



Assess Existing Pumping Capacities, Permits and Current and Future Vulnerabilities

Massachusetts Bay Transportation Authority



Scope of Work

1 - Review Existing Permit Information



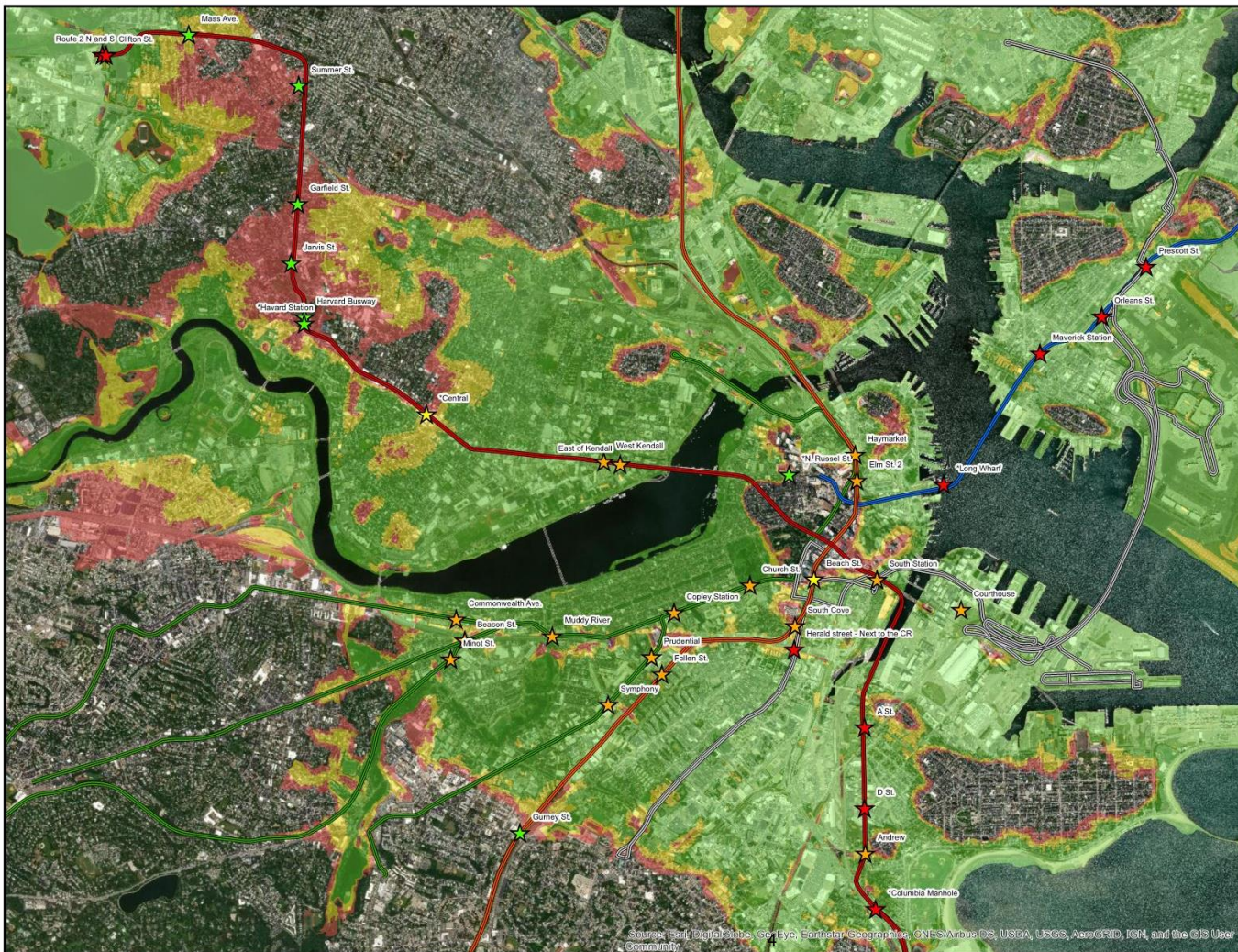


Scope of Work

2 – Identify Floodplains and Wetlands



Map Document: C:\Users\mact6262\Documents\ArcGIS\MapXpress\MBTA_Pumps_Budget.mxd | 1/28/2019 7:46:28 AM | MCD6262606



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

MBTA GREATER BOSTON AREA, MA PUMP RESILIENCY & CLIMATE CHANGE HURRICANE SURGE MAP

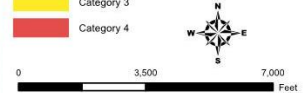
Legend

- Pump Room**
- ★ Inundation with Category 1 Hurricane (10)
 - ★ Inundation with Category 2 Hurricane (17)
 - ★ Inundation with Category 3 Hurricane (2)
 - ★ Inundation with Category 4 Hurricane (8)

