s)

This recommendation will migrate data into the selected model, identify calibration and validation needs and provide model software training to City staff and Project Team.

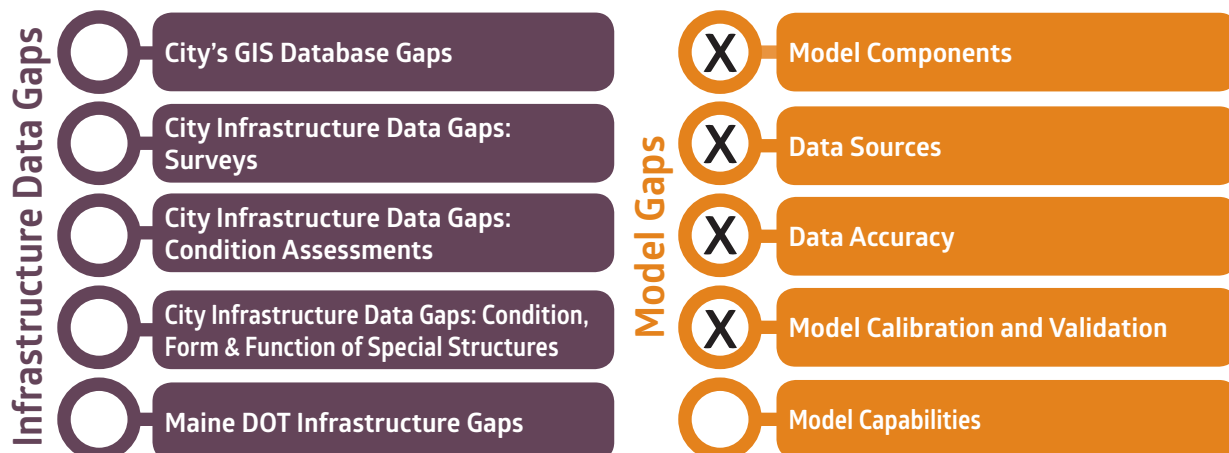
Specific tasks include:

- ▶ Provide software training to City and consultant team. Update/build model inputs based on data acquired during previous recommendations. Additional hydrologic data inputs such as drainage areas for separate storm sewer additions and the latest land use information will be included in the model.
- ▶ Identify areas necessary for calibration and validation. This task should consider calibration efforts previously undertaken by the City during CSO abatement planning. The range of flows assessed during the period of calibration may be useful for flood planning as they may have accommodated design storms and tides of interest.
- ▶ Conduct calibration and validation.
- ▶ Refine model based on calibration results.

Budget Cost: TBD at later date, upon completion of recommendation #3

Key Assumptions: The City establishes a multi-year relationship with a consultant or hires staff to ensure that there is consistency in building and updating the model throughout the first years of adaptation planning.

Data Gaps Resolved





Section 7

References & Glossary



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GLOSSARY

C

Combined Sewer: Pipes carrying both sewage and stormwater.

CSO (Combined Sewer Overflow): During large precipitation events, pipes carrying both sewage and stormwater can exceed the capacity of the combined pipe, pump station, or wastewater treatment plant and “overflow” into surface water. During heavy rain events, combined sewer pipes in the Bayside neighborhood overflow into Back Cove.

CSO Abatement: Systematic reduction of combined sewer overflows through separation of drainage from sanitary wastewater, storage of combined sewage, reduction of runoff from drainage collection areas, or increases in combined sewer pipe capacity. The City has a multi-year, multi-million dollar CSO Abatement program that is in the process of reducing combined sewer overflows throughout the City.

I

I&I Maps (Infiltration-Inflow Analysis Maps): The City and Portland Water District have a library of scanned maps developed in the 1970s and 1980s that show the known extent of the sanitary and combined sewer system; these maps were developed to assist with an infiltration and inflow abatement program and are commonly referred to as I&I Maps. These maps were utilized as the base data for the City’s sewer GIS data layers.

L

LGIM (Local Government Information Model): The City currently utilizes ESRI’s Local Government Information Model for attribute data schema in GIS.

M

MHHW (Mean Higher High Water): The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. There are two high tides in each tidal day; one of them is higher than the other. Higher high water height refers to the height of highest of the two daily high tides.

N

NACCS (North Atlantic Comprehensive Coast Study): A 2015 initiative that evaluated storm surge elevations at numerous study points for various storm event conditions conducted by the U.S. Army Corps of Engineers. For this report, storm surge elevations for various recurrence intervals have been extracted from the NACCS.

National Tidal Datum Epoch: The specific 19-year period adopted by the National Ocean Service as the official time segment over which tide observations are taken and reduced to obtain mean values (e.g. mean higher high water, etc.) for tidal datums.

NGVD29 (National Geodetic Vertical Datum of 1929): NGVD29 is the vertical datum of record for the City of Portland, utilized as the base datum for surveys, GIS, and I&I Maps.





S

Separate Stormwater: Unlike Combined Sewer pipe systems that carry both sewage and stormwater, Separate Stormwater pipe systems convey only stormwater.

Special Structure: “Special Structure” is the term used in this Report to describe combined sewer infrastructure that contains various flow control devices such as weirs, orifices, tide gates, etc.

Storm Surge: Rise in sea level that occurs due to a storm.

Storm Water Management Model (SWMM): The Environmental Protection Agency’s (EPA) stormwater management model, SWMM is a dynamic hydrology-hydraulic water quantity and quality simulation model. It is used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The City of Portland and the Portland Water District use a SWMM model for evaluating compliance with the City’s combined sewer overflow abatement program.

SWEL (Stillwater Elevation): The flood elevation not including the effects of waves (wave amplitude and wave setup).



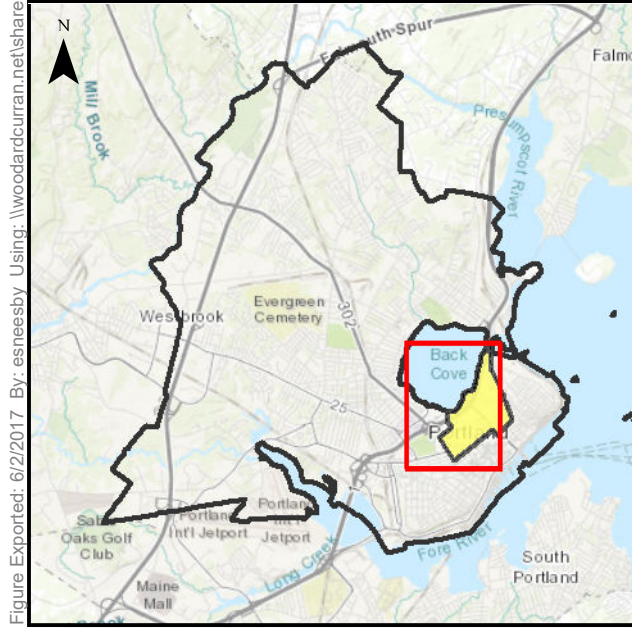
Appendix A

Existing GIS Data





Figure A-1: Available Sewer & Stormwater Infrastructure GIS Data. Data as of 12/2017. Using: Woodard & Curran, Inc. Project: Sewer & Stormwater Infrastructure Study. Available: GIS Data.mxd



LEGEND

Stormwater System

Discharges to or below Special Structure (Sewer Network Structure or Sewer Diversion Chamber)

- Storm Gravity Main
- Storm Under Drain
- Storm Discharge Points
- Storm Inlets
- Storm Manholes

Sewer System

- Sewage
- Combined Waste Water
- Sewer Pressurized Mains
- Sewer Manholes
- Sewer Network Structure (Other)
- Sewer Diversion Chamber
- Sewer Pump Station
- Sewer Tide Chamber

Stormwater System

- Storm Gravity Mains
- Under Drain
- Storm Virtual Drainlines
- Storm Open Drains
- Storm Inlets
- Storm Discharge Points
- Storm Manholes

Available Sewer & Stormwater Infrastructure GIS Data

City of Portland, ME
FIGURE A-1

Woodard & Curran shall assume no liability for any of the following:
1. Any errors, omissions, or inaccuracies in the information provided regardless of how caused or; 2. Any decision or action taken or not taken by the reader in reliance upon any information or data furnished hereunder. Data Sources:



41 Hutchins Drive
Portland, Maine 04102
800.426.4262 | www.woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

SCALE: 1" = 225'
DATE: JUNE 2017

PROJECT #: 0230429.00
DRAWN BY: ES

Null Analysis of Existing City GIS Attribute Data

(City's Sewer and Stormwater Infrastructure GIS Database)

Dataset	Selected Features	DIAMETER (Value is Assigned)	% Assigned	MATERIAL (Value is Assigned)	% Assigned	DOWNSTREAM ELEV. (Value is Assigned)	% Assigned	UPSTREAM ELEV. (Value is Assigned)	% Assigned
swGravityMain	550	400	73	321	58	87	16	106	19
<i>swGravityMain (Previous)</i>	<i>487</i>	<i>342</i>	<i>70</i>	<i>258</i>	<i>53</i>	<i>Not Analyzed</i>		<i>Not Analyzed</i>	
ssGravityMain (subtype = Sewer)	39	33	85	31	79	0	0	0	0
<i>ssGravityMain (subtype = Sewer)(Previous)</i>	<i>39</i>	<i>33</i>	<i>85</i>	<i>26</i>	<i>67</i>	<i>Not Analyzed</i>		<i>Not Analyzed</i>	
ssGravityMain (subtype = Combined)	396	382	96	364	92	18	5	13	3
<i>ssGravityMain (subtype = Combined)(Previous)</i>	<i>380</i>	<i>365</i>	<i>97</i>	<i>326</i>	<i>86</i>	<i>Not Analyzed</i>		<i>Not Analyzed</i>	
ssGravityMain (subtype = NULL)	12	10	83	10	83	0	0	0	0
<i>ssGravityMain (subtype = NULL)(Previous)</i>	<i>12</i>	<i>7</i>	<i>58</i>	<i>7</i>	<i>58</i>	<i>Not Analyzed</i>		<i>Not Analyzed</i>	

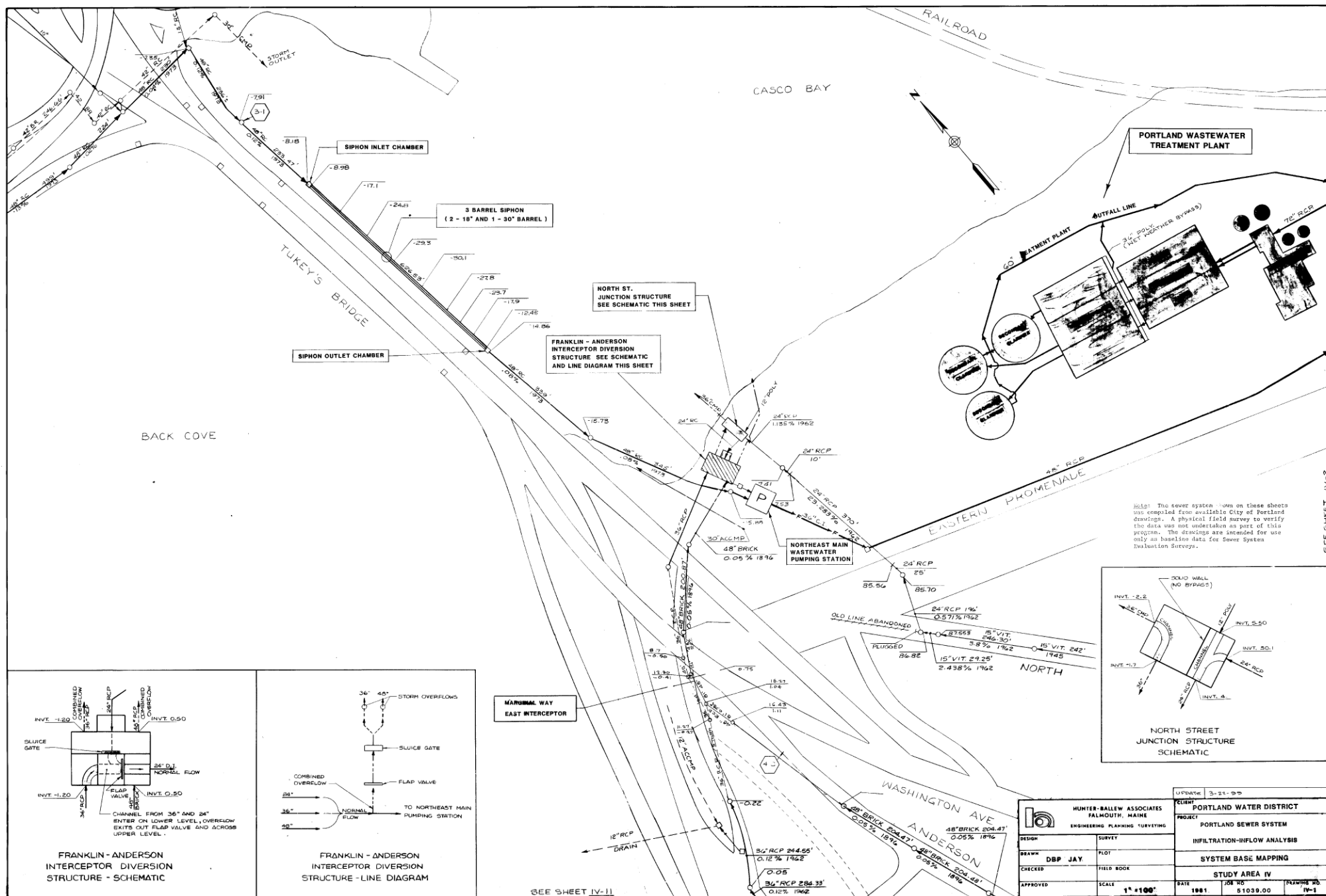
Dataset	Selected Features	INVERT ELEVATION (Value is Assigned)	% Assigned	RIM ELEVATION (Value is Assigned)	% Assigned
swManhole	113	0	0	17	15
<i>swManhole (Previous)</i>	<i>98</i>	<i>0</i>	<i>0</i>	<i>6</i>	<i>6</i>
swInlet	497	260	52	64	13
<i>swInlet (Previous)</i>	<i>491</i>	<i>267</i>	<i>54</i>	<i>14</i>	<i>3</i>
ssManhole	365	0	0	45	12
<i>ssManhole (Previous)</i>	<i>346</i>	<i>0</i>	<i>0</i>	<i>45</i>	<i>3</i>

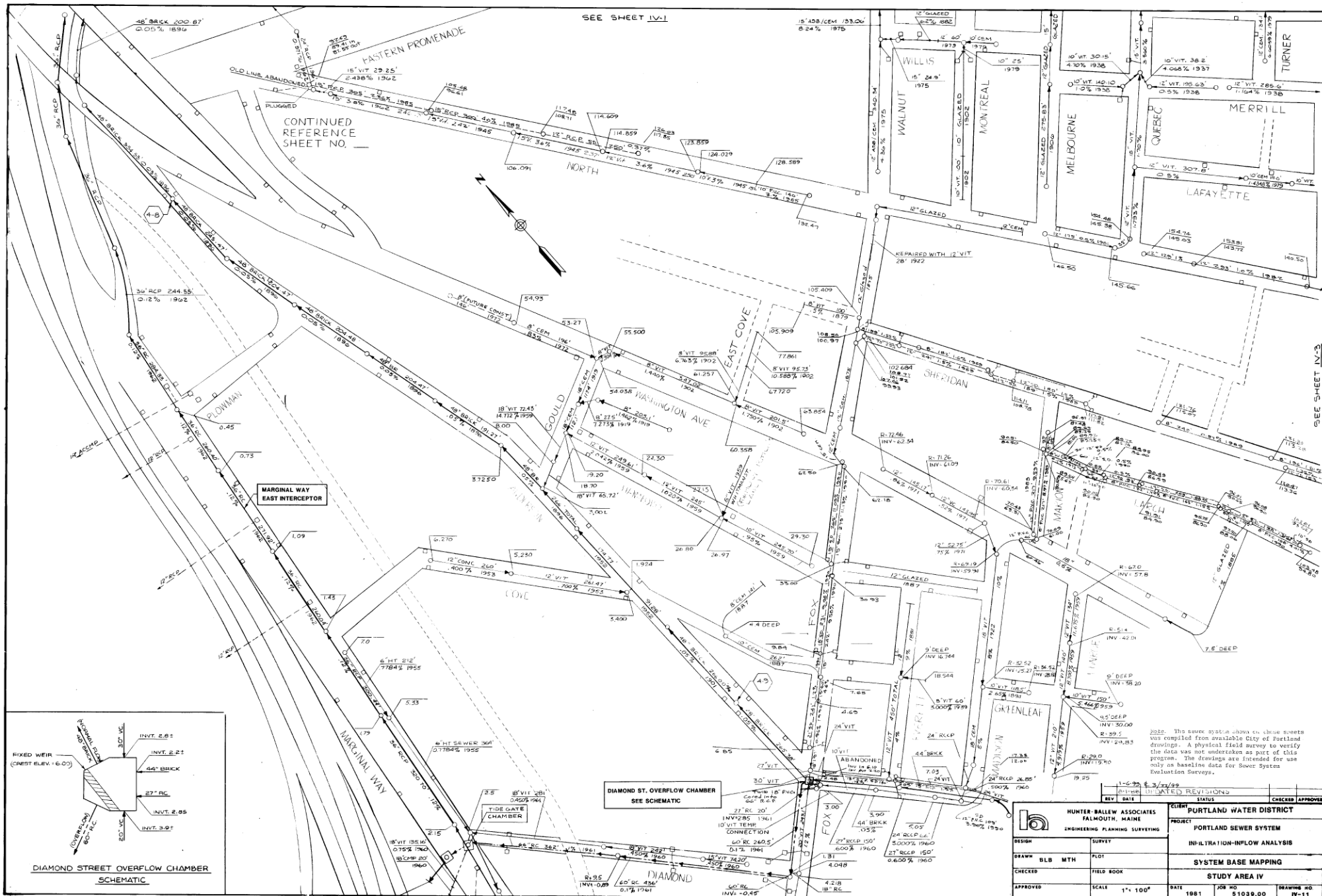


Appendix B

Existing I&I Map and Special Structures Data

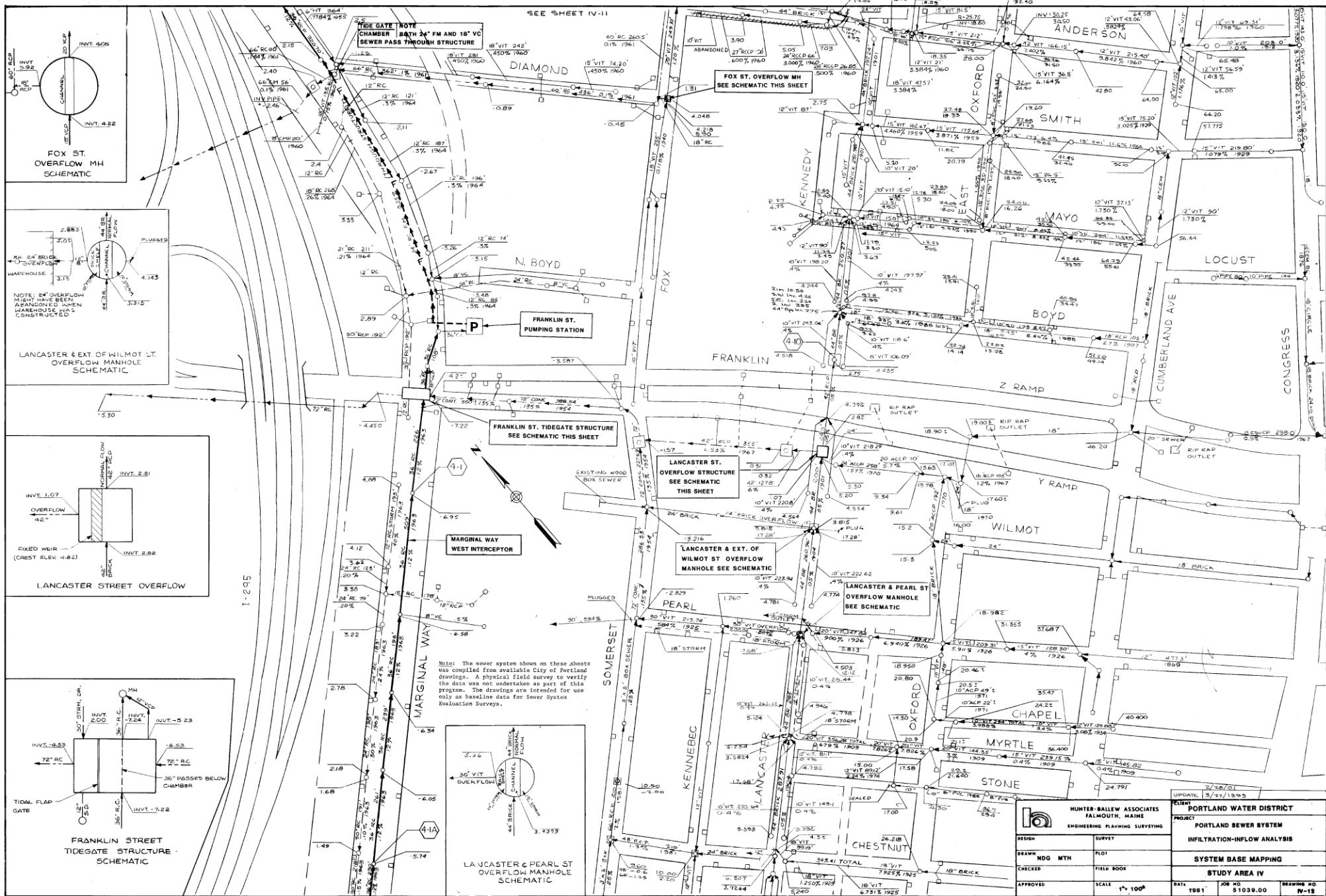




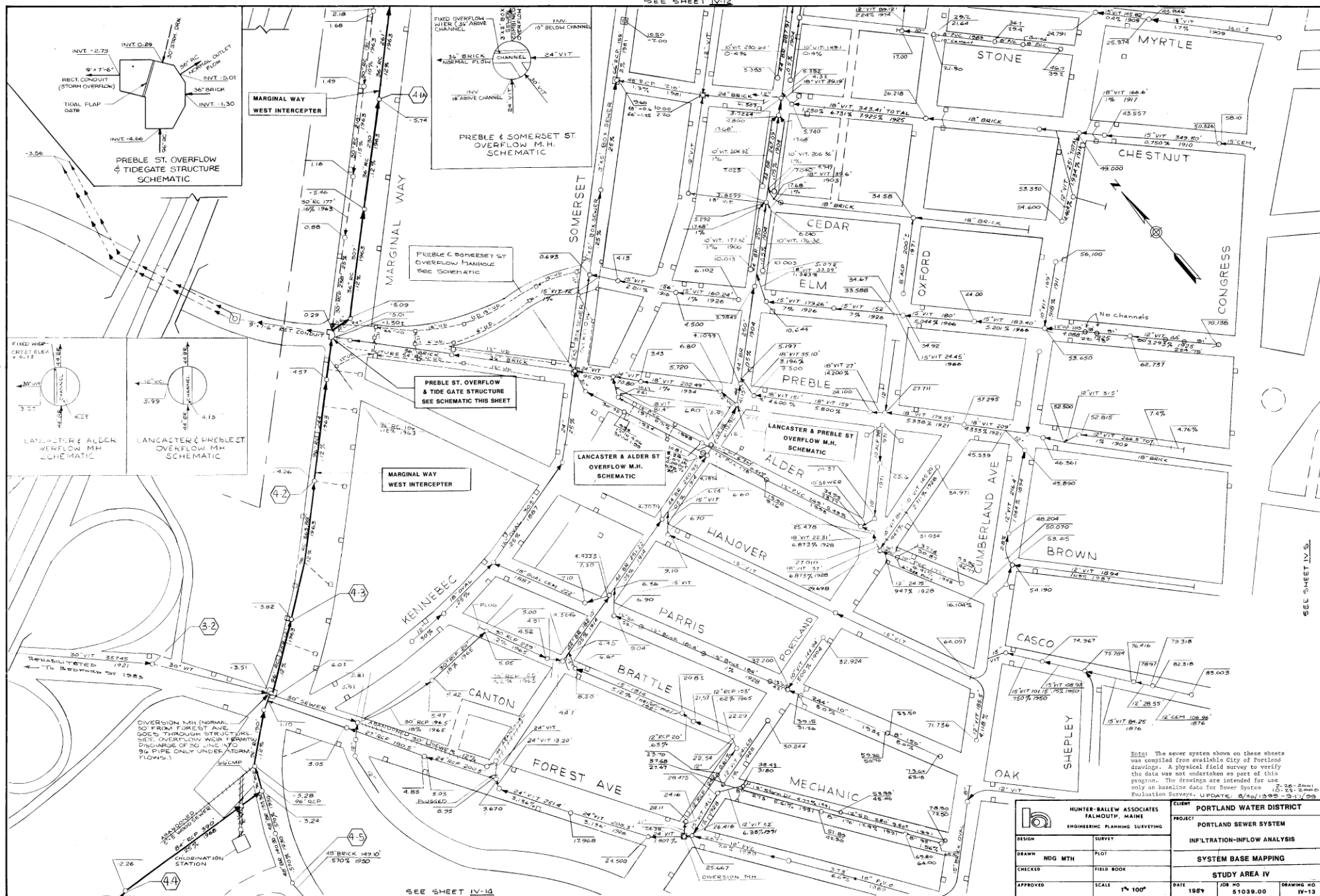


Note: The sewer system shown on these sheets was compiled from available City of Portland drawings. A physical field survey to verify the data was not undertaken as part of this program. The drawings are intended for use only as baseline data for Sewer System Evaluation Surveys.

REV		DATE	DESCRIPTION	CHECKED	APPROVED
1	0	1-6-99	1-6-99		
HUNTER-BALLEW ASSOCIATES FALMOUTH, MAINE ENGINEERING PLANNING SURVEYING CLIENT PORTLAND WATER DISTRICT PROJECT PORTLAND SEWER SYSTEM INFLTRATION-INFLOW ANALYSIS SYSTEM BASE MAPPING STUDY AREA IV					
DESIGN	BLB	MTM	PLOT		
CHECKED			FIELD BOOK		
APPROVED			SCALE 1" = 100'	DATE 1981	JOB NO. 81039.00
					DRAWING NO. PW-11



HUNTER-BALLEW ASSOCIATES FALMOUTH, MAINE ENGINEERING PLANNING SURVEYING		CLIENT: PORTLAND WATER DISTRICT PROJECT: PORTLAND SEWER SYSTEM INFILTRATION-INFLOW ANALYSIS SYSTEM BASE MAPPING STUDY AREA IV
DESIGN	SURVEY	DATE: 3/22/1993
DRAWN	NOG MTH	DATE: 3/22/1993
CHECKED	FIELD BOOK	DATE: 3/22/1993
APPROVED	SCALE: 1"=100'	DATE: 3/22/1993
		DATE: 3/22/1993



Notes: The sewer system shown on these sheets was compiled from available City of Portland drawings. A physical field survey to verify the data was not undertaken as part of this program. The drawings are intended for use only as baseline data for Sewer System Evaluation Surveys. UPDATE: 8/30/13 (2013-2014)

 HUNTER-BALLEW ASSOCIATES FALMOUTH, MAINE ENGINEERING PLANNING SURVEYING		CLIENT PORTLAND WATER DISTRICT	
DESIGN NDG MTH		PROJECT PORTLAND SEWER SYSTEM INFILTRATION-INFLOW ANALYSIS	
CHECKED FIELD BOOK		SYSTEM BASE MAPPING	
APPROVED SCALE 1" = 100'		STUDY AREA IV	
DATE 1987		JOB NO. 61039.00 DRAWING NO. IV-13	

Summary of Available Data on Special Structure in the Bayside

(From City's GIS Database and I&I Maps)

GIS Info

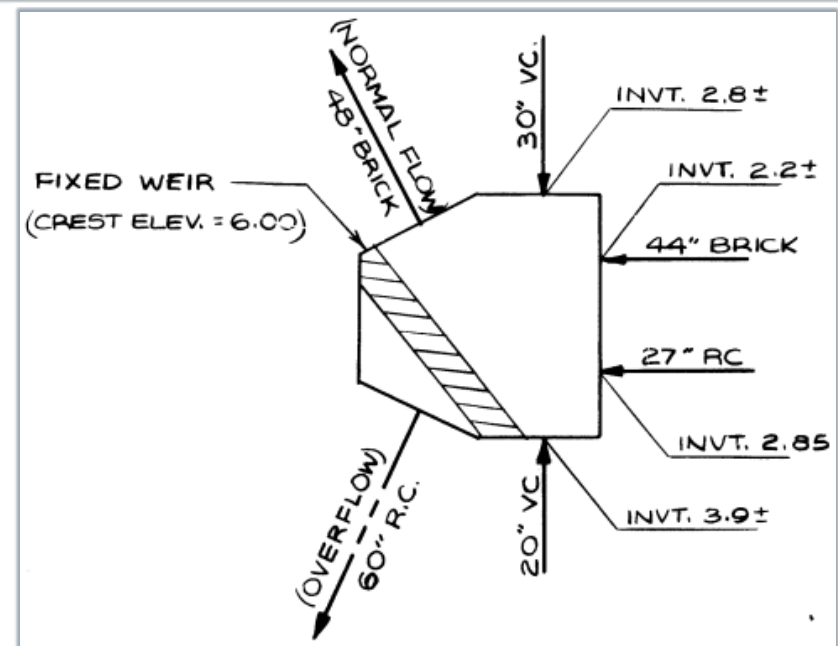
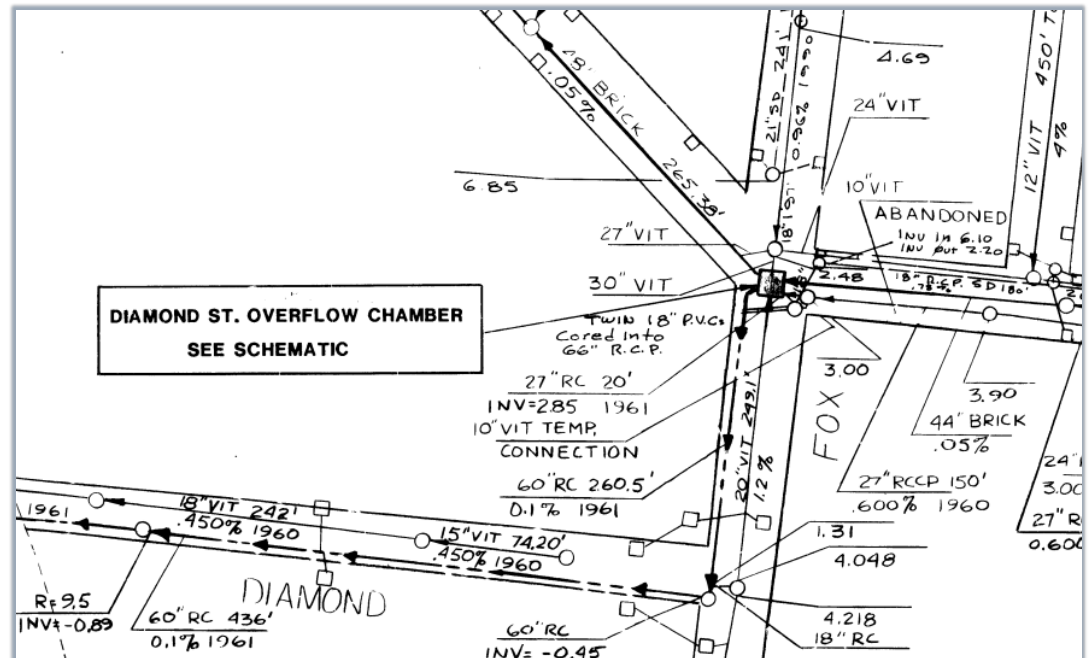
ID No:	SSNS-0089
Feature Class:	ssNetworkStructure
Structure Type:	Flow Control
Comment:	Diversion Structure; see vault plan 485_023_001
Reference Document	00926_011_002
Install Date	1/1/1961

Estimated Rim Elevation: 10.41' NGVD29
(based on LiDAR data)



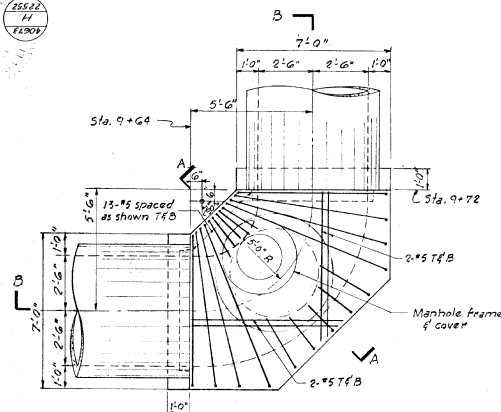
I&I Map Info

Map No:	IV-11
Structure Type	Overflow Chamber

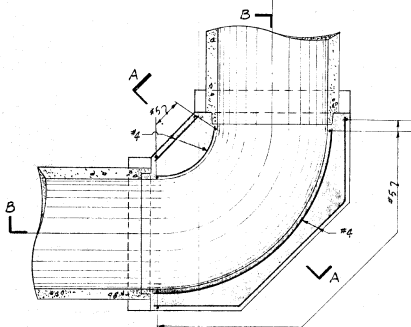


***More info available from Anderson Street project**

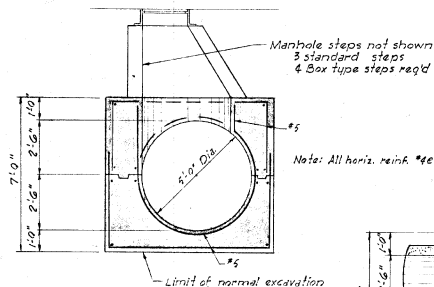
25622
H
E1901



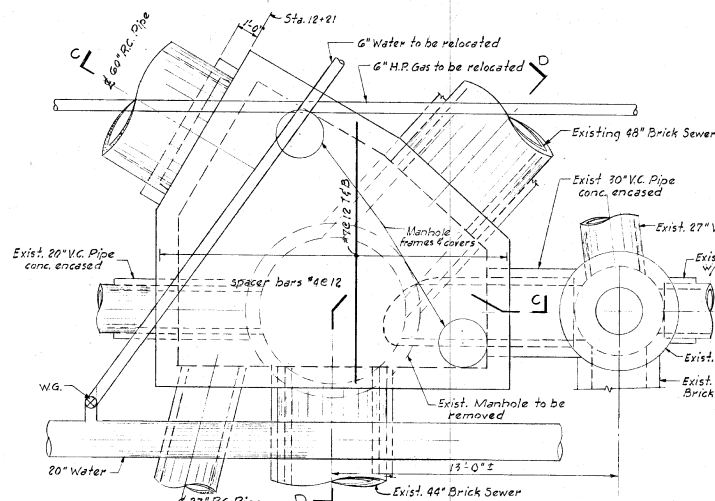
TOP PLAN
M.H. AT STA. 9+67



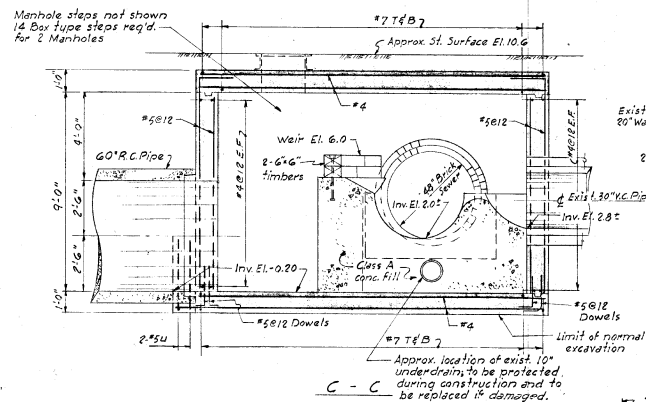
PLAN SECTION
M.H. AT STA. 9+67



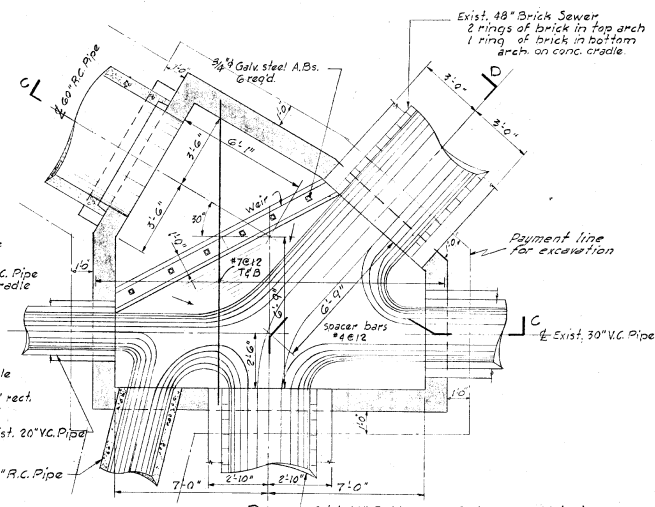
SECTION A-A



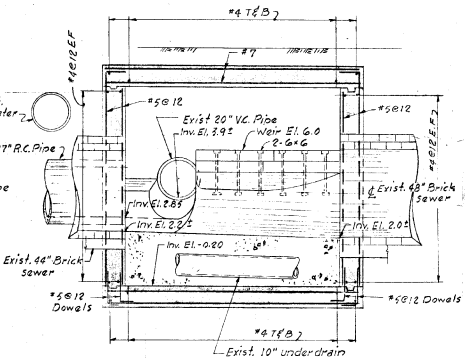
TOP PLAN
OVERFLOW CHAMBER



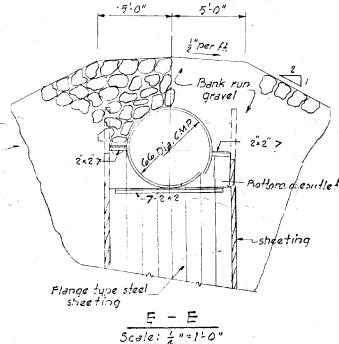
C - C



PLAN SECTION
OVERFLOW CHAMBER

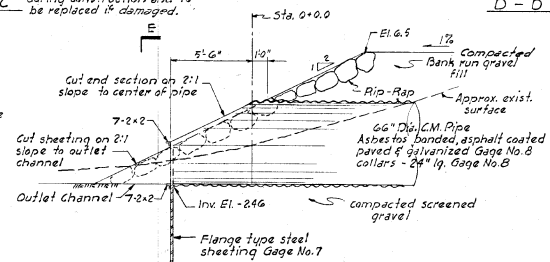


D - D



E - E

Note:
The contractor shall provide suitable means to connect the 66" pipe to the steel sheeting and the steel sheeting to the timber sheeting.



SECTION AT OUTLET OF 66" C.M. PIPE

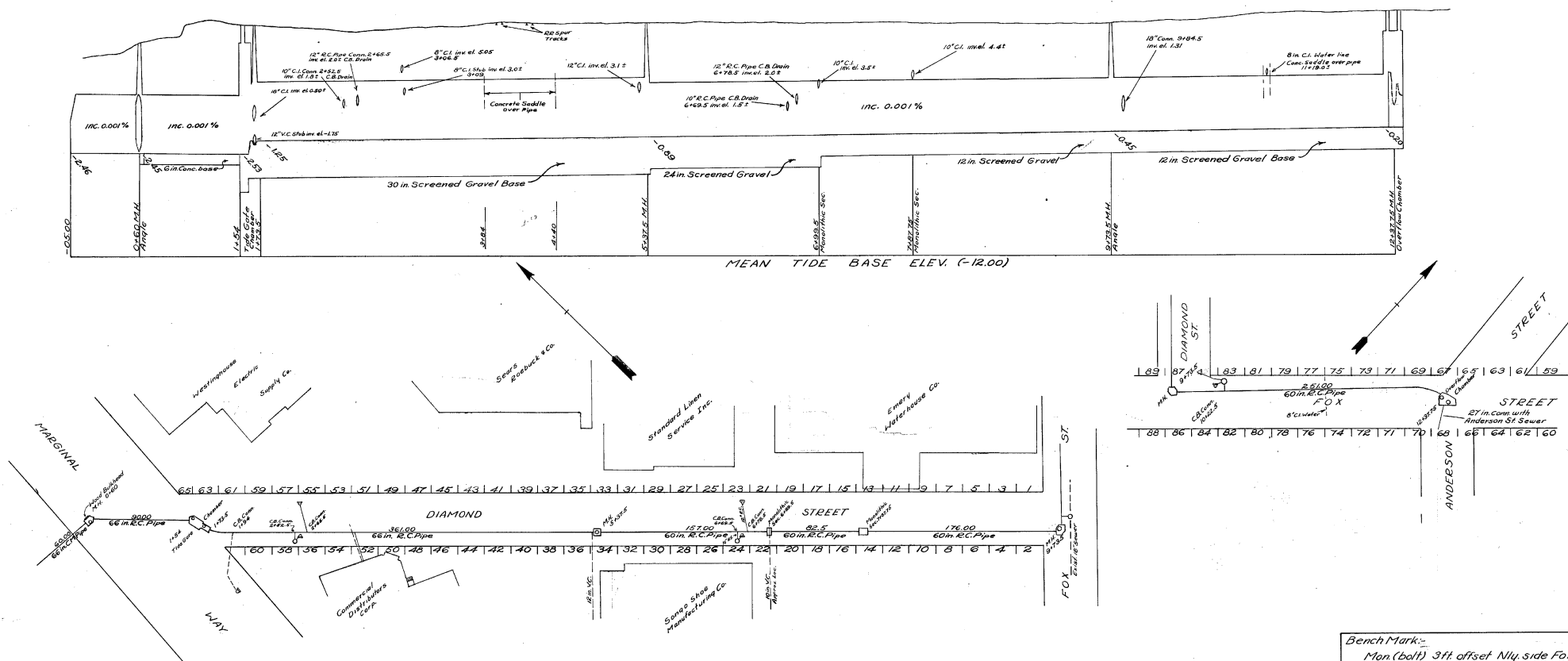
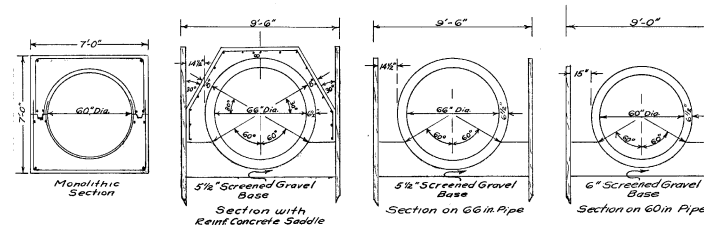
Scale: 1/4" = 1'-0"

DRAWN BY A.F. DIV.
TRACED BY A.F. DIV.
CHECKED BY L.M. DIV.

APPROVED
FOR METCALF & EDDY, ENGINEERS
John W. Raymond
REG. PROF. ENGR. (MAINE NO. 935) DATE

PORTLAND MAINE
SEWERAGE
DIAMOND ST. OVERFLOW SEWER
STRUCTURAL DETAILS III
OVERFLOW CHAMBER

SCALE: 3/8" = 1'-0"
EXCEPT AS SHOWN
MAY 1961
METCALF & EDDY
ENGINEERS
BOSTON, MASS.



Portion in Red built Aug. 24, 1961 to Jan. 4, 1962	Portion in Black built Oct. 12, 1959 to Oct. 24, 1959
Contractor - E.J. Asselyn	Contractor - E.J. Asselyn
Total Cost - \$167,243.30	Total Cost - \$11,315.57

Bench Mark:-
Mon. (bolt) 3ft offset Nly. side Fox
St. at 1st angle Wly. of Anderson St.
Elev. 10.955

CITY OF PORTLAND, MAINE
DEPARTMENT OF PUBLIC WORKS
DIAMOND STREET
OVERFLOW SEWER

DRAWN <u>5837/62</u>	REFERENCES	SCALE
TRACED <u>PP 597/62</u>		HOR. - 1 IN = 50 FT
CHECKED <u>MM 3-4-62</u>		VER. - 1 IN = 5 FT
DIRECTED <u>FEF</u>		
APPROVED, <u>4-13-62</u>	<u>Frederick E. Galt</u> Deputy CITY ENGINEER	<u>485</u> <u>23</u>

GIS Info

ID No:	SSNS-0135
Feature Class:	ssNetworkStructure
Structure Type:	Diversion Chamber
Comment:	see vault plan 485_023__001, also a tide gate
Reference Document	00473_018__007
Install Date	1/1/1961

Estimated Rim Elevation: 8.29' NGVD29

GIS Info

ID No:	SSNS-0098
Feature Class:	ssNetworkStructure
Structure Type:	Tide Chamber
Comment:	see vault plan 485_023__001
Reference Document	00473_018__002
Install Date	1/1/1961

Estimated Rim Elevation: 8.17' NGVD29

(based on LiDAR data)

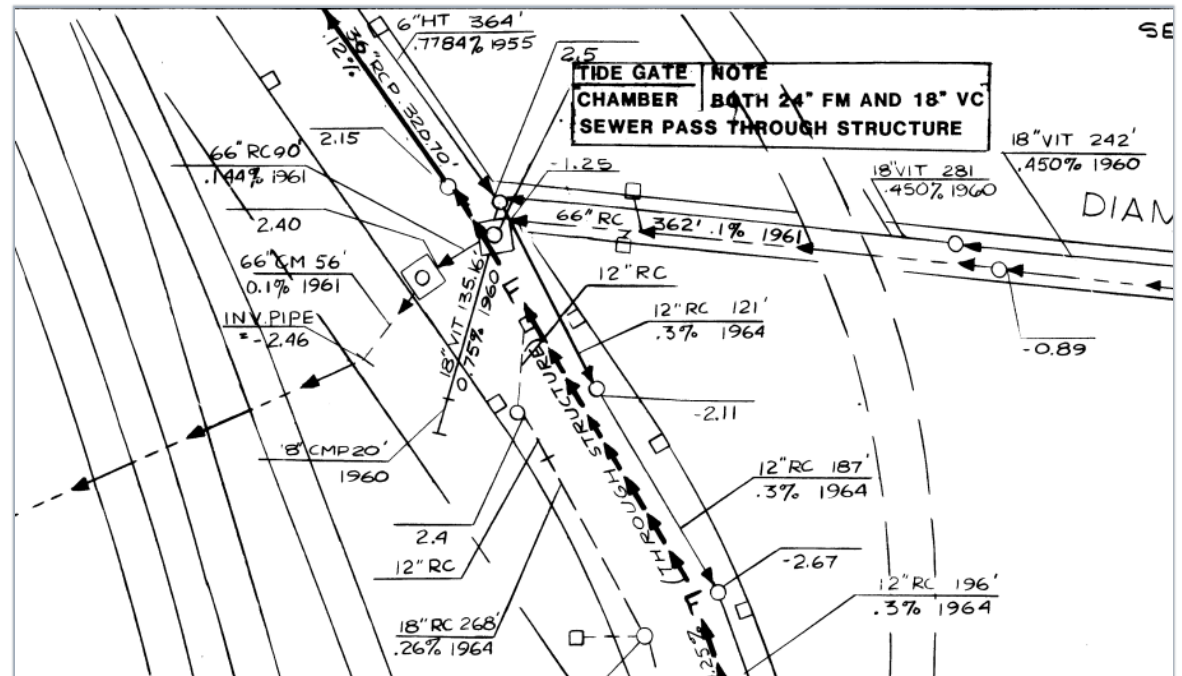


I&I Map Info

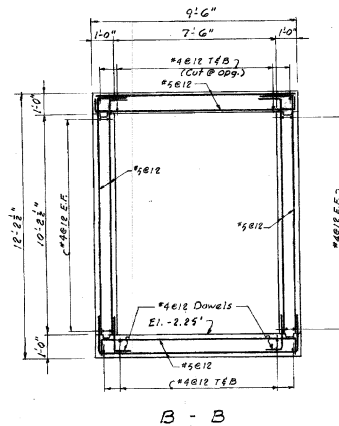
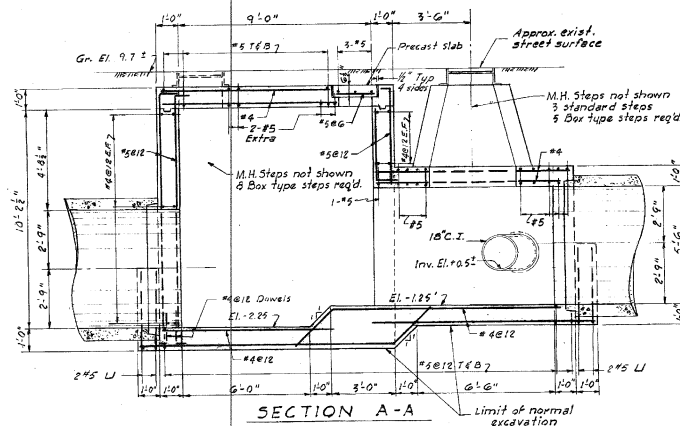
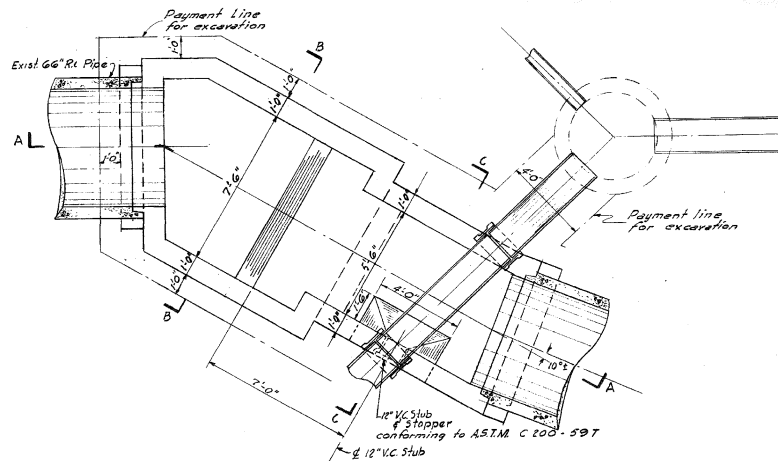
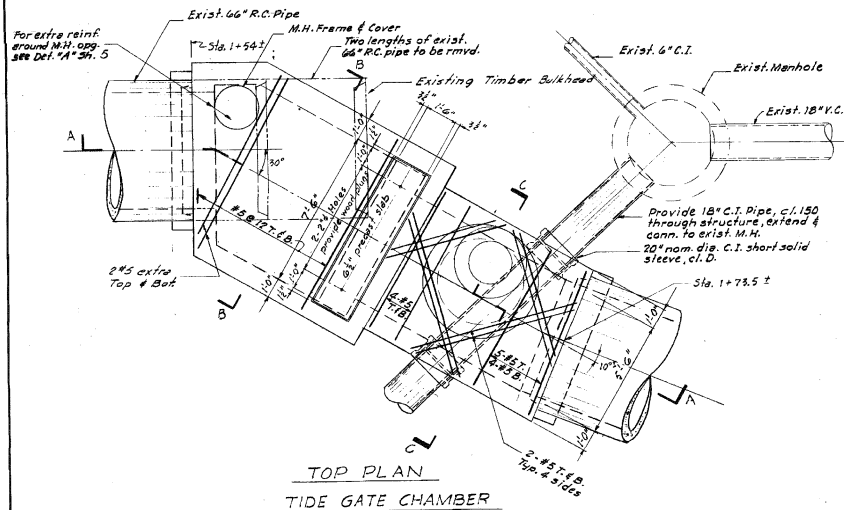
Map No:	IV-12
Structure Type	Tidegate Chamber
Schematic available?	No

I&I Map Info

Map No:	IV-12
Structure Type	Standard Manhole

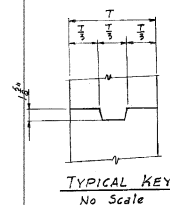
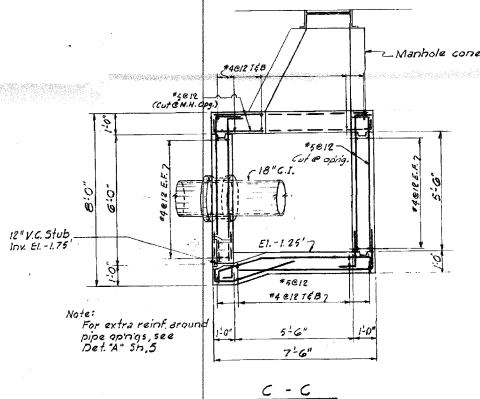


0528
H
10909



GENERAL NOTES

1. Concrete shall be Class A.
2. Continuous reinforcing shall be lapped 24 bar diameters at splices with splices of adjacent bars staggered.
3. Tie steel shall be as noted on #4@16.
4. At least two hours shall elapse after depositing concrete in walls, before depositing in slabs supported thereon.
5. Main reinforcing steel shall be placed and maintained at the minimum clear distances from surface of concrete as follows:
 Walls 2" clear
 Top Slab 2" clear
 Bottom Slab 3" clear Top
 3" clear Bottom
6. Apply 2 coats of bituminous waterproofing to top slabs of Tide Gate Chamber and Over-Flow Chamber.



AS BUILT PLAN

PORTLAND, MAINE
SEWERAGE
DIAMOND ST. OVERFLOW SEWER
STRUCTURAL DETAILS I
TIDE GATE CHAMBER

SCALE, $\frac{3}{8}'' = 1'-0''$

MAY 1961

METCALF & EDDY
ENGINEERS
BOSTON, MASS.

488
4

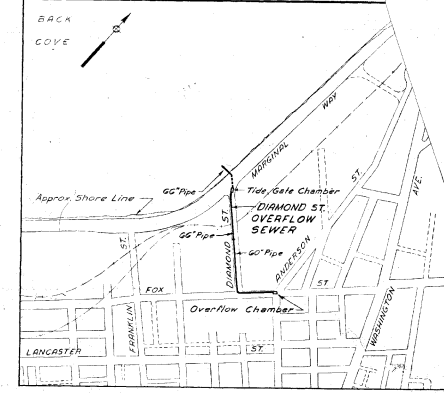
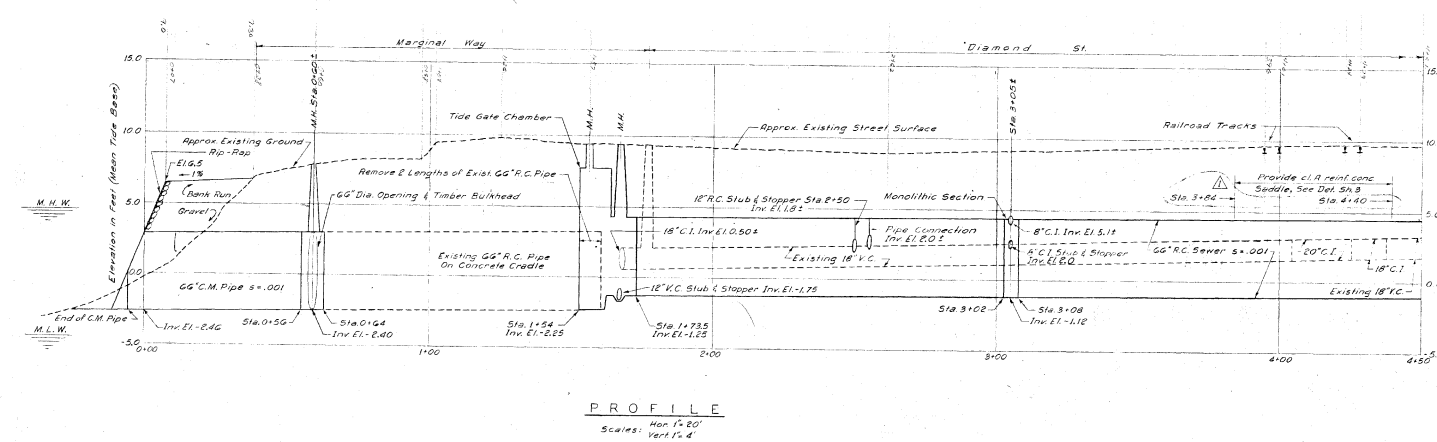
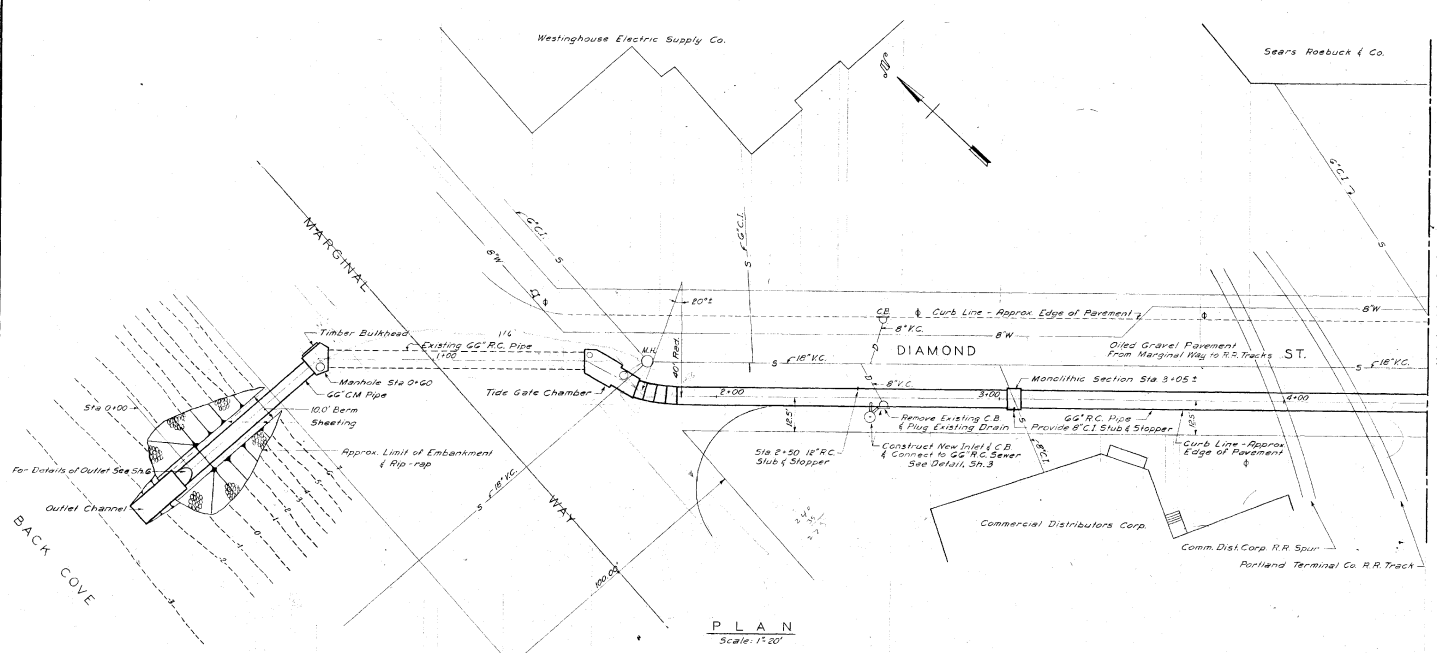
40671
H
17550

SHEET 4 OF 6

DRAWN BY A.E.D.K.
TRACED BY A.E.D.K.
CHECKED BY L.M.V.D.

APPROVED
FOR METCALF & EDDY, ENGINEERS
John W. Raymond Jr.
REG. PROF. ENGR. MAINE NO. 935 DATE

H
P2207



LOCATION PLAN

LEGEND

S	Existing Sewer
D	Existing Drain
W	Existing Water Main
G	Existing Gas Main
□	Existing Drain Inlet (D.I.) or Catch Basin (C.B.)
⊕	Hydrant
⊙	Electric Pole

GENERAL NOTE

1. Service connections for water.
2. Existing utility pipes crossing the sewer trench shall be provided with permanent support by compacted screened gravel fill of suitable top width extending to the screened gravel cradle to the horizontal center of the utility pipe and to the sides of the trench.
3. The depth of excavation below normal grade, if required shall be determined in the field by the engineer.
4. Manhole frames (covers, catch basin frames, grates and traps, standard manhole steps and catch basin stones furnished by City.
5. No sheeting shall be left in place above E.L.G., except for the 15' connection at Fox St. where sheeting shall be removed above the top of the pipe.
Sheeting shall be measured for payment as follows:
a. For pipe trenches; below top of the pipe.
b. For the Tidegate and Overflow Chambers; below E.L.G.
c. For other structures; below the top of the roof slab.

Construction Plan
PORTLAND, MAINE
SEWERAGE
DIAMOND ST. OVERFLOW SEWER
PLAN AND PROFILE
STA. 0+00 (BACK COVE) TO STA. 4



APPROVED
FOR METCALF & EDDY, ENGINEERS
John W. Raymond Jr.
REG. PROF. ENGR. MAINE NO. 531-11
DATE

SCALE AS SHOWN
MAY 1961
METCALF & EDDY
ENGINEERS
BOSTON, MASS.

DRAWN BY V.P.S.
TRACED BY V.P.S.
ED BY V.P.S.

1/8" RAIL V.P.S. 1/8" D. Permitted lengths of rail cone saddle
NO. 0172. 100% PROTECTIVE DESCRIPTION

GIS Info

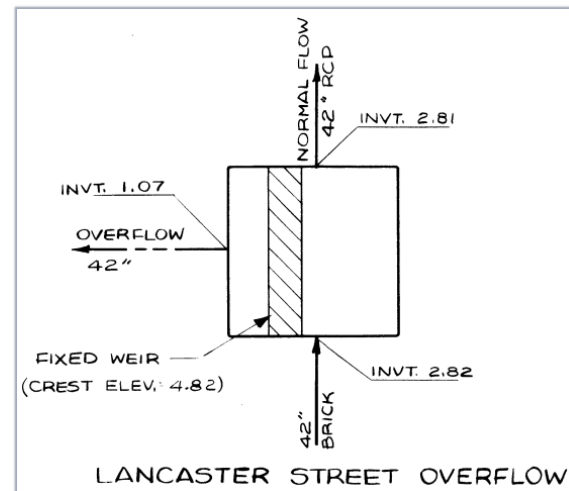
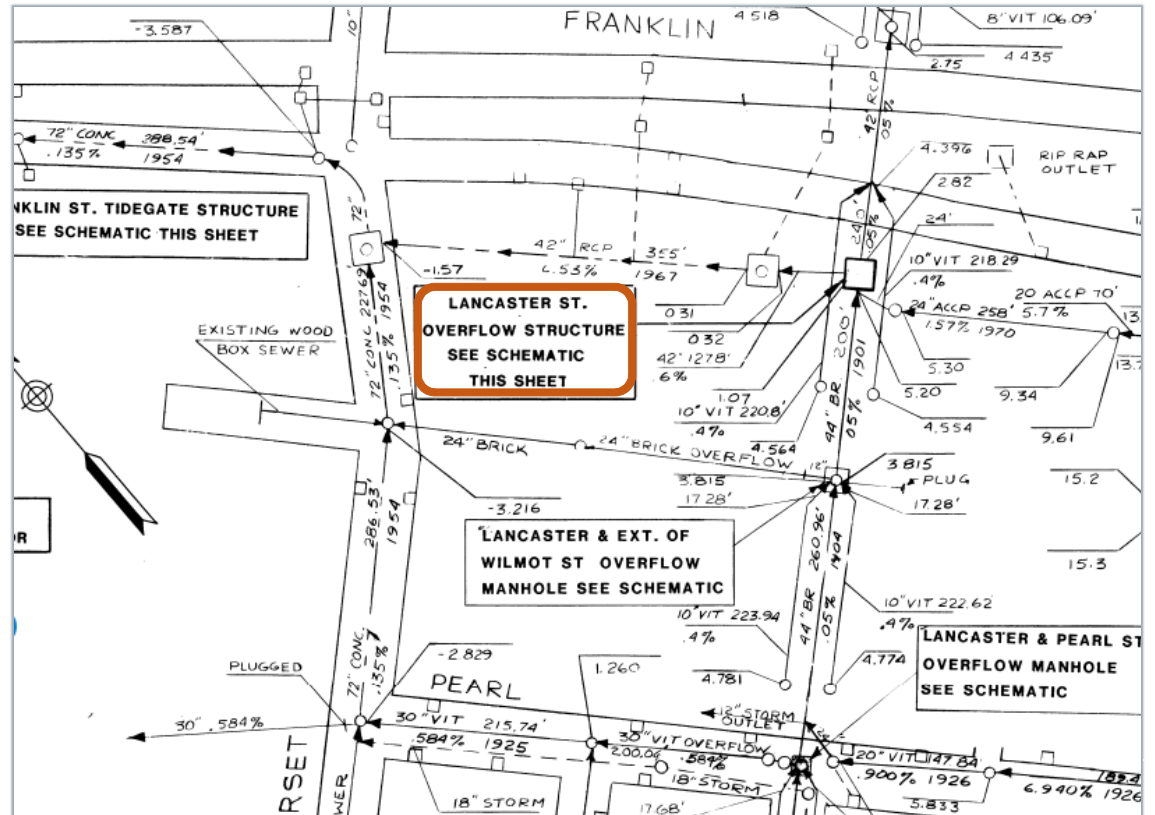
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Reference Document	00488_020_003
Install Date	<Null>

Estimated Rim Elevation: 9.45' NGVD29
(based on LiDAR data)



I&I Map Info

Map No:	IV-12
Structure Type	Overflow Structure



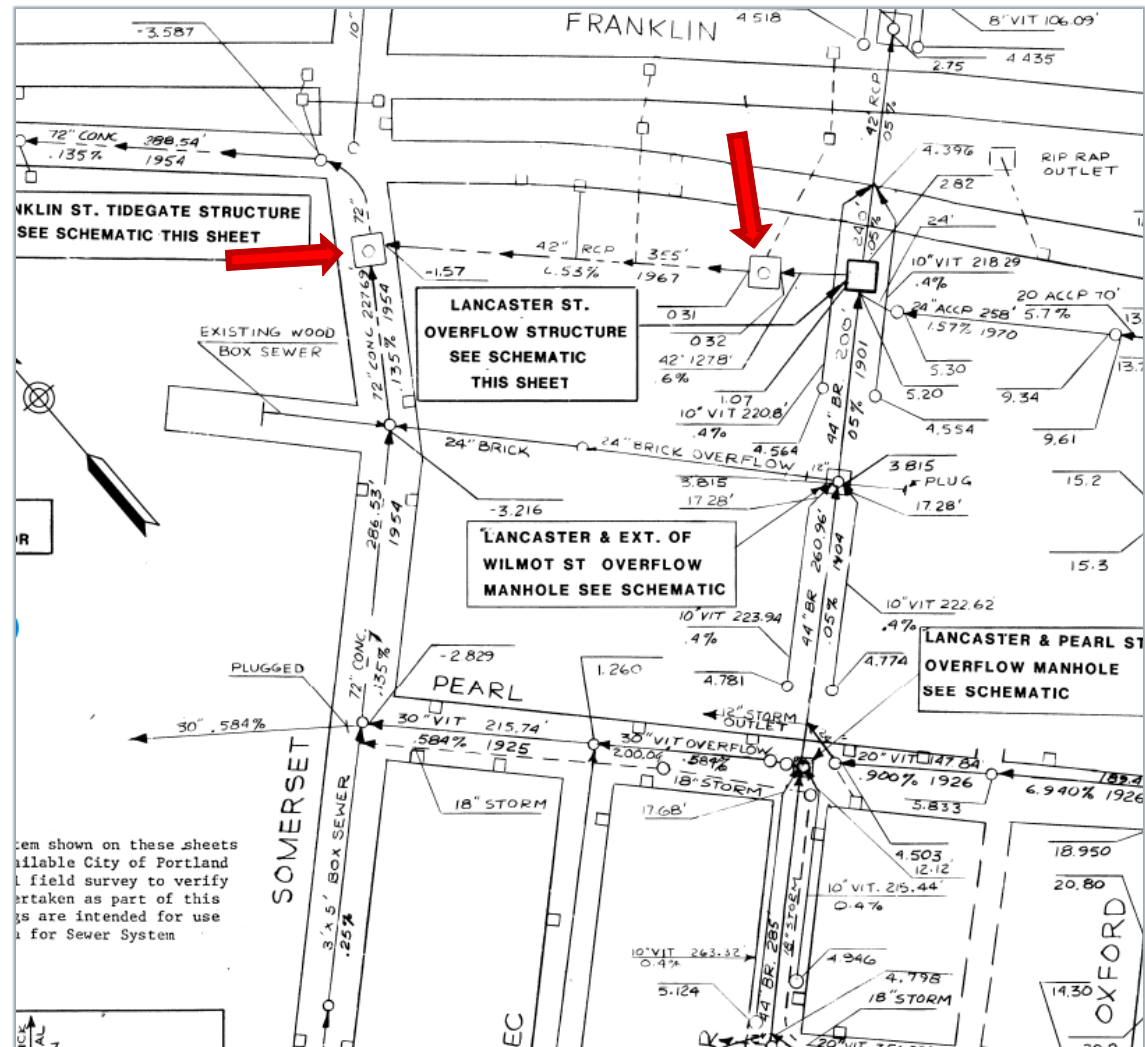
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GIS Info	
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Reference Document	<Null>
Install Date	<Null>



I&I Map Info	
Map No:	IV-12
Structure Type	Standard Manhole

I&I Map Info	
Map No:	IV-12
Structure Type	Standard Manhole



SSMH-3770 Potential Lancaster St Structures

Lancaster Street & Extension of Wilmot Street

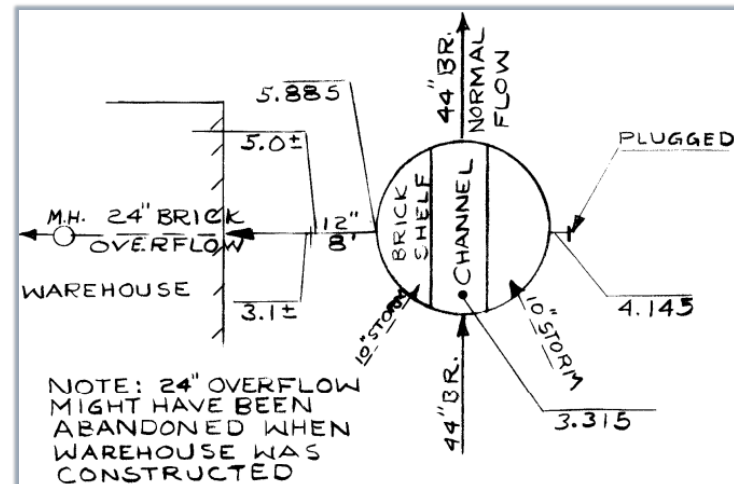
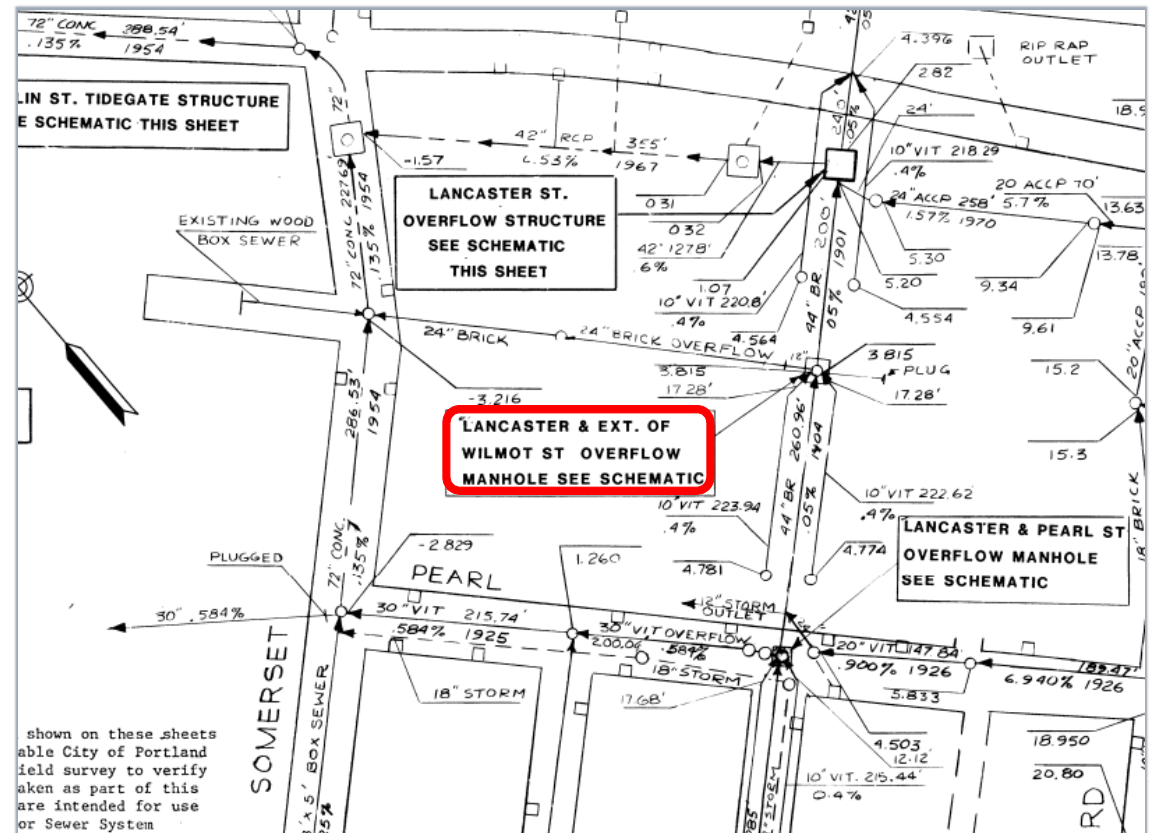
GIS Info

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Structure Type:	Sewer
Comment:	North Side Intercepting Sewer
Reference Document	00123_003_001
Install Date	1/1/1902



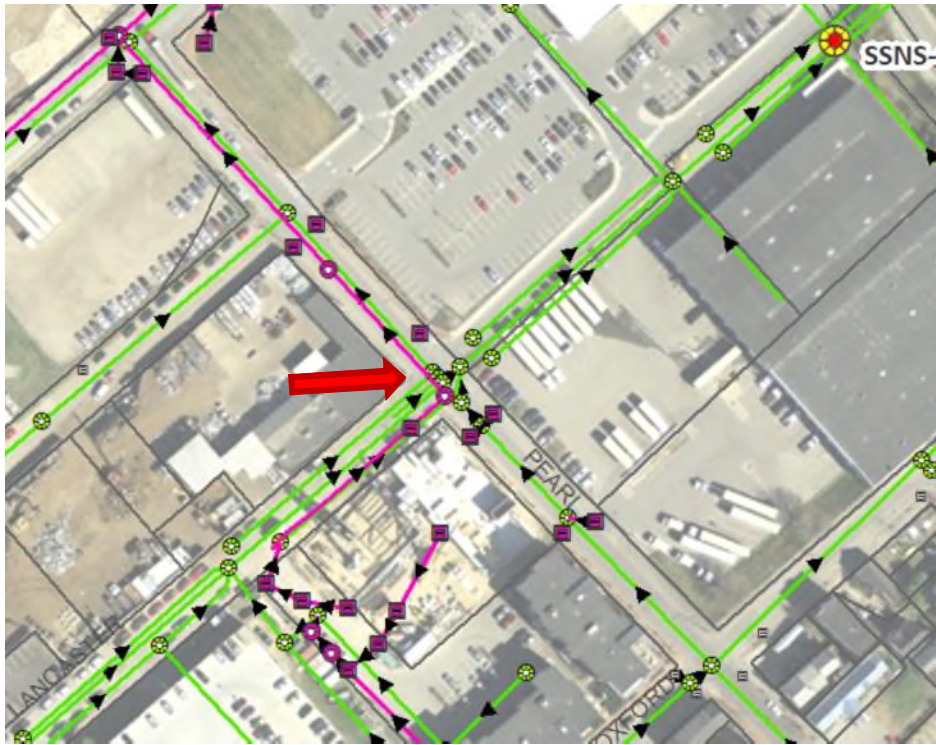
I&I Map Info

Map No:	IV-12
Structure Type	Overflow Manhole



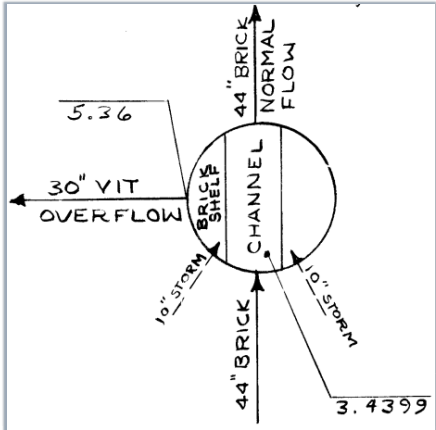
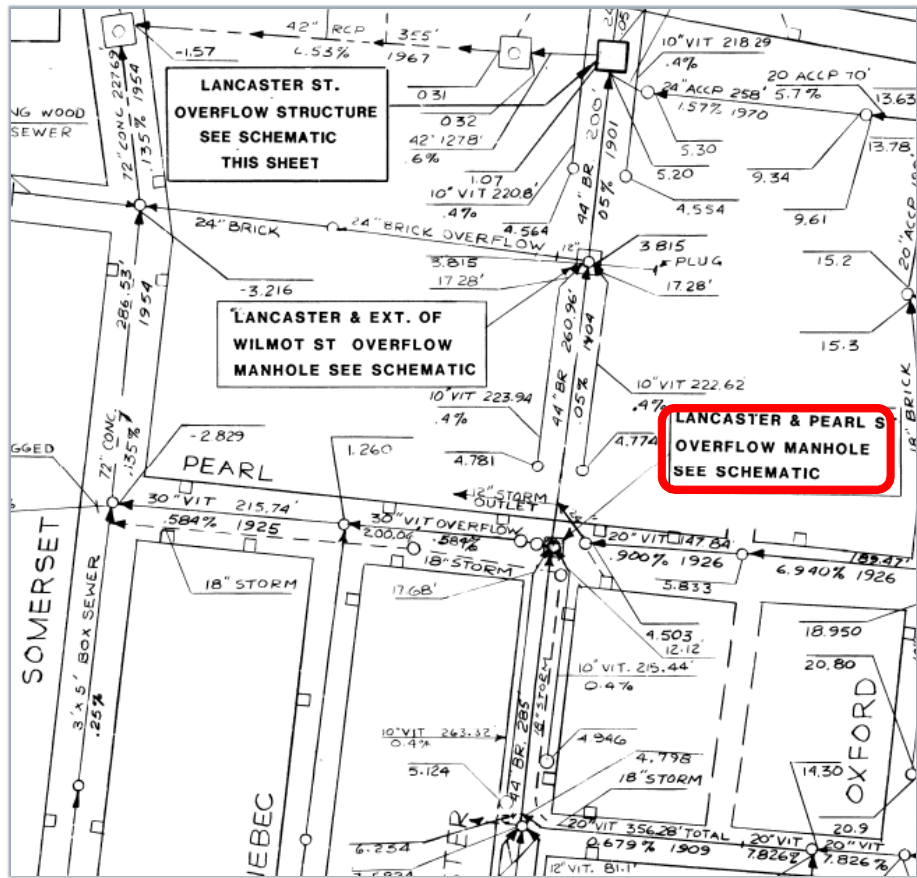
Potential Lancaster St Structures

GIS Info	
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Feature Class:	ssManhole
Structure Type:	
Comment:	
Reference Document	
Install Date	



Lancaster Street & Pearl Street

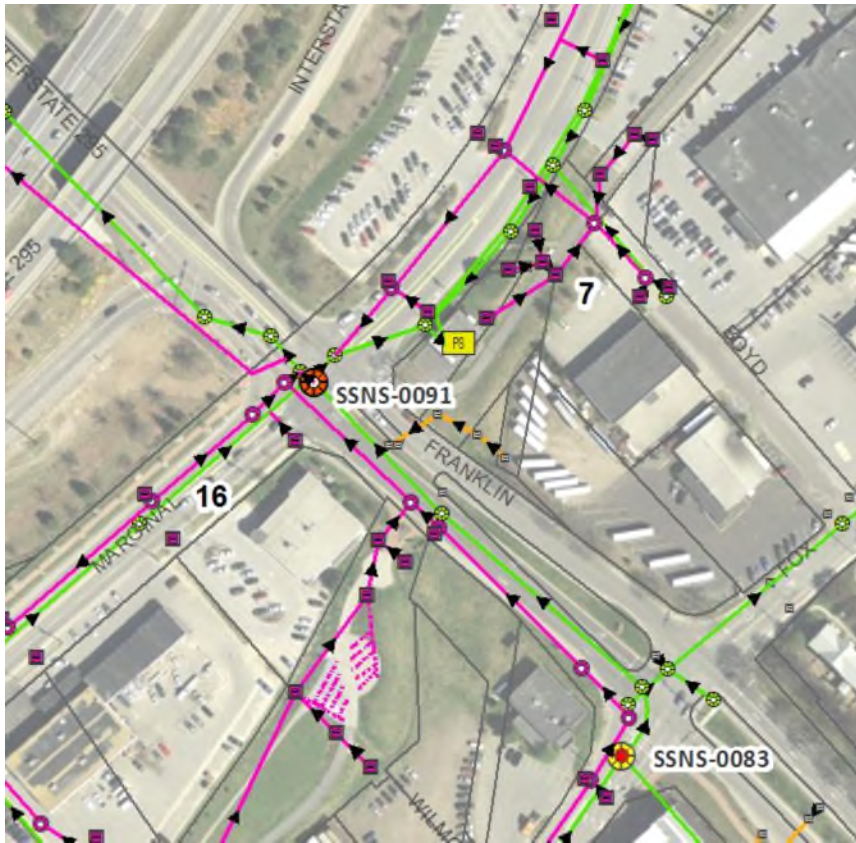
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Structure Type	Overflow Manhole



GIS Info

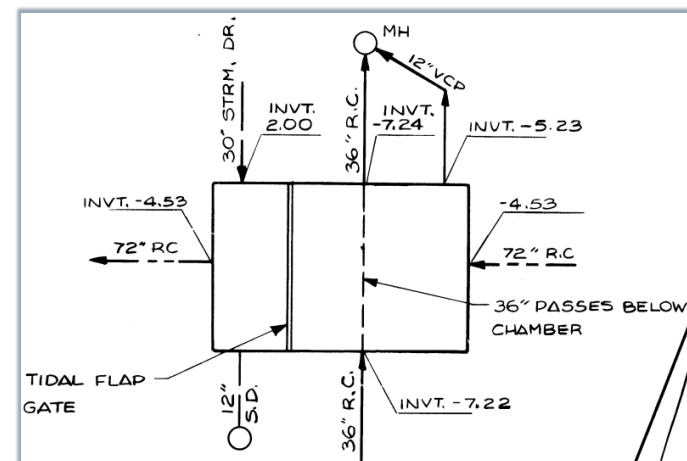
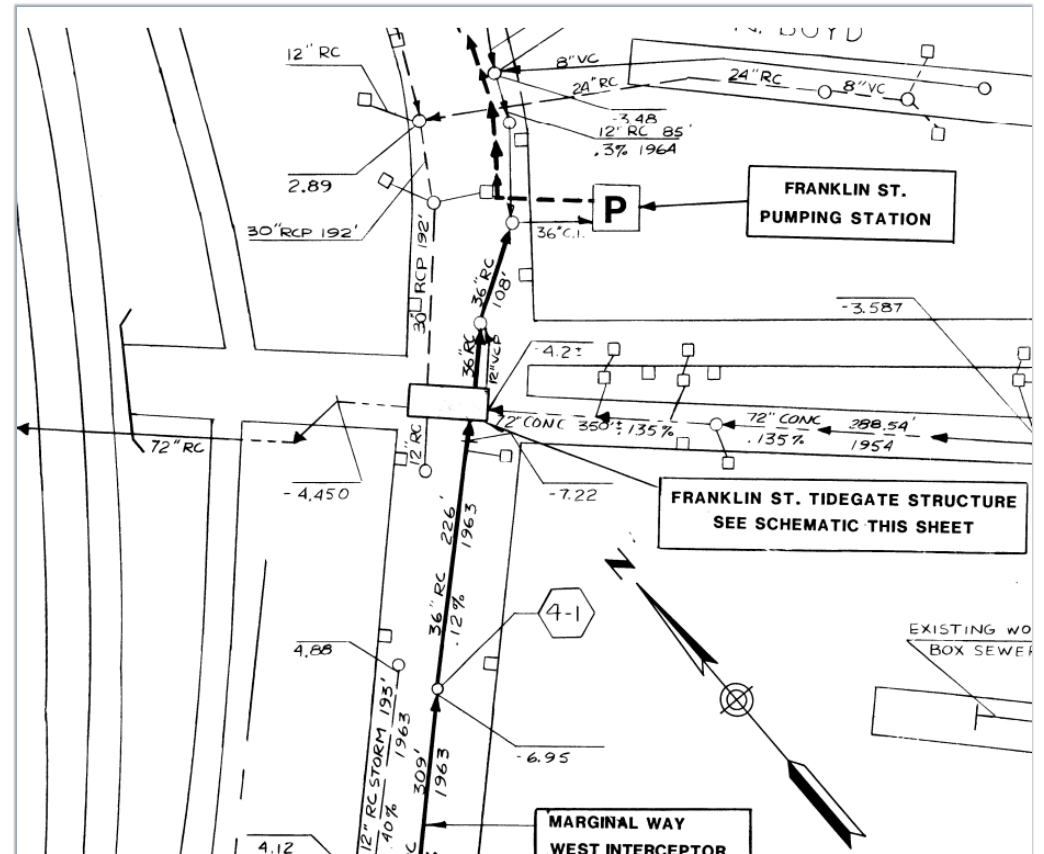
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Structure Type:	Diversion Chamber
Comment:	see vault plan plan 473_018__005, also a tide gate
Reference Document	01006_014A_005
Install Date	<Null>

Estimated Rim Elevation: 10.06' NGVD29
(based on LiDAR data)



I&I Map Info

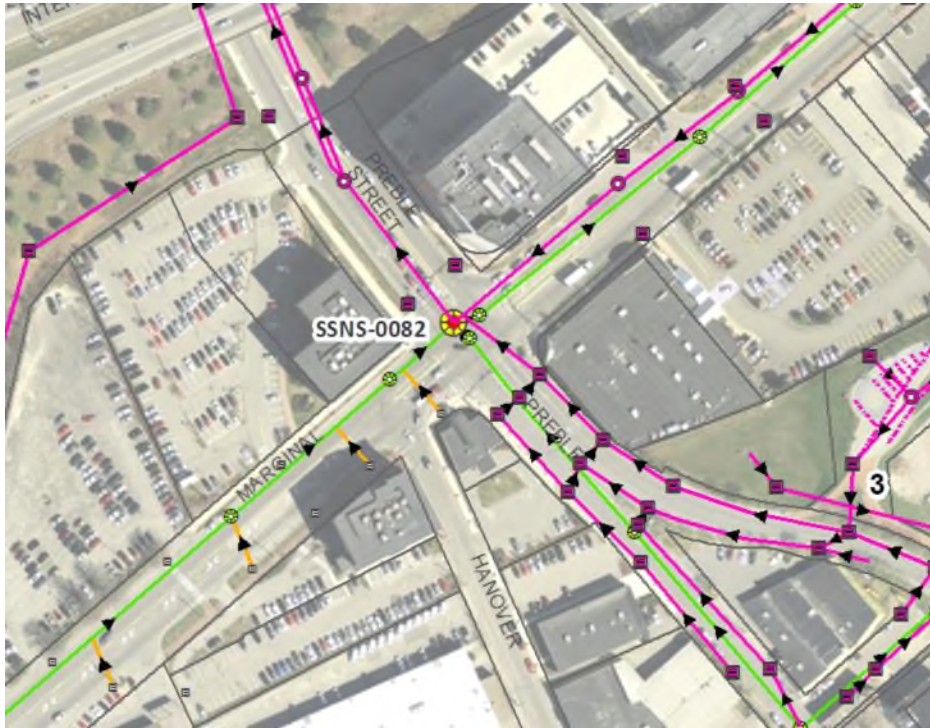
Map No:	IV-12
Structure Type	Tidegate Structure



GIS Info

ID No:	SSNS-0082
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Structure Type:	<Null>
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Reference Document	<Null>
Install Date	<Null>

Estimated Rim Elevation: 10.35' NGVD29
(based on LiDAR data)

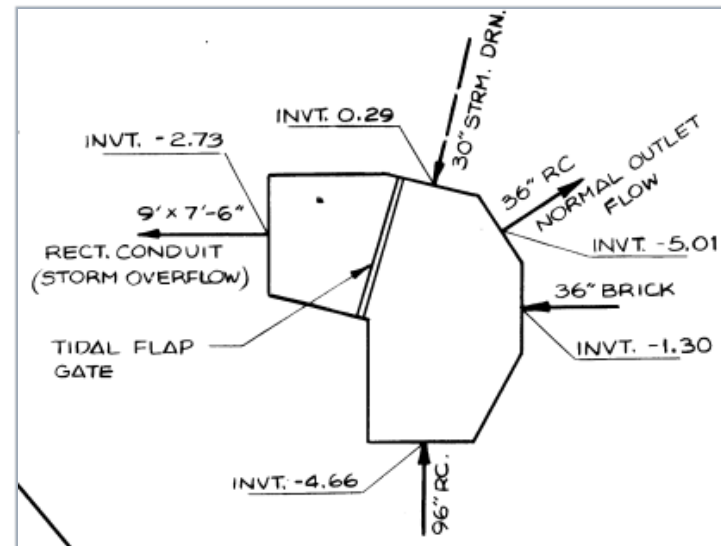
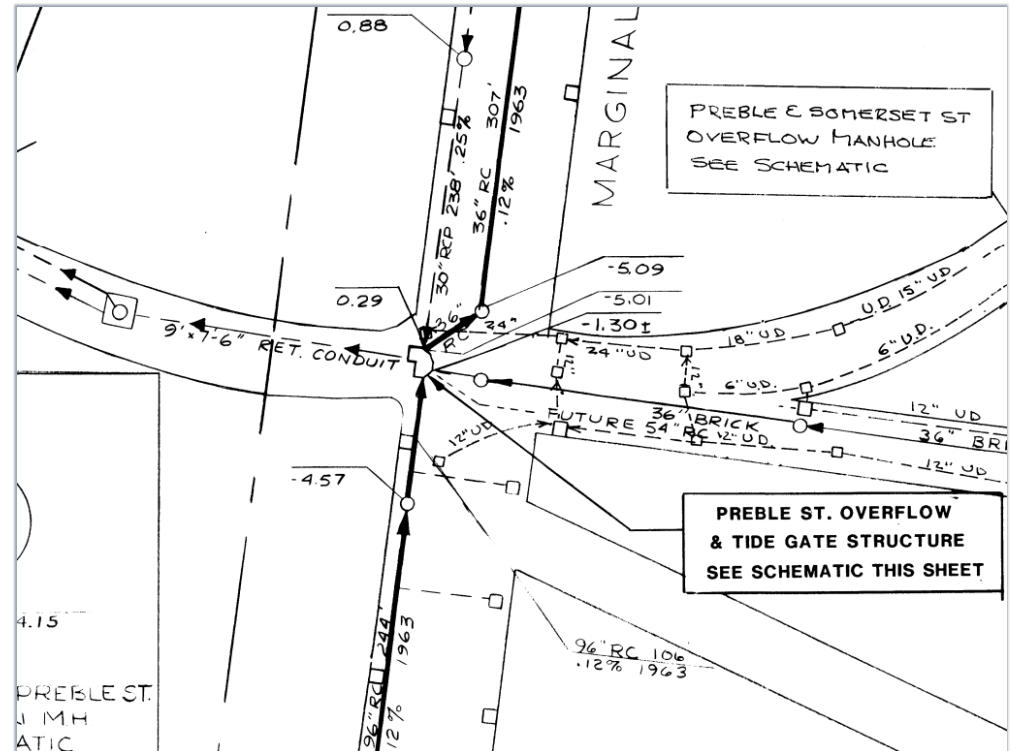


Google street view:

<https://www.google.com/maps/@43.6621188,-70.2654362,3a,75y,152.19h,59.49t/data=!3m6!1e1!3m4!1sCG3YhbeBiQaYeO1ZcmYidg!2e0!7!13312!8i6656!6m1!1e1>

I&I Map Info

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Structure Type	Overflow and Tidegate Structure

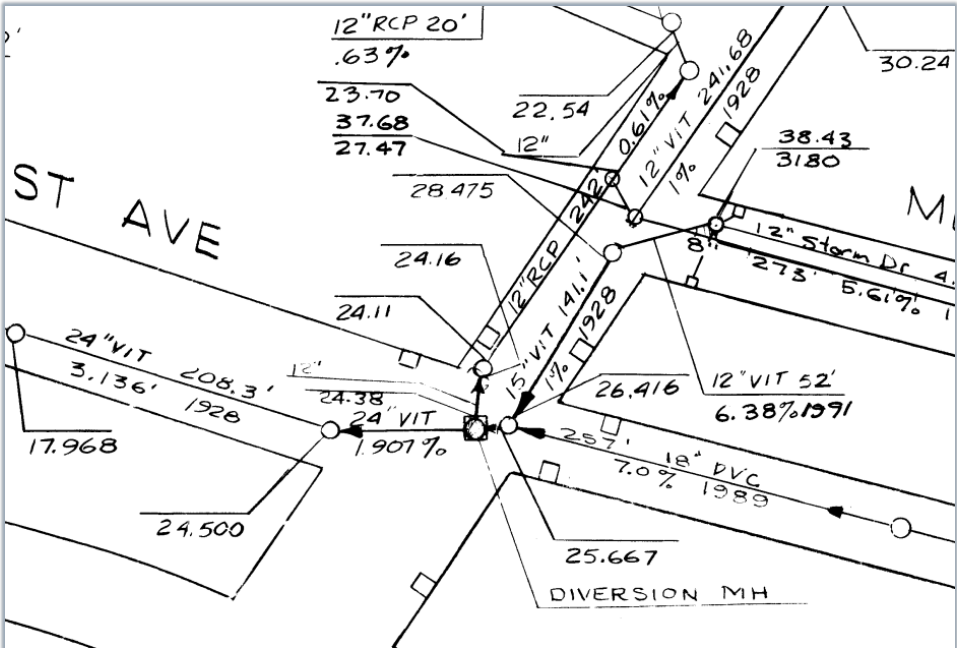


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Reference Document	00697_001_001
Install Date	1/1/1965

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(based on LiDAR data)



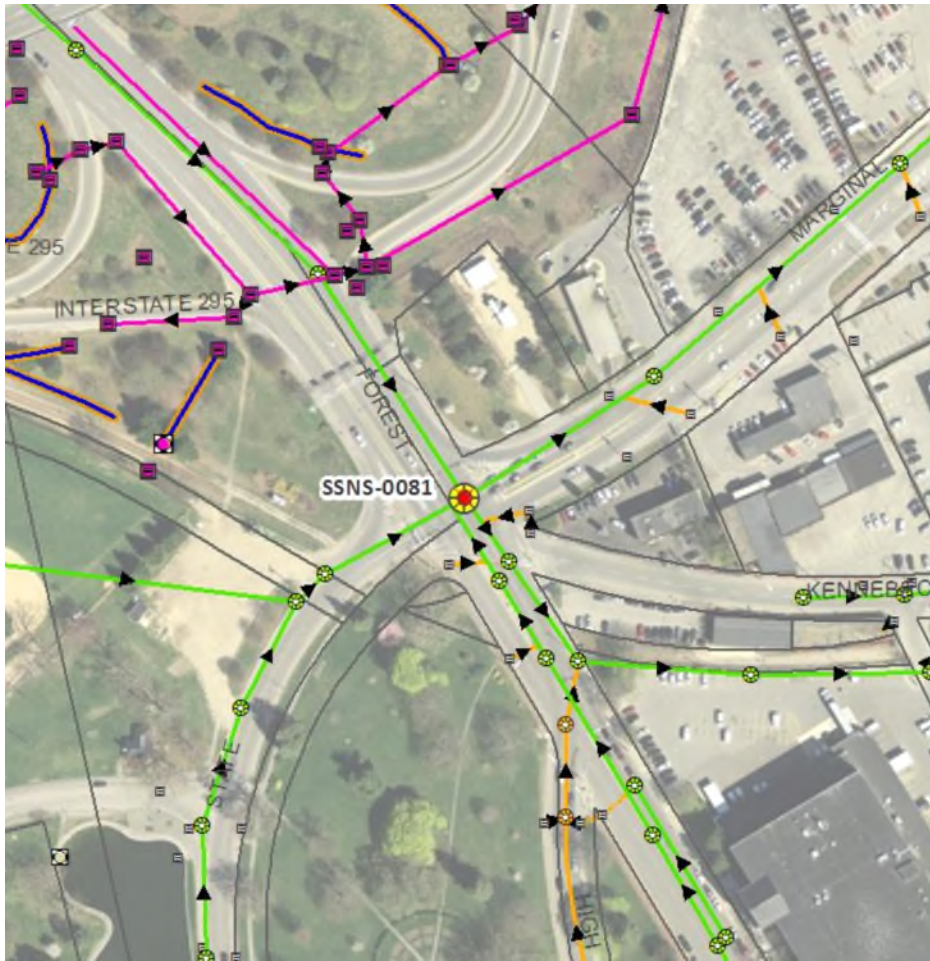
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Map No:	IV-13
Structure Type	Diversion MH
Schematic Available?	No



GIS Info

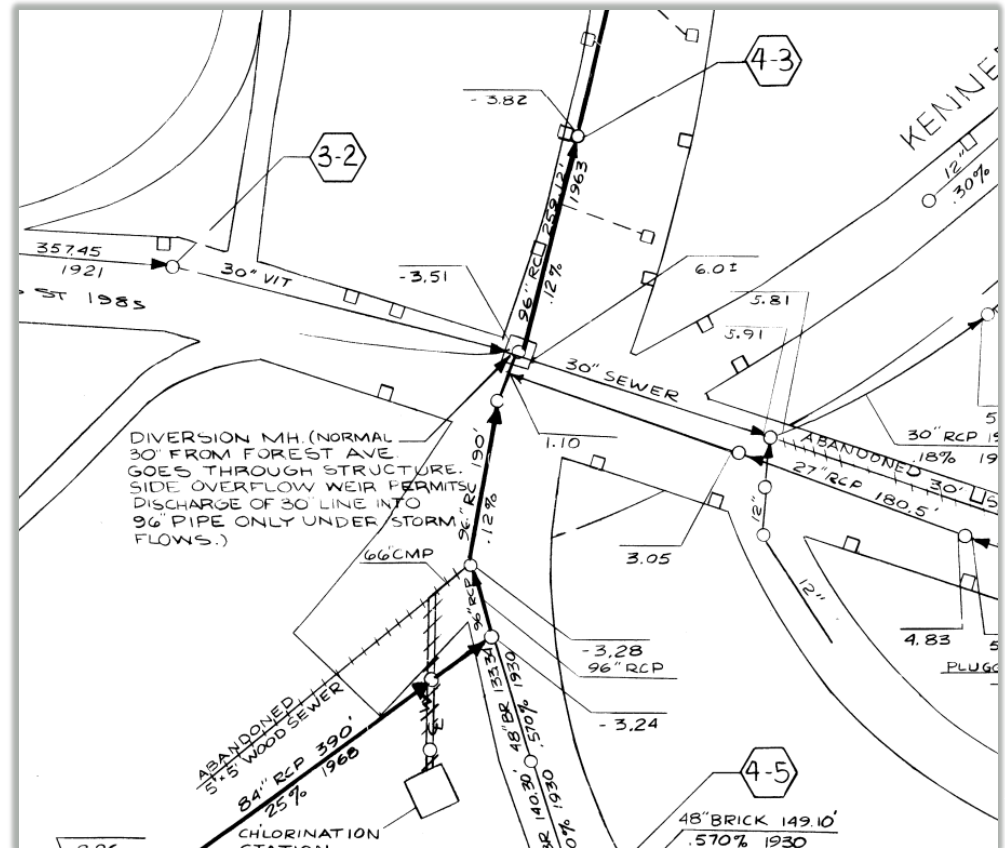
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Structure Type:	
Comment:	Overflow structure/diversion structure
Reference Document	00488_005_005
Install Date	

Estimated Rim Elevation: 10.94' NGVD29
(based on LiDAR data)



I&I Map Info

Map No:	IV-13
Structure Type	Diversion Manhole
Schematic available?	No



Google street view:

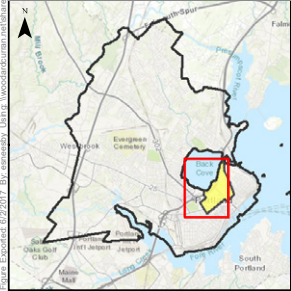
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Appendix C

Existing SWMM Model Schematic



LEGEND

SWMM Schematic Data

- Conduit
- Junction
- Outfall
- Pump Station

- Stormwater System**
- Discharges to or below Special Structure (Sewer Network Structure or Sewer Diversion Chamber)**
- Stormwater Gravity Main
 - Under Drain

- Sewer System**
- Sewage
 - Combined Waste Water
 - Sewer Pressurized Mains
 - Sewer Network Structure (Other)
 - Sewer Diversion Chamber
 - Sewer Pump Station
 - Sewer Tide Chamber

- Stormwater System**
- Storm Gravity Mains
 - Under Drain
 - Storm Virtual Drainlines
 - Storm Open Drains

Existing SWMM Schematic

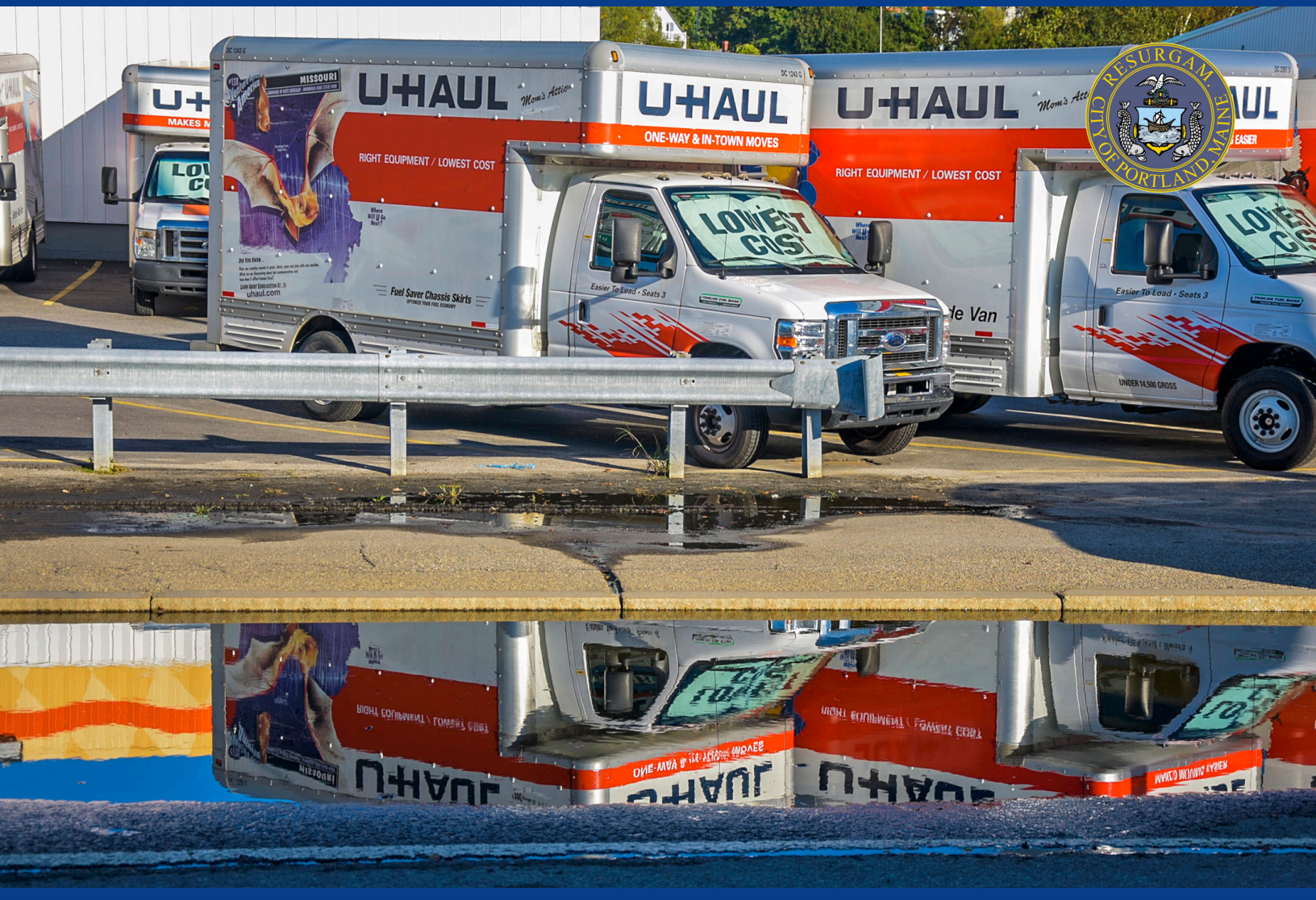
City of Portland, ME
FIGURE 3 of 3

Woodard & Curran shall assume no liability for any of the following:
1. Any errors, omissions, or inaccuracies in the information provided regardless of how caused or; 2. Any decision or action taken or not taken by the reader in reliance upon any information or data furnished hereunder. Data Sources:



SCALE: 1" = 225'
DATE: JUNE 2017

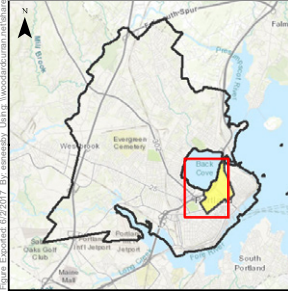
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DRAWN BY: ES



Appendix D

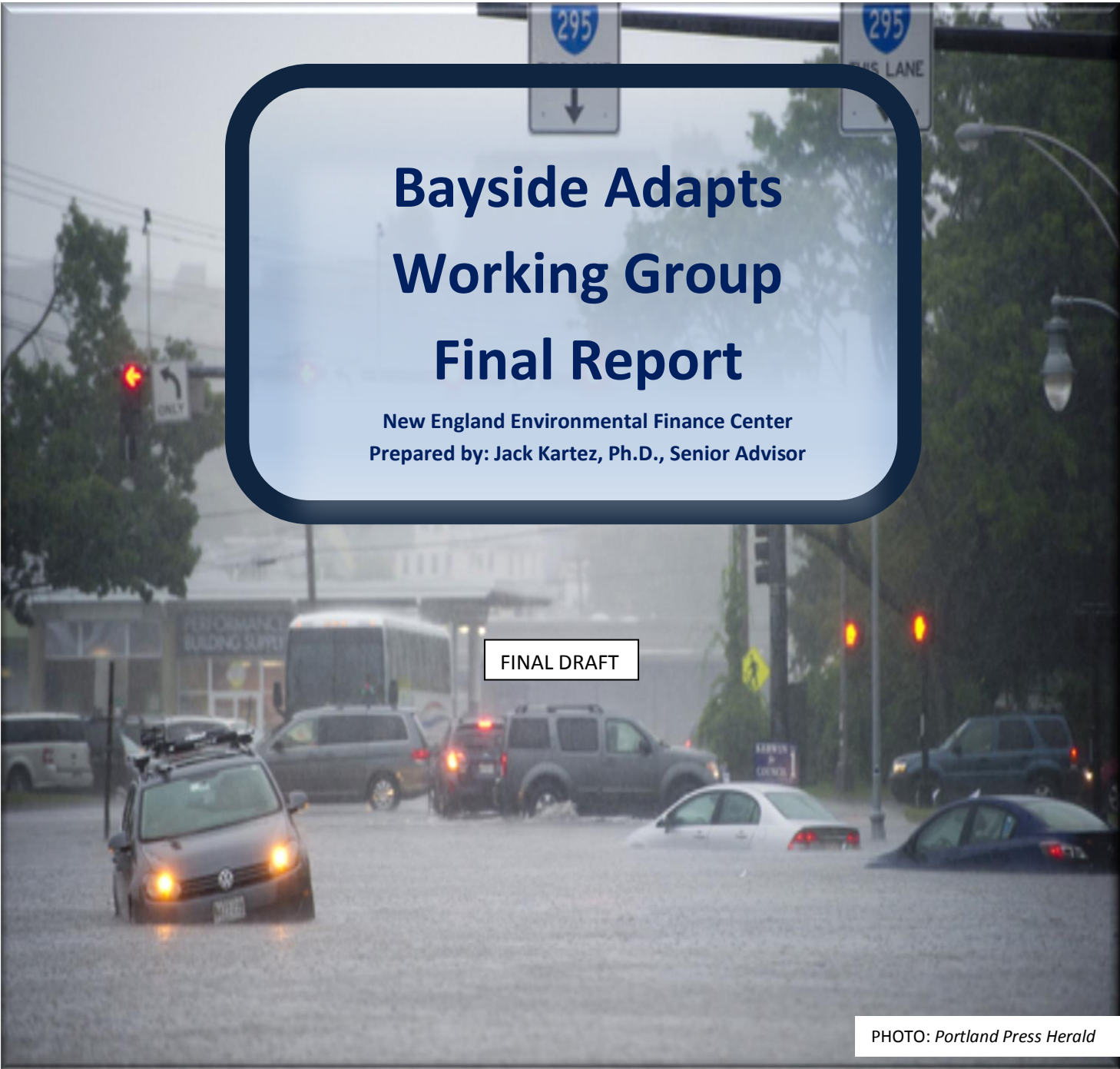
Areas Recently Surveyed





Stormwater System		Sewer System		Stormwater System	
Discharges to or below Special Structure (Sewer Network Structure or Sewer Diversion Chamber)					
Storm Gravity Main		Sewage		Storm Gravity Mains	
Storm Under Drain		Combined Waste Water		Under Drain	
Storm Discharge Points		Sewer Pressurized Mains		Storm Virtual Drainlines	
Storm Inlets		Sewer Manholes		Storm Open Drains	
Storm Manholes		Sewer Network Structure (Other)		Storm Inlets	
		Sewer Diversion Chamber		Storm Discharge Points	
		Sewer Pump Station		Storm Manholes	
		Sewer Tide Chamber			

Areas Recently Surveyed	
City of Portland, ME FIGURE 2 of 3	
Woodard & Curran shall assume no liability for any of the following: 1. Any errors, omissions, or inaccuracies in the information provided regardless of how caused or; 2. Any decision or action taken or not taken by the reader in reliance upon any information or data furnished hereunder. Data Sources:	
SCALE: 1" = 225'	PROJECT #: 0230429.00
DATE: JUNE 2017	DRAWN BY: ES



Bayside Adapts Working Group Final Report

New England Environmental Finance Center
Prepared by: Jack Kartez, Ph.D., Senior Advisor

FINAL DRAFT

PHOTO: *Portland Press Herald*

July, 2017



UNIVERSITY OF
SOUTHERN MAINE



New England
Environmental
Finance Center

Acknowledgements

The Bayside Adapts Working Group process was coordinated and staffed by the New England Environmental Finance Center (NE EFC) for the City of Portland as part of Bayside Adapts Phase 1. A number of City staff directly assisted with this process including:

- William Needleman, Waterfront Coordinator**
- Troy Moon, Sustainability Coordinator**
- Doug Roncarati, Stormwater Program Coordinator**

Special thanks to the following resource experts who presented to the Working Group:

- Pete Slovinsky, Maine State Geologist’s Office**
- Cameron Wake, Ph.D., University of New Hampshire**
- Gayle Bowness, Gulf of Maine Research Institute**
- Wayne Feiden, FAICP, U. Mass-Amherst & Town of Amherst**

Table of Contents

Working Group Final Report 3

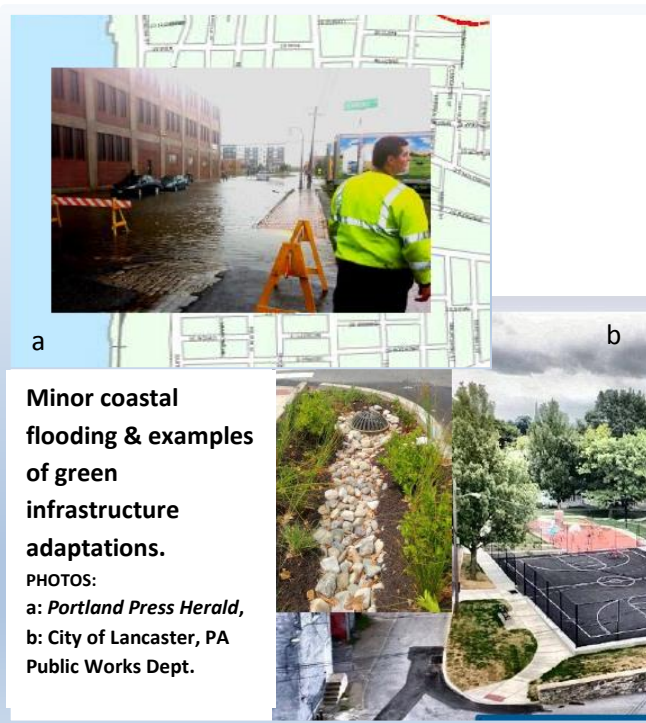
Attachment A: Executive Summary, Data Gap Report 8

Attachment B: NE EFC White Paper to Working Group 12

Bayside Adapts Working Group (BAWG) Final Report

Context: Bayside Adapts Phase 1

The City of Portland has undertaken an analysis of information needs to plan for adaptation the Bayside District to accommodate flood conditions. The neighborhood experiences flooding currently and existing risk is assumed to grow due to the interaction of rain events, high tides, changing sea level, wind storm surge, and the capacity of drainage infrastructure and other features of the area. A primary component of this effort has been to engage engineering and risk analysis services to identify “data gaps” in the information available. Limits of current information is a barrier to adaptation planning due to limited understanding of the city’s drainage infrastructure as well as the direction and magnitude of likely changes in the environmental demands on those systems. This work has been completed and a final report submitted by the team consisting of Woodard and Curran, RPS, and Jordan Environmental Engineering. That report will assist the City with decisions about further adaptation planning in Bayside as well as other related water infrastructure management (such as the recently initiated Infiltration Study). The executive summary is included here as Attachment A.



The City also engaged affected stakeholders from the Bayside area at the earliest stage of these efforts, to provide a foundation of public input and informed community and business interests for subsequent phases of infrastructure adaptation work. This public engagement has resulted in a set of preliminary **goals or principles for adaptation** in Bayside based on citizen, housing provider, landowner and user perspectives, to assist the City in discussions moving forward. The City chose to engage different perspectives through an ad hoc and neutrally facilitated and staffed working group rather than a formally appointed body. The process and products of the Bayside Adapts Working Group (BAWG) are reported in following sections.

Additionally, in discussions preparing for the two sets of activities noted above, the City take advantage of a recent National League of Cities small grant to the City Council Sustainability Committee to conduct a judged and prized design competition to engage the Portland creative community in conceiving new built environment approaches that can contribute to hazard adaptation and produce other benefits for livability and a robust local economy. The **Bayside Design Challenge** has been conducted alongside the BAWG process including with joint events of the two activities. The Design Challenge has added

educational and exploratory sources of information contributing diverse vision, creative thinking and imagery to the process. The Design Challenge rules, submitted entries, events and awards can be found on the City's Sustainability web pages (<http://www.portlandmaine.gov/1890/Sustainability-Office>) under the direction of Troy Moon. The NE EFC served as the nominal project manager for the data gap and stakeholder components, as the lead staff for the stakeholder process, and as an advisor to the City Sustainability Office for the Design Challenge.



DETAIL: Judge's Choice Design Challenge Entry, May, 2017
SOURCE: Aceto Landscape Architects, Portland, ME

BAWG Membership and Roles

The NE EFC facilitator and city staff jointly developed categories of participants to directly recruit to the working group of 12-16 people with the expectation that some invitees would defer and that as public engagement publicized the process that other participants would join the process. All were welcome to participate. Most important was to have a group that could bring together multiple interests in Bayside, discuss the task creatively and reach a working consensus on preliminary principles if possible.

The initial interests identified included gaining representation from the two formal neighborhood associations in Bayside, from landowner/developers/operators of commercial and residential properties in Bayside, from retail business in the area, from Portland Trails, from the two institutions building and developing low and moderate-income housing in Bayside (Portland Housing Authority and AVESTA Housing, Inc.), and from the Portland Society for Architecture, the design community which has sponsored both general participatory visioning events for Bayside starting with the 2000 Bayside Charrette and a number of later sea level rise-focused workshops.

Working Group Participants:

John Anton	Anton Consulting	Alyssa Phanitdasack	Portland Society for Architecture
Jim Hanley	West Properties	Laura Cannon	Bayside Neighborhood Association
Brent Noyes	Noyes Moving & Storage	Steve Hershon	Bayside Neighborhood Association
Matt Peters	AVESTA Housing Inc.	Jay Waterman	Portland Housing Authority
Peter Quesada	Fore River Company	Jan Piribeck	E. Bayside Neighborhood Assoc.
Kara Wooldrik	Portland Trails	George Rheault	West Bayside

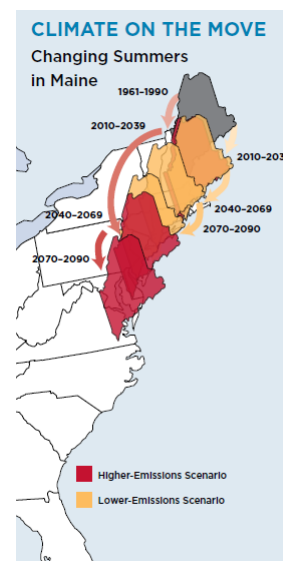
In addition the process benefitted from science-based agencies and nonprofits who attended multiple meetings and provided information, including Gayle Bowness, Science Education Program Manager at the Gulf of Maine Research Institute and Peter Slovinsky, Maine State Coastal Geologist at the Department of Agriculture, Conservation and Forestry. The working group benefitted from the input and contributions from City staff, scientists, visiting experts, the Design Challenge, and the consultant team for information as well as collaboration on the development of **principles**. City staff from economic development, public works and water resources, the Sustainability Office, and planning and urban development participated throughout.

Meetings & Process

The Bayside Adapts Working Group held four meetings open to the public between November, 2016 and early June, 2017. The process was lengthened in order to coordinate with both the results of the Design Challenge and the draft report by the data gap analysis consultant team lead by Woodard and Curran. Each meeting included presentations of information and discussion of draft principles for adaptation. At the first meeting, Nov. 4, 2016, the group heard presentations by the Gulf of Maine Research Institute (GMRI) on its new Portland-focused coastal climate change public education program funded by the National Oceanic and Atmospheric Administration (NOAA) and, by Pete Slovinsky of the Maine State Geologist's Office on sea level rise future scenarios for the coast.

The Dec. 14, 2016 meeting was held in conjunction with a meeting and presentations held by the City Sustainability Office to announce the Design Competition. Presentations were made by Dr. Cameron Wake of the University of New Hampshire, who develops climate information for use New England-wide, and Wayne Feiden, Planning Director of Amherst, MA, who discussed resiliency planning. In the discussion of draft principles to date, the Working Group requested two specific briefings from city staff: 1. The relationship of adaptation planning in Bayside to the City's comprehensive plan update; 2. The status and future of the City's planned Marginal Way storm sewerage conduit (a project to comply with federal regulatory requirements, which is currently on hold).

At the March 20, 2017 meeting the Working Group heard the requested briefings from city Public Works Director Chris Branch and Planning and Urban Development Director Jeff Levine, as well as an overview of the data gap work being started by the consultant team, and an update on the Design Challenge from city Sustainability Coordinator Troy Moon. The facilitator also held discussions outside of the BAWG meetings with individual working group participants to inform the draft principles. The Sustainability Office held a public showing of the Design Challenge entries on May 3, 2017 with the independent judge's panel selection of the winning entry and awarding of the cash prize provided by the National League of Cities grant.



SOURCE: Earth Systems Research. Ctr.
University of New Hampshire

After the May 3 meeting the Working Group received and participated in providing information to assist with the final development of the principles at the fourth and final June 8 meeting. First, the group received a brief white paper from the EFC staff on issues to consider in finalizing the principles, based on the EFC's information on emerging practices in other communities, Portland's situation and the Working Group's own discussions in the preceding months. (The white paper is included as Attachment B here). Second, the group was informally and anonymously polled on the draft list of adaptation principles to develop a rough grouping of importance/priority to assist with the final discussions on June 8.

In the detailed discussion at the June 8 meeting, a number of the principles were consolidated and terms clarified. A couple of principles suggested by staff were judged by participants to be technical and operational guides best left to managers and dropped from the working group's list. Several points made in the discussions were agreed to be included here as context: The discussions that finalized the principles included the points that 1. adaptation of Bayside should involve adequate public review; 2. that adaptation needs to be integrated appropriately in both and private efforts including for new and existing development and redevelopment, and; 3. that because adaptation for resilience takes place at multiple scales, an ongoing educational effort to communicate examples and reveal options is needed. A working consensus resulted on sending the following list of principles as advice to city leadership and management.

Bayside Adapts Working Group: Suggested Principles for Adaptation Actions

1. Adaptation in Bayside is a citywide concern and creative means should be developed to fund and leverage adaptation efforts including private-public partnerships.
2. City regulations, where possible, should not create barriers to innovative and useful adaptation in development projects, with decisions that receive adequate public review.
3. Use opportunities for multiple or co-benefits early in resilient infrastructure project planning and incorporate resilience benefits into other infrastructure projects where possible.
4. Take early actions to improve resilience when they do not preclude or raise the cost of later actions that are likely to be needed.
5. Make resilience an integrated design principle in the building cycle (renewal, replacement) of infrastructure.
6. Connect adaptation to overall growth planning for Portland and Bayside being carried out through the Comprehensive Plan and other policies such as integrated water resource planning, keeping stakeholders informed and educated about resilience and innovative opportunities.
7. Public and private projects and changes to increase resilience in Bayside should not impede or detract from one use or property due to uncoordinated action elsewhere and; effects on future infrastructure and use opportunities should be taken into account.
8. Pursue both green and gray resilient infrastructure where appropriate as well as a mix of large and smaller scale actions (as illustrated by the Judge's Choice in Design Challenge) with a variety of strategies appropriate to each setting including reduction, hold and treat, and diversion.

Using The Principles—Next Steps

The principles have been developed as a basis for further discussions about adaptation and resiliency design, investments and relationships in Bayside, and potentially elsewhere in Portland. The principles reflect multiple points about needs, roles, timing and sources of support wall of which will require choices. The best use is as a guide to consistently asking questions about design, investment and partnership decisions in Bayside at each stage where such decisions will have to be made and at multiple scales from small to large projects. These principles will change with such experience and in response to changing conditions in Portland's environment and economy.

The most important use is as a prompt to actively addressing opportunities and questions in those decisions and discussions with involved and affected stakeholders as well as internally among departments:

- Is there a balance of solutions and effects?
- Can different project design or partnerships add value and co-benefits that would be missed without that effort, as well as expanded means for funding resilience efforts?
- Can investment in the shorter term save costs in the future and what should that future look like?

An integrated approach across functional units and offices of City government will facilitate the early examination of these opportunities in projects and policies necessary. That is a lesson learned over time in local emergency management but it applies very well to long-term, effective risk management and resilience efforts. An excellent first step can be the ongoing reference to these principles as a tool by appropriate Council committees and by departmental managements.



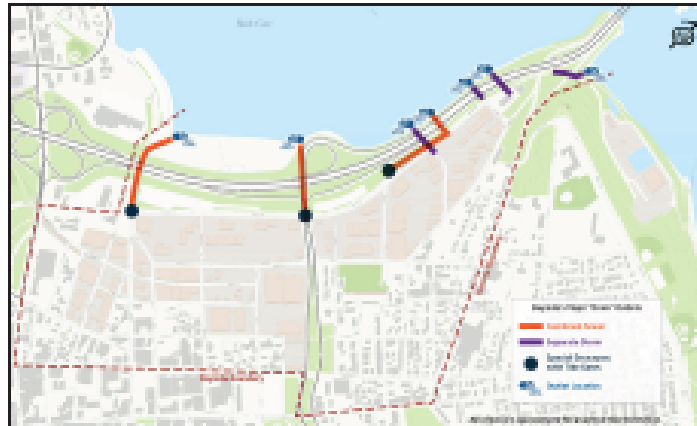
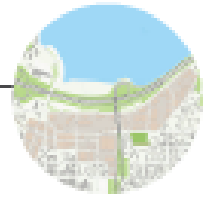
BAYSIDE ADAPTS

How do we make our neighborhood more resilient to flooding?
Effective planning starts with good information.



RPS asa





Overall, Bayside's combined sewer and separated stormwater system is made up of over 19 miles of pipe and over 900 structures. The figure is a simplified rendering of Bayside's primary drainage system outlet locations.

WHAT WE KNOW

The primary contributors to flooding in Bayside are rainfall, sea level (tides), and the adequacy and functionality of the drainage system. We have developed Portland-specific sea level and climate change information to assist with flood and adaptation planning; however, more data is needed to evaluate the adequacy and functionality of the drainage system in relation to these climate change projections.

Sea Level Rise Scenarios for Years 2050 and 2100, Portland, Maine			
Year 2050		Year 2100	
	Rise in Sea Level		Rise in Sea Level
Commit to Manage	1.5 ft.	Commit to Manage	3.8 ft.
Prepare to Manage	3.4 ft.	Prepare to Manage	8.8 ft.
		Be Aware of	10.8 ft

In addition to identifying the planning scenarios for sea level rise, numerous Portland-specific storm surge and precipitation tables have been developed to aid in future modeling and planning. These climate change tables, combined with sewer and drain system information, ground surface information, and other model inputs, will help plan the adaptation strategies for the Bayside.

HERE IS WHAT WE KNOW ABOUT THE DRAINAGE SYSTEM IN BAYSIDE:

Seven primary pipes provide drainage for stormwater from the Bayside neighborhood to the ocean. Most the Bayside area is serviced by pipes that carry a combination of sanitary sewage and stormwater. The remaining portions are serviced by separate stormwater drains.

+

The inner workings of these systems are complex, and require computer-based models checked against actual conditions to predict how the system may respond to a storm or tidal event.

The three largest pipe systems have "Special Structures with Tide Gates" to regulate sewer overflows and the inflow of ocean water.

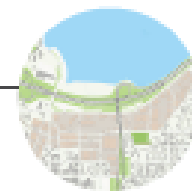
+

Tide gates alone cannot protect upstream areas from precipitation-based flooding.

The separated stormwater drains are largely unprotected from tidal influence.

+

Many of the pipes cross Interstate 295 and are partly owned/operated by Maine DOT, complicating maintenance and planning needs.



BAYSIDE NEEDS TO CLOSE THE GAPS

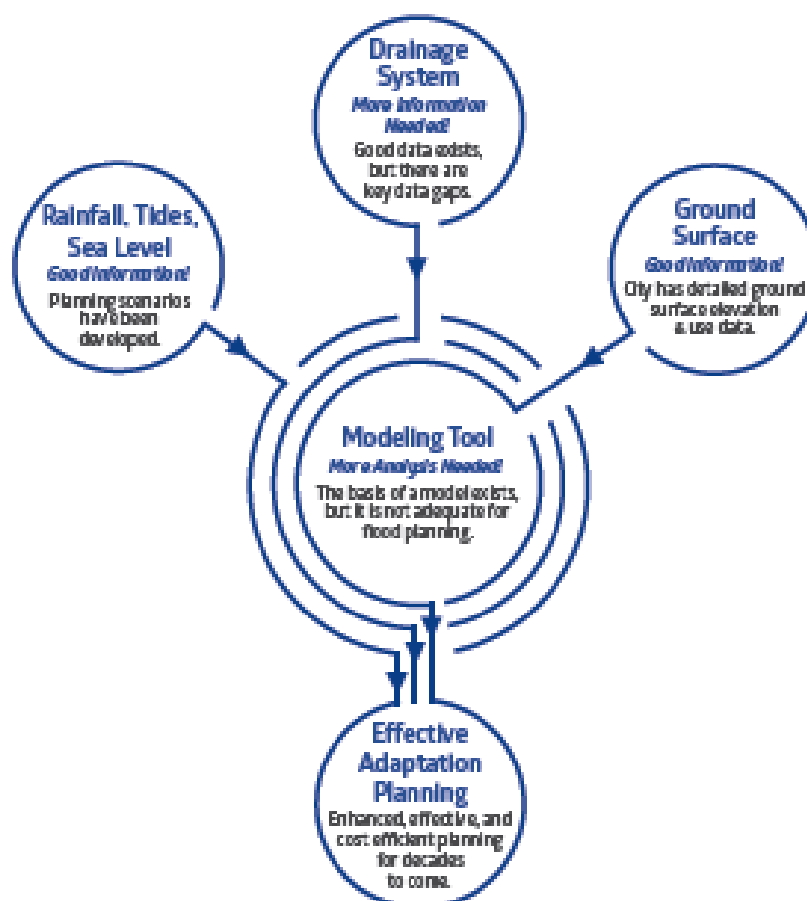
Flooding has been a problem in Portland's Bayside area for decades. The low-lying neighborhood is susceptible to flooding during high tides. When coupled with heavy rain, these conditions worsen. The City and its partners are identifying the key information and tools necessary to assist in addressing today's issues and to adapt to tomorrow's changing climate.

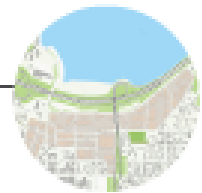
With the right funds, collaboration, leadership, and implementation of both short-term and long-term efforts, the right information can be collected and the City can continue to adapt in a smart and efficient way. This document summarizes the climate change planning scenarios and the data collection needs which will serve as the foundation for adaptation planning in Bayside. In-depth detail on these topics is presented in a 2017 report entitled *Bayside Adapts Phase 1 - Sewer & Stormwater System Data Gap Analysis*.

EFFECTIVE ADAPTATION PLANNING REQUIRES GOOD INFORMATION AND THE RIGHT MODELING TOOLS

Coastal urban flooding is caused by several key factors which must be collectively considered to properly plan for, predict, and manage flooding. Key factors can include things like storm and sewer system pipe capacity, tide level, and precipitation rates, amongst various other factors. The City is lacking some of the information needed to develop tools (models) that can simulate and assess the combined effects of these key factors on flooding in Bayside.

BAYSIDE ADAPTATION PLANNING





GOOD INFORMATION AND A DRAINAGE MODEL ALREADY EXIST!

The City has:

- ▶ Reasonably up-to-date information on the location of drainage and combined sewer pipes and structures (GIS data)
- ▶ Excellent surface elevation data
- ▶ Electronic Survey files covering most of the key sewer and combined sewer areas
- ▶ Schematic drawings of the Special Structures
- ▶ A hydraulic and hydrologic model of the major combined sewer drains (SWMM Model)

RECOMMENDED NEXT STEPS

1

Compile and Extract Important Existing Information for Integration into City GIS

Existing surveys, existing pipe condition information, existing ground surface information

2

Targeted Field Data Collection Program

Targeted field surveys and condition assessments of critical drain pipes and structures

3

Explore Additional Model Capabilities / Model Options for Adaptation Planning

4

Update / Calibrate / Validate Model(s)

TO: Bayside Adapts Working Group & Interested Parties
 FROM: Jack Kartez
 DATE: May 26, 2017
 RE: White paper on your charge to draft beginning adaptation principles

*It may be useful to review issues relevant to your preliminary principles for Bayside adaptation—still to be completed by you. We need to engage on this June 8. The following is based on previous discussions, speaking further with some of you, the Design Challenge entries and information from city staff on conditions (we will get more condition information from Woodard Curran June 8). **This brief will be followed by questions for you after Memorial Day.***

As environmental conditions continue expected trends, and as development and redevelopment in Bayside continue, every design and investment choice will have implications for resilience. That includes both public infrastructure and private property development and how they connect. The following will bear on how change is approached:

1. It is likely that the best resilience outcomes cannot be achieved through public or private actions alone. How do both sectors play the most beneficial role in district resilience?
2. Practically speaking, no single public infrastructure fix alone is likely to meet resilience needs which may require a portfolio of actions.
3. Significant new development is likely to be guided by the risk management requirements of lenders, investors and insurers (and already has) resulting in single-site resilience investments.
 - a. Not all beneficial adjustments can be achieved on a project-by-project basis alone, however—some for example will involve property development interactions with public infrastructure and district-wide changes.
 - b. Adjacent or nearby existing development may also be affected by changes that may occur in access and elevations, such as considered at Somerset Street.
4. To paraphrase Charlie Colgan (from Changing Maine II) by the time the value of enough development & activity becomes too great to leave to disruption or damage, it may be too expensive or too late to make the best adjustments. How should the City plan to stay ahead of opportunities with least regret?
 - a. The Rockefeller Foundation-sponsored Refocus Partners group, adaptation finance innovators, point out that simultaneous or co-benefits can be leveraged in public and private projects when there is intentional, early pre-project exploration and packaging. As ideas are raised, what approach is needed to tap opportunities?
 - b. As projects and infrastructure adjustments to roads, trails and spaces take place, the impacts may be unevenly distributed (positive and negative both, and to commercial, residential and other users). How can effects on the district be balanced for best results? How should costs be distributed?
5. Given all of the above, are there principles for addressing costs of improvements at different types and scales, such as (for example) major infrastructure like seawalls/tidegates, versus the city's drainage system improvements, versus off-site impacts of specific projects to adjacent uses? You may think of further points to raise and please forward any to me in advance of June 8. Thank you.



Bayside Adapts



**Bayside
Adapts**

DESIGN CHALLENGE
PORTLAND, MAINE
FEBRUARY–MAY 2017

Sustainability and Transportation Committee
October 18, 2017

Sustainable
Portland:
2007
Adopted
2009

“Ultimately, ... we must begin the conversation of how to adapt our lower lying neighborhoods and districts to rising sea level, and ... to begin ... to comprehend the magnitude of the financial burden that climate change will place on our City.

Climate change may be the greatest challenge to our City since the re-building after the Great Fire of 1866” .”

Excerpt from Sustainable Portland Report, Climate Change Sidebar, Page 5. Adopted 2009

List of Actions and Processes to date

2007-2009 **Sustainable Portland Report**

2008 **Climate Action Plan**

2009-2010 **Maine Climate Change Adaptation Taskforce**

2011 **City Council Resolution on Sea Level Rise Adaptation**

2011 **Bayside Vulnerability Assessment:**
Portland Society for Architecture
New England Environmental Finance Center
State of Maine Geologic Survey

2013 **Commercial Street /Waterfront Vulnerability Assessment**

2014 **Urban Land Institute - Urban Resiliency Panel**

2014 **Department of Homeland Security –**
Regional Resiliency Assessment Program:

2015 *Maine Climate Adaptation “Table Top Exercise” pilot*

2015 **US Green Building Council North East Regional Conference**

2015 **Comprehensive Plan Updates**

Ongoing **Bayside Flooding Adaptation:**



What do we expect from Bayside Adapts?

- Common understanding of vulnerability
- A first formal City community conversation on Sea Level Rise estimates
- Better tools to address the issues
Goals/Principles
Common Language
- Technical Base line for future work
- Inspiration, Images, and Activism



BAYSIDE ADAPTS PHASE 1

Sewer & Stormwater System Data Gap Analysis



September 1, 20
Project Number. 230429

Data Gaps - History

Figure 1: Historic Fill in Bayside Neighborhood 1870 - 2003



Environmental Conditions: Gaps &

■ Sea Level Rise Rate

- Many sources of information from regional, global, and national sources
- Potential for acceleration of rate over time

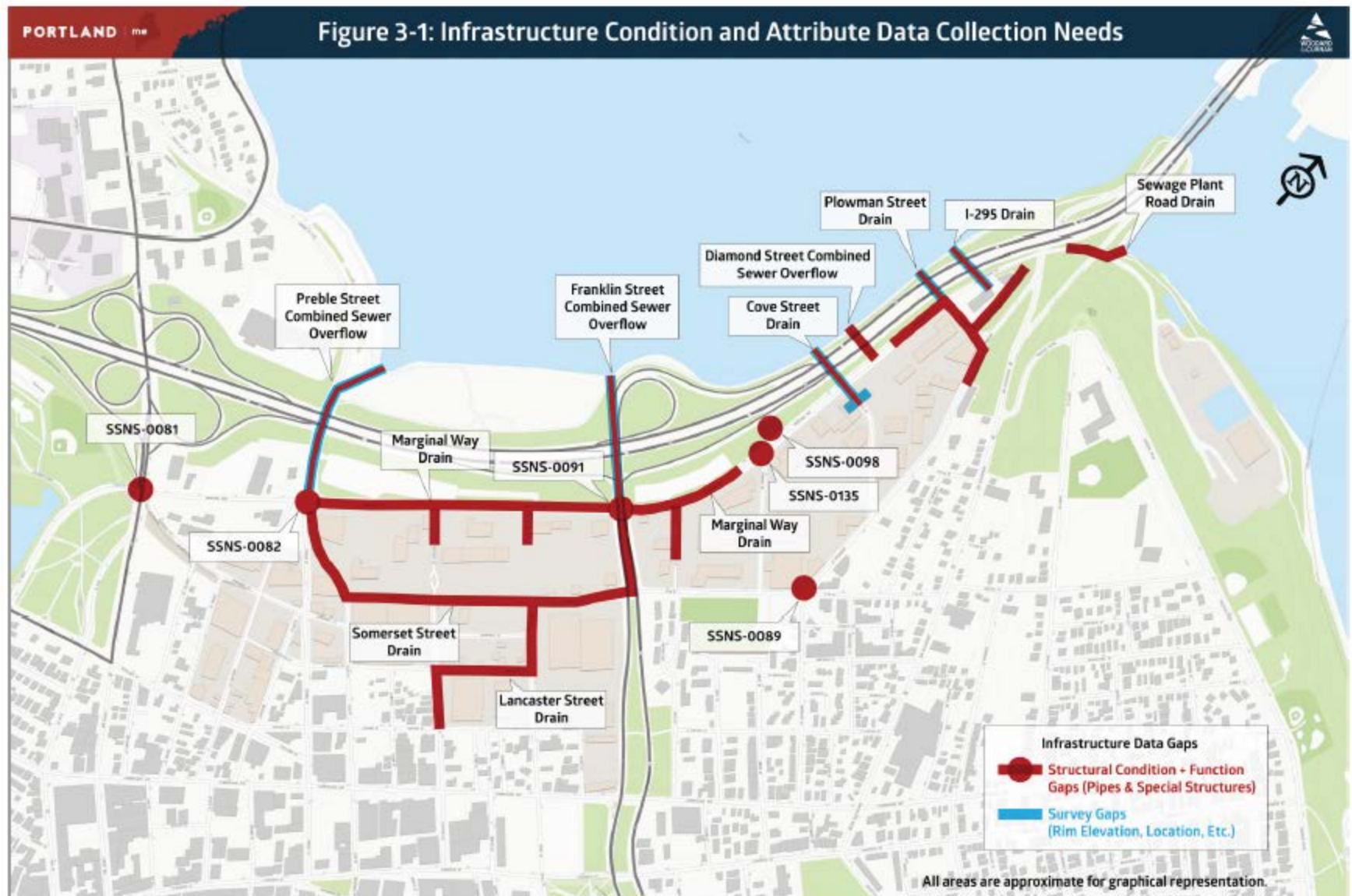
■ Precipitation

- Design storms vary among studies
- Design storms should change as precipitation patterns change
- Several sources of predicted changes

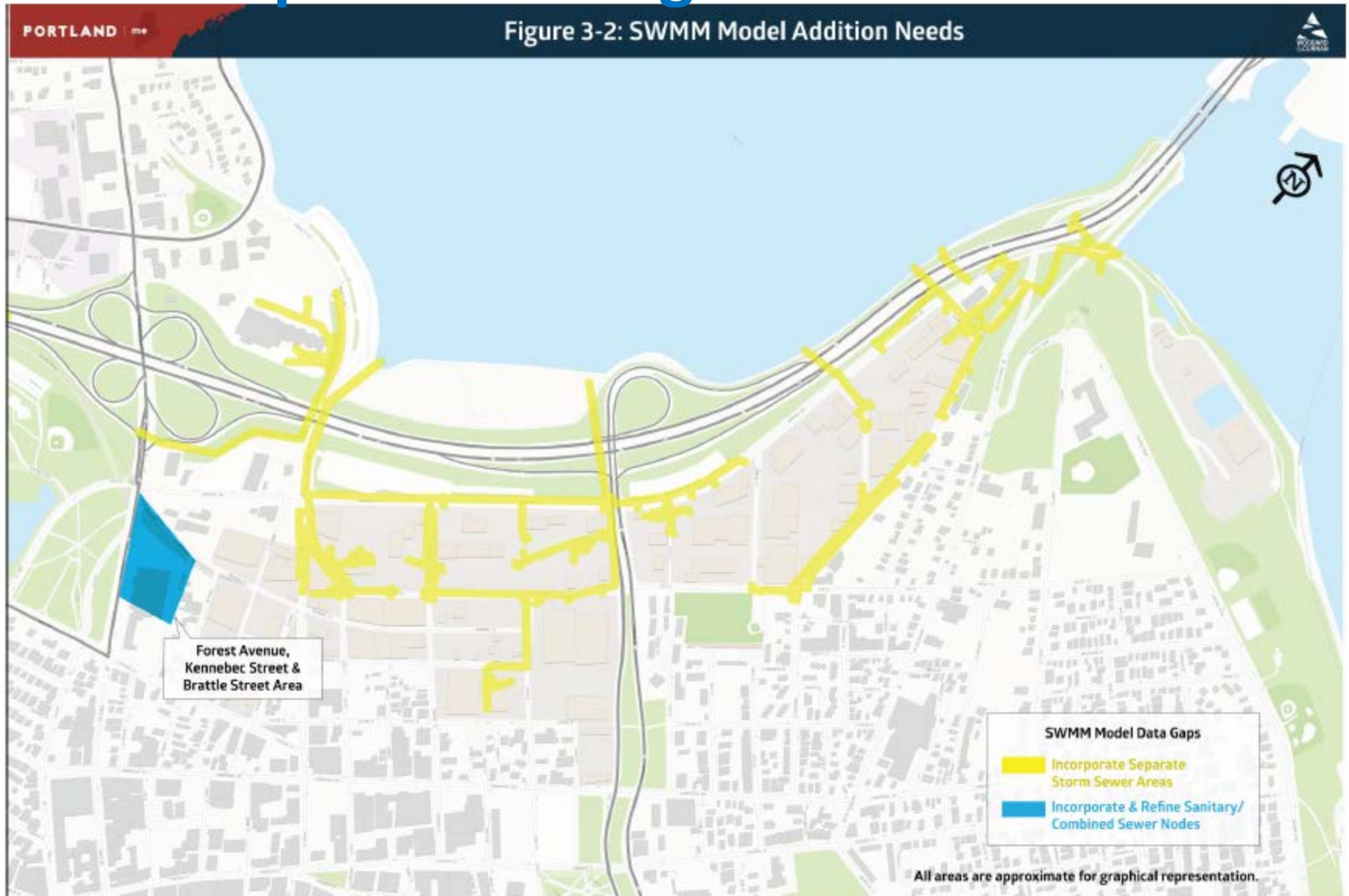
■ Storm Surge

- Many sources of information at local & regional scales
- Potential for large local spatial variation
- Dependence on sea level rise rate
- Uncertainty about future storm intensity and frequency

Data Gaps - Infrastructure



Data Gaps - Modeling



Data Gaps – Sea Level Rise

Table 4-1: Global Mean Sea Level Rise Scenarios for 2100 with corresponding exceedance probabilities (Sweet et al., 2017)

Scenario	GMSL (m)	Probability of Exceedance
Low	0.3	94-100%
Intermediate Low	0.5	49-96%
Intermediate	1	2-17%
Intermediate High	1.5	0.4 to 1.3%
High	2	0.1 to 0.3%
Extreme	2.5	0.05 to 0.1%

Data Gaps – Sea Level Rise, translated to the City Datum (NGVD 29)

Table 4-2: Summary of Sea Level Rise Scenarios for 2050 and 2100, Portland, Maine

Scenario	2050: RSL, ft. / Mean Sea Level, ft. relative to NGVD29	2100: RSL, ft. / Mean Sea Level, ft. relative to NGVD29
Low	0.62 / 1.08	1.12 / 1.58
Intermediate Low	0.82 / 1.28	1.53 / 2.00
Intermediate	1.48 / 1.94 – commit to manage	3.84 / 4.30 – commit to manage
Intermediate High	2.16 / 2.63	6.00 / 6.46
High	2.95 / 3.41	8.72 / 9.19 – prepare for
Extreme	3.38 / 3.84 – prepare for	10.79 / 11.25 – be aware of
<i>Note: The first value is the RSL rise in ft., as originally reported by Sweet et al (2017). The second value is the RSL converted to Mean Sea Level relative to NGVD29 following the methodology presented in Sweet et al., (2017).</i>		

DAILY HIGH TIDE LEVELS IN 2100

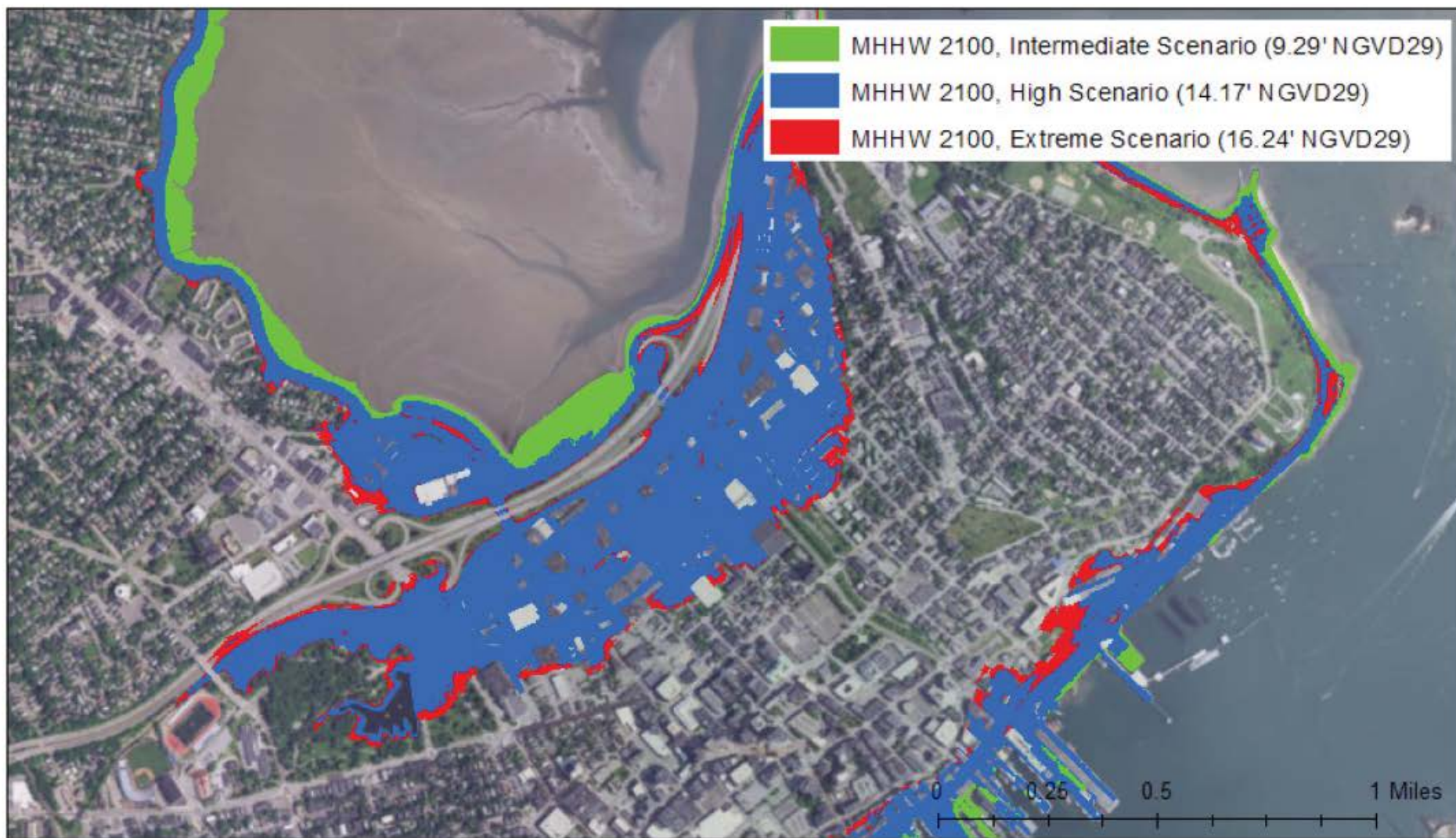


Figure 1: Historic Fill in Bayside Neighborhood 1870 - 2003



Table 4-8: Summary of Extreme Water Levels from the NACCS Study combined with MSL scenarios for 2050.

Data Gaps Storm Surge

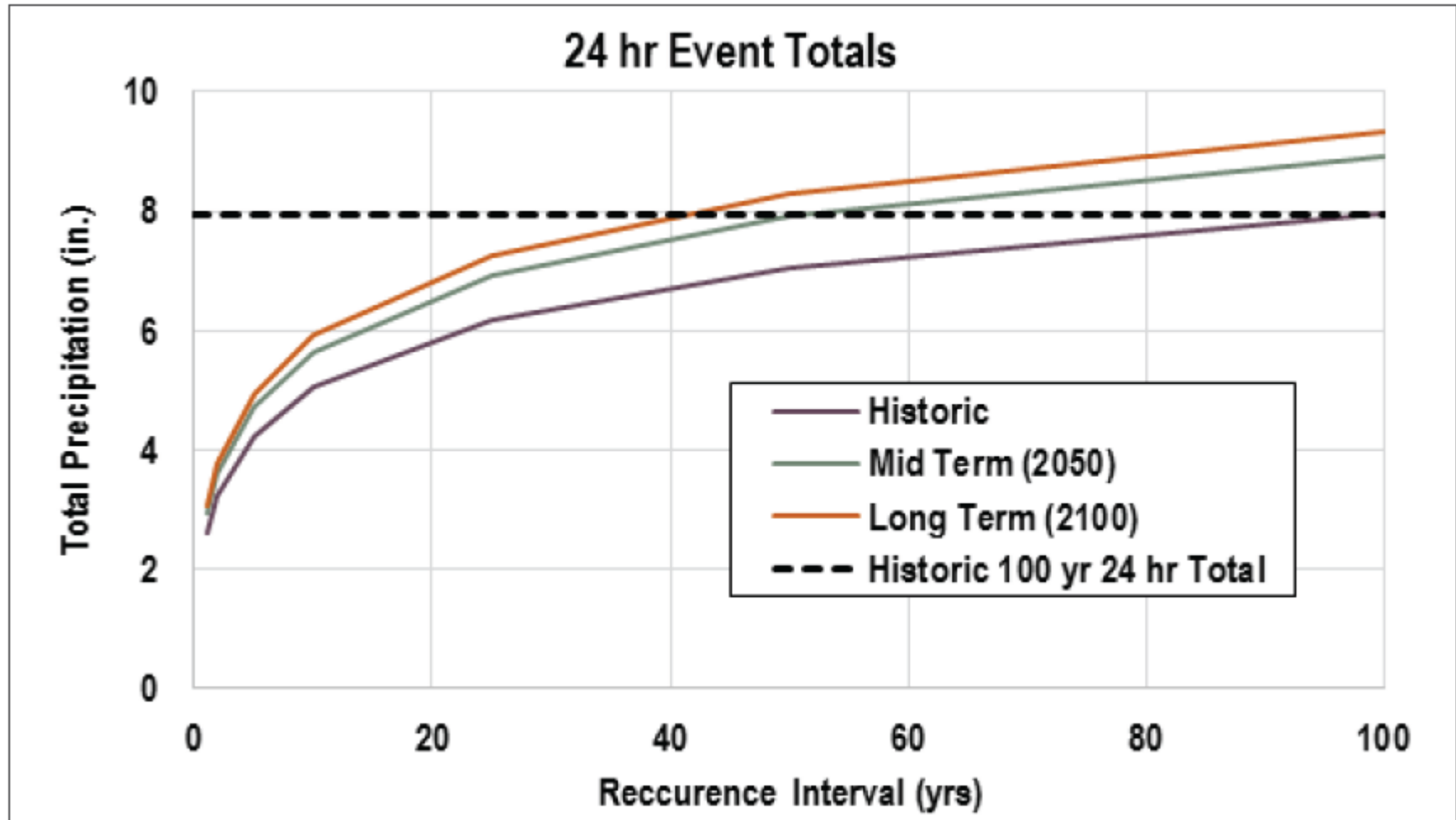
Under the Intermediate/High Scenario – the “100 year” storm becomes the “10 year” storm in Back Cove

NACCS Station	Water Level Return Period	Storm Surge Water Level (ft.) ¹	Storm Surge Water Level + 2050 Intermediate MSL of 1.94 (ft. NGVD29)	Storm Surge Water Level + 2050 Intermediate-High MSL of 2.63 (ft. NGVD29)	Storm Surge Water Level + 2050 High MSL of 3.41 (ft. NGVD29)	Storm Surge Water Level + 2050 Extreme MSL of 3.84 (ft. NGVD29)
7221 Back Cove	10-yr	8.04	9.97	10.66	11.45	11.88
	20-yr	8.73	10.66	11.35	12.14	12.57
	100-yr	10.73	12.67	13.35	14.14	14.57
	500-yr	11.45	13.39	14.08	14.86	15.29
7047 Maine State Pier	10-yr	7.81	9.75	10.43	11.22	11.65
	20-yr	8.17	10.11	10.79	11.58	12.01
	100-yr	8.89	10.83	11.52	12.30	12.73
	500-yr	9.95	11.48	12.17	12.96	13.39

¹ Relative to mean sea level

Data Gaps – Precipitation

Figure 4-16: 24-hr Event Recurrence Interval Totals for Historic and Future Timeframes



Recommendations

Sea Level Rise

Sea Level Rise Scenarios for Years 2050 and 2100, Portland, Maine			
Year 2050		Year 2100	
	Rise in Sea Level		Rise in Sea Level
Commit to Manage	1.5 ft.	Commit to Manage	3.8 ft.
Prepare to Manage	3.4 ft.	Prepare to Manage	8.8 ft.
		Be Aware of	10.8 ft

**Source: The 'Rise in Sea Level' values are the Relative Sea Level rise values for the Intermediate, High, and Extreme scenarios for Portland, ME reported by a NOAA publication titled "Global and Regional Sea Level Rise Scenarios for the United States" (Sweet et al, 2017).*

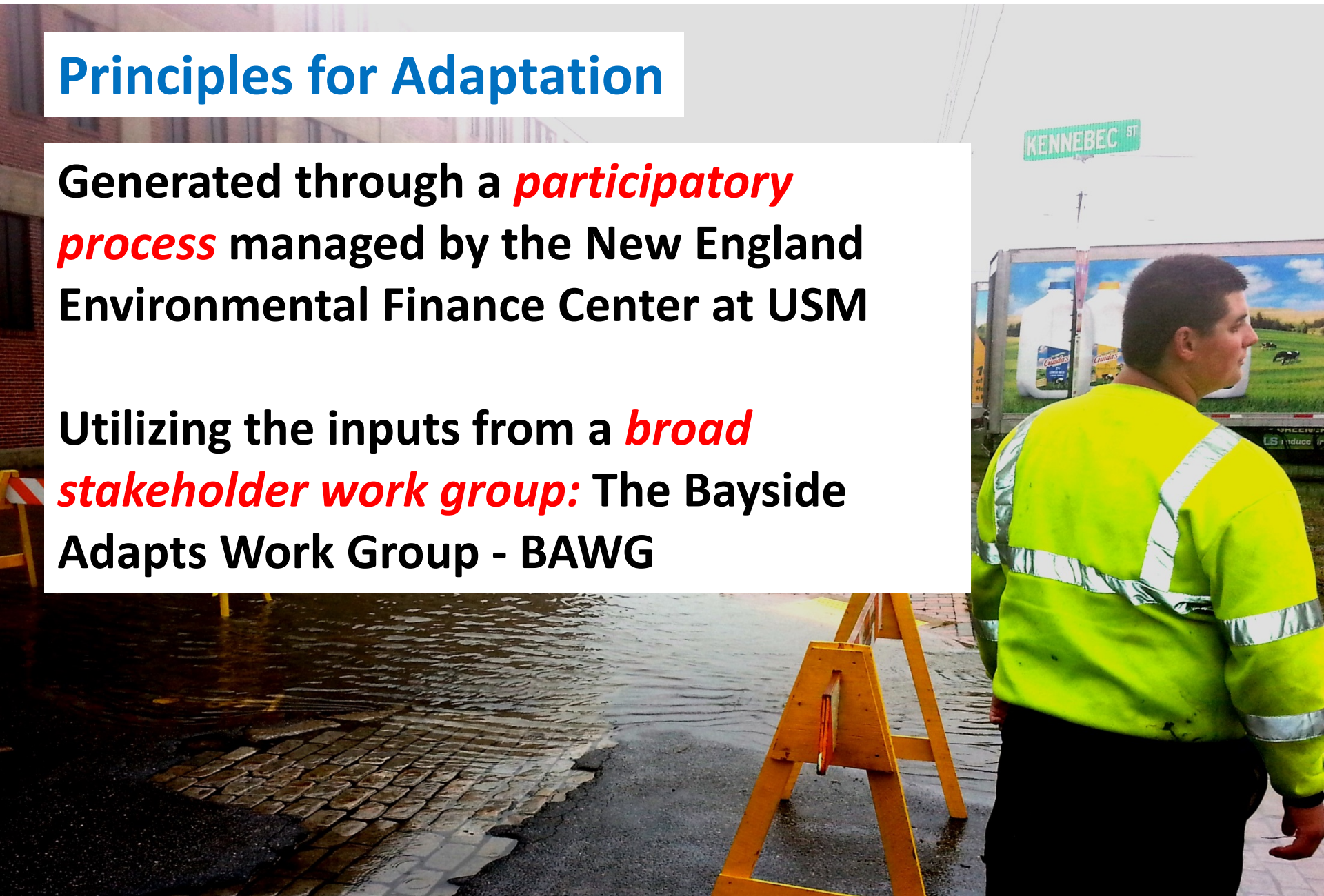
Modeling



Principles for Adaptation

Generated through a *participatory process* managed by the New England Environmental Finance Center at USM

Utilizing the inputs from a *broad stakeholder work group*: The Bayside Adapts Work Group - BAWG



Bayside Adapts Working Group: Suggested Principles for Adaptation, Summary

- ***Foster participation*** - Adaptation in Bayside is a ***citywide concern***
- ***Remove barriers to adaptation*** in City regulations
- ***Leverage Adaptation Efforts*** to create multiple or ***co-benefits***
- ***Take early actions***
- ***Integrate resilience into*** infrastructure and project design (full life cycle)
- ***Connect adaptation to overall growth planning*** for Portland and Bayside
- ***Coordinate public and private*** projects
- ***Pursue both green and gray*** resilient infrastructure and a mix of ***large and smaller scale*** actions

Design Challenge

Bayside Adapts

**DESIGN CHALLENGE
PORTLAND, MAINE
FEBRUARY–MAY 2017**

2020

THE SURGE: Rapidly rising sea level combined with strengthened storm surge and a glut of impervious paved surfaces and asphalt roads interventions lead to widespread flooding and property damage across the Bayside district.



2050

RECONNECT: A sea wall and dewatering is introduced along the newly re-aligned Bayside Parkway. The local street grid is reconnected to historic alignments and reconnected with gardens paving bio-retention swales and gardens to help mitigate localized flooding. The 140-acre expanse is reconnected with the Gateway State waterway.



2030

THE RETREAT: Physically constrained infrastructure and property damage force the Bayside community to come to terms with rising sea level. The first step is to reconfigure Bayside to unshackling natural systems. Here, the historic Mill Cove is unseamed from Interstate 285, and roads are re-aligned to accommodate the flooding.



2100

PROTECT: The fully integrated sea wall allows for full redevelopment of the Bayside district, creating a network of walkable streets and first neighborhoods. Dunes, street-level blocks encourage walking and transit, contributing drastically to overall reduction of global carbon emissions.



IT'S ALIVE!: YOUR CITY IS A SUPER-ORGANISM

Bayside Adapts

BOARD 2 OF 4

Project Title

Team ID

ITS ALIVE:

BACK TO MILL

ACOTO LANDSCAPE ARCHITECTS

Without proper infrastructure, the city is at risk of becoming a ghost town. This plan for infrastructure development is a first step in creating a resilient city that can withstand the challenges of the future.

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ALA

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Bayside Adapts

BOARD 1 OF 4	BACK TO MILL
Project Title	BACK TO MILL
Team/ID	NORTOLANDSCAPE ARCHITECTS

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ALA
LANDSCAPE ARCHITECTURE • URBAN DESIGN • INTERIOR
ARCHITECTURE • LANDSCAPE ARCHITECTS • FORMERLY ARCHITECTS

Ongoing Initiatives and Next Steps:

- Flooding Response Protocols
- Flood Map Amendments
- FEMA and US ACOE High Watermarks
- Planning and Development Review

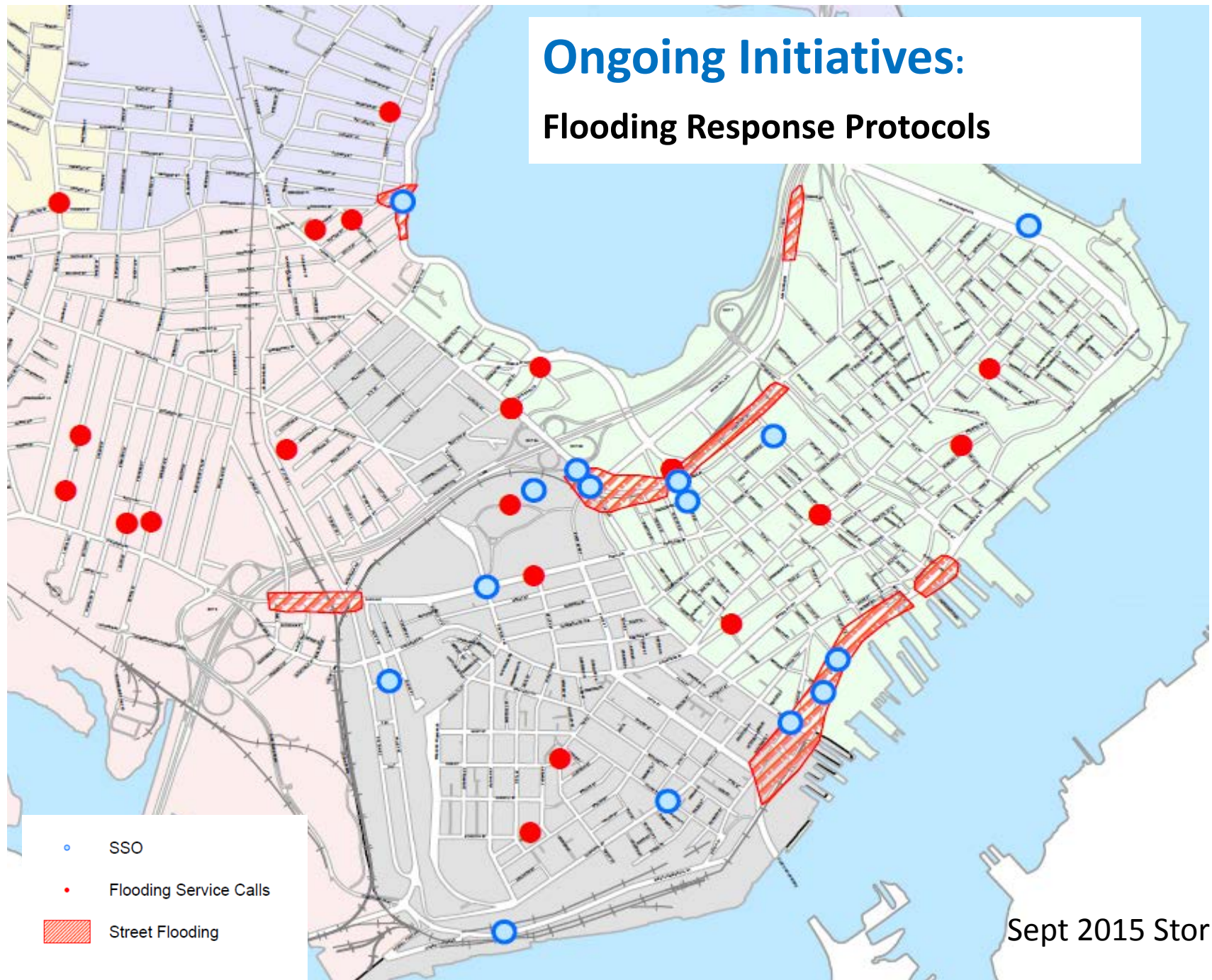
Land Use Code Rewrite

- DPW – Integration with ongoing work



Ongoing Initiatives:

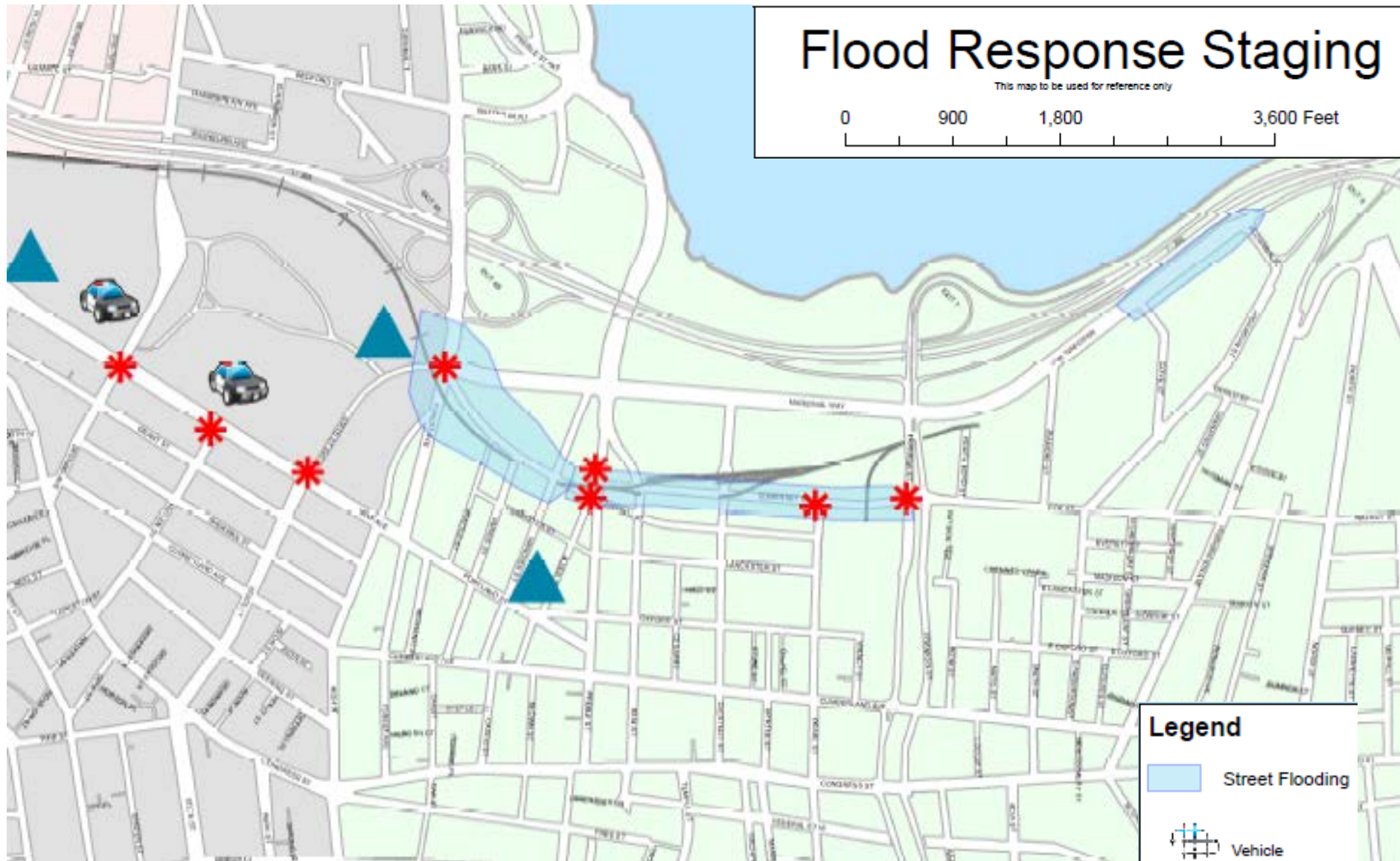
Flooding Response Protocols



Flood Response Staging

This map to be used for reference only

0 900 1,800 3,600 Feet



Legend

Street Flooding

Vehicle

Barricades

Staging Area

Coordinated Response in Flood Prone Areas



A proactive response to king tide flooding on Marginal Way

Ongoing Initiatives – Outreach and Education



Ongoing Initiatives – Outreach and Education

FEMA High Water Mark Initiative.

- Program was developed by FEMA in ***coordination with other federal and state agencies*** across the United States, in response to Hurricane Katrina in 2005
- Identify key High Water Mark site locations across the Bayside, such as ***Blizzard of 1978***
- Design and install ***kiosks/or signage*** illustrating past and anticipated flooding risk
- Enhance the ***public awareness*** surrounding flood risks



Ongoing Initiatives – Planning/Development

How will we use Bayside Adapts?

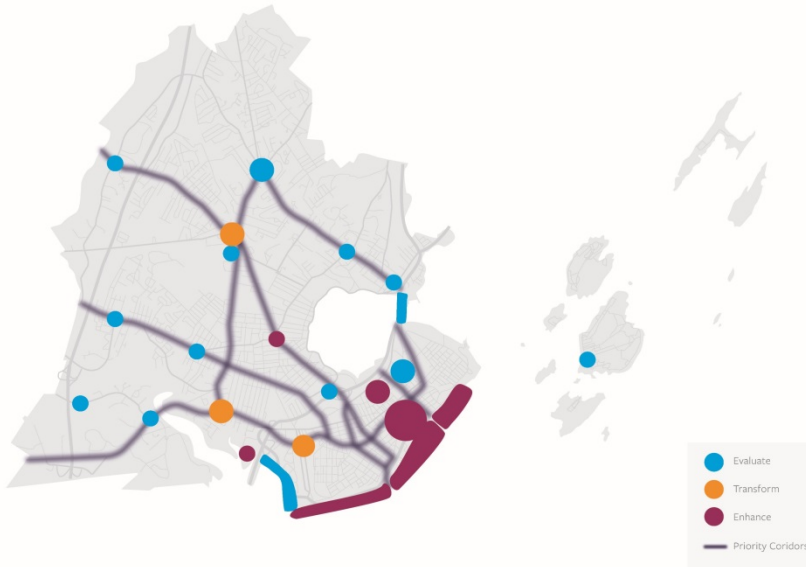
- City Planning staff is starting a project to rewrite Chapter 14 (the Land Use Code): the “ReCode Portland” project
- Chapter 14 has never been fully rewritten and updated in 50+ years
- ReCode Portland is an opportunity to update the code to look at new ways of living and values of Portland in 2017
- Based on Portland’s Plan 2030, the new Comprehensive Plan
- Additionally, work like Bayside Adapts will inform the new code

ReCode Portland:

Issues of Resiliency from Portland's Plan 2030

Bayside is identified as a growth area, but one with specific needs related to flooding, sea level rise, and subsurface conditions

CITY OF PORTLAND'S PRIORITY GROWTH AREAS
Draft 1/2017



Portland's Plan calls for a sustainable and resilient future that plans for climate change

PORTLAND'S PLAN 2030

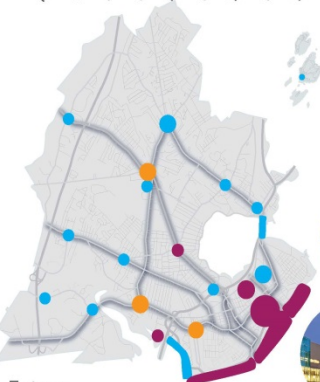
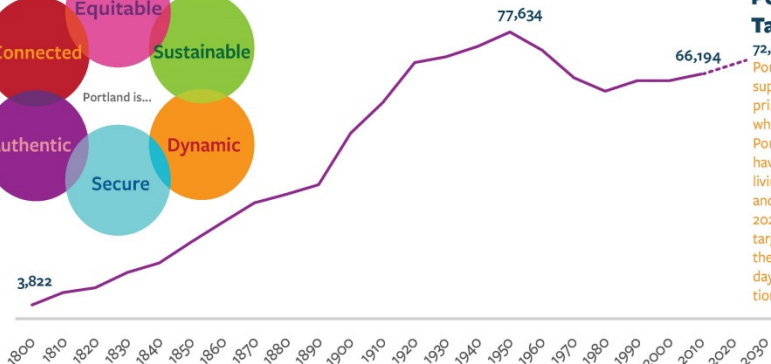
In 2017, the City Council adopted Portland's Plan. The plan is the result of a years-long conversation about the Portland we envision for the future.

Vision



Population Target

72,000
Portland's Plan supports the principle that all who work in Portland should have the option of living in Portland, and establishes a 2027 growth target of 75% of the current daytime population.



Future Land Use Principles

Portland's Plan anticipates that today's land use patterns will remain largely consistent in the future. The plan lays the foundation for focused population and employment growth in priority nodes and corridors, but also allows that incremental change will occur in all areas of the city.



One Portland. The form and characteristics of neighborhoods vary, but the city functions as a cohesive whole. No one area of the city carries all the expectations for accommodating development and all areas can expect appropriate City services and amenities.



Complete Neighborhoods. All residents, regardless of age, ability, or income, have access to the basic necessities of daily life – high quality and affordable housing, schools and other civic functions, food, open space, other amenities and services – within a walkable, bikeable distance.



Reinforce the Center. Downtown Portland remains at the center of the region's arts and cultural, economic, and civic health.



Support Our Waterfront. The City prioritizes an active port that is responsive to the economic and environmental demands of the 21st century while enhancing public access to the water.



Connect the Chain. Physically-integrated transportation systems, utilities, and open spaces provide an efficient and resilient structure for the city's growth.

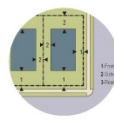
Up Next: RECODE

The ReCode is the process of bringing Portland's Plan one step closer to reality by translating it into zoning and land use standards.



What is the Code?

The 'code' is shorthand for the city's land use code: a set of regulations that apply to all of Portland's land. The code essentially determines how properties within the city are used and built upon.



Why ReCode?

One of the top recommendations of Portland's Plan is to develop a new, accessible land use code. When finished, the new code should provide a framework through which the vision of Portland's Plan is realized in physical terms.



What Does Portland's Plan Say About the ReCode?

Portland's Plan calls for the new code to better integrate land use with the city's transportation and environmental objectives. Among many ways to do this is by prioritizing housing and population growth in priority nodes and corridors.

Primary Outcomes

1 Streamline and simplify code

2 Create consistency across the code

3 Introduce graphics to improve legibility

4 Align the code with Portland's Plan

Process



Portland's Plan
The ReCode builds upon the input of over 3,000 stakeholders who were engaged in the process of developing Portland's Plan.



1 Community Conversations (Phase I)
The City will host a series of community conversations to hear what works in the current code, what needs to be improved, and how the code could better meet the vision of Portland's Plan.



2 ReStructure
Based on public input, an analysis of the existing code, and best practices, the City will reorganize the existing code to streamline and simplify it.



3 Community Conversations (Phase II)
Following the initial restructuring, the City will hold a second round of community conversations to gather public input on substantive changes to the code.



4 ReWrite
Ultimately, the City will rewrite elements of the code to better align with Portland's Plan and address substantive issues raised by public input and technical analysis.

Chapter 14 Anatomy of the Code

14-1	Title & Purpose
14-2	Definitions
14-3	Administration & Procedures
14-4	Zones
14-5	Uses
14-6	Dimensions
14-7	Subdivision
14-8	Site Plan
14-9	Historic Preservation
14-10	Housing
14-11	Signs
14-12	Access & Parking

Bayside Adapts: Ideas for Exploration in ReCode Portland

- Bayside is primarily in the B-7, B-5 and I-Lb zones
- B-7 allows – and even requires – significant height
- B-5 is a relatively traditional business district
- I-Lb is a light industrial zone that encourages “makers spaces” and the contemporary economy (breweries, food production and fabrication)
- B-7 and B-5 zones may need incentives and/or requirements that plan for sea level rise and flooding
- Concepts will include looking and floor/ceiling clearances on the first floor, ground level materials and uses, and location of utilities

Department of Public Works/Water Resources

Response to Bayside Adapts

- Water Resources will continue to include Sea Level Rise data in all sewer and stormwater design projects through the design engineer consultant, making any recommended adjustments to existing systems required within that design.
- Move forward with replacing old tide gates
- Continue to aggressively clean and maintain the combined sewer system to maximize capacity during smaller rain events.
- Continue to aggressively sweep the Bayside neighborhood to maximize stormwater system capacity and drainage.
- Continue to manage events that have a high tide influence along with heavy localized flooding rains.
- Continue to promote stormwater technical design standards, in collaboration with the Planning Dept, that reduce the impacts of runoff from development and redevelopment projects

Future Decisions

- Accommodate water
- Elevate infrastructure
- Armor against water
- Retreat
- ???????

Bayside Adapts

DESIGN CHALLENGE
PORTLAND, MAINE
FEBRUARY–MAY 2017