- BLUE LINE
- GREEN LINE
- ORANGE LINE
- RED LINE
- SILVER LINE

Hurricane Inundation Zones

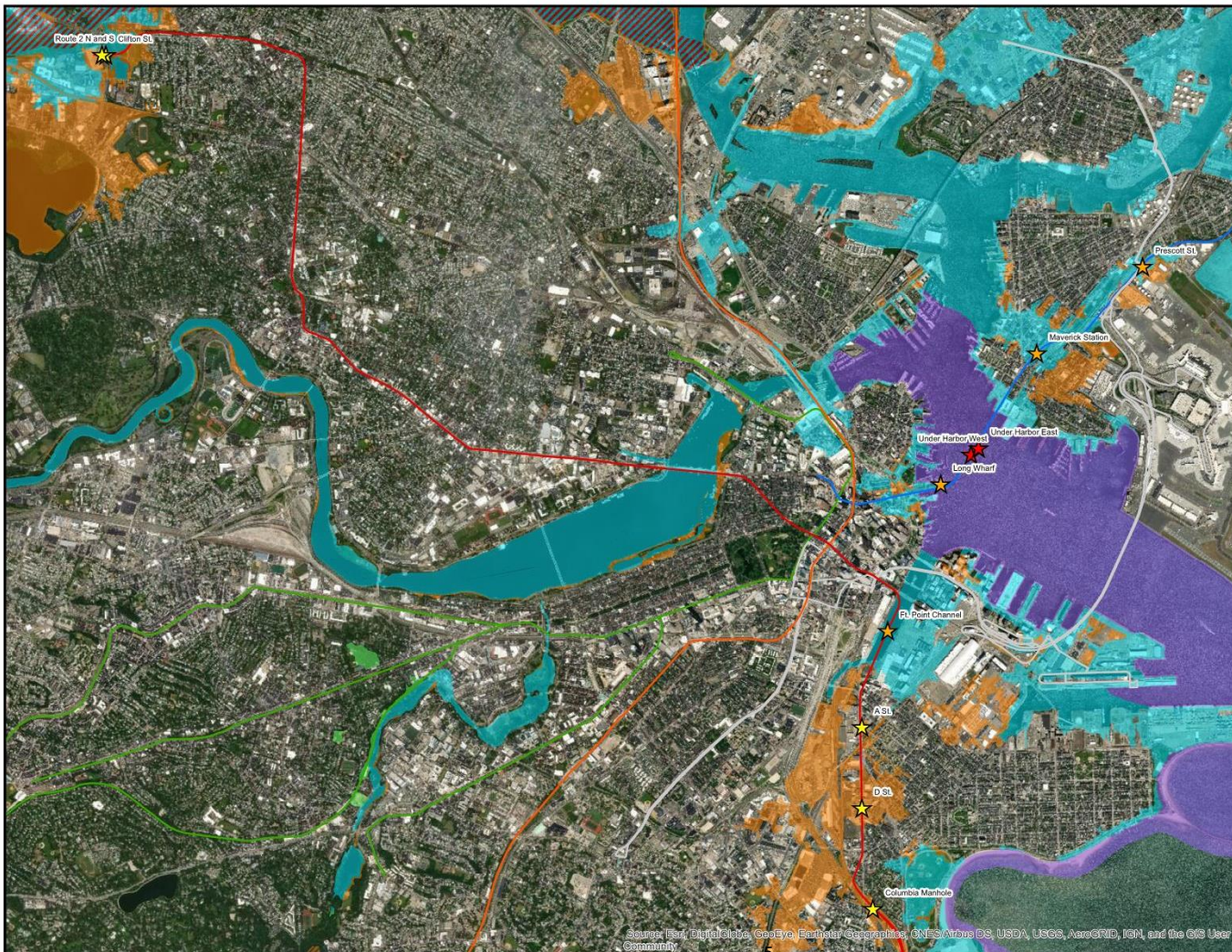
- Hurricane Category**
- Category 1
 - Category 2
 - Category 3
 - Category 4



Mott MacDonald developed this map using publicly-available geospatial datasets from various sources, including but not limited to MassGIS, MassDOT, NWE, and USGS. MassGIS distributes datalayers developed by ERIECA and its agencies, as well as data from Federal agencies. These datalayers include those developed by the agencies for the purpose of enforcing environmental regulations or in support of various types of environmental analysis. Responsibility for maintaining and updating these datalayers remains with the agencies that produced them, as indicated in the individual descriptions. Many of these datalayers were compiled at "Quadr" or larger scale and are suitable for spatial analysis using the MassGIS base map data. Mott MacDonald assumes no liability for the accuracy of the data displayed on this map.



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MBTA GREATER BOSTON AREA, MA PUMP RESILIENCY & CLIMATE CHANGE FLOOD ZONE MAP

Legend

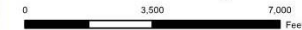
Flood Zone

- 100-Year (4)
- 100-Year with Wave Action (2)
- 500-Year (5)

FEMA National Flood Hazard Layer

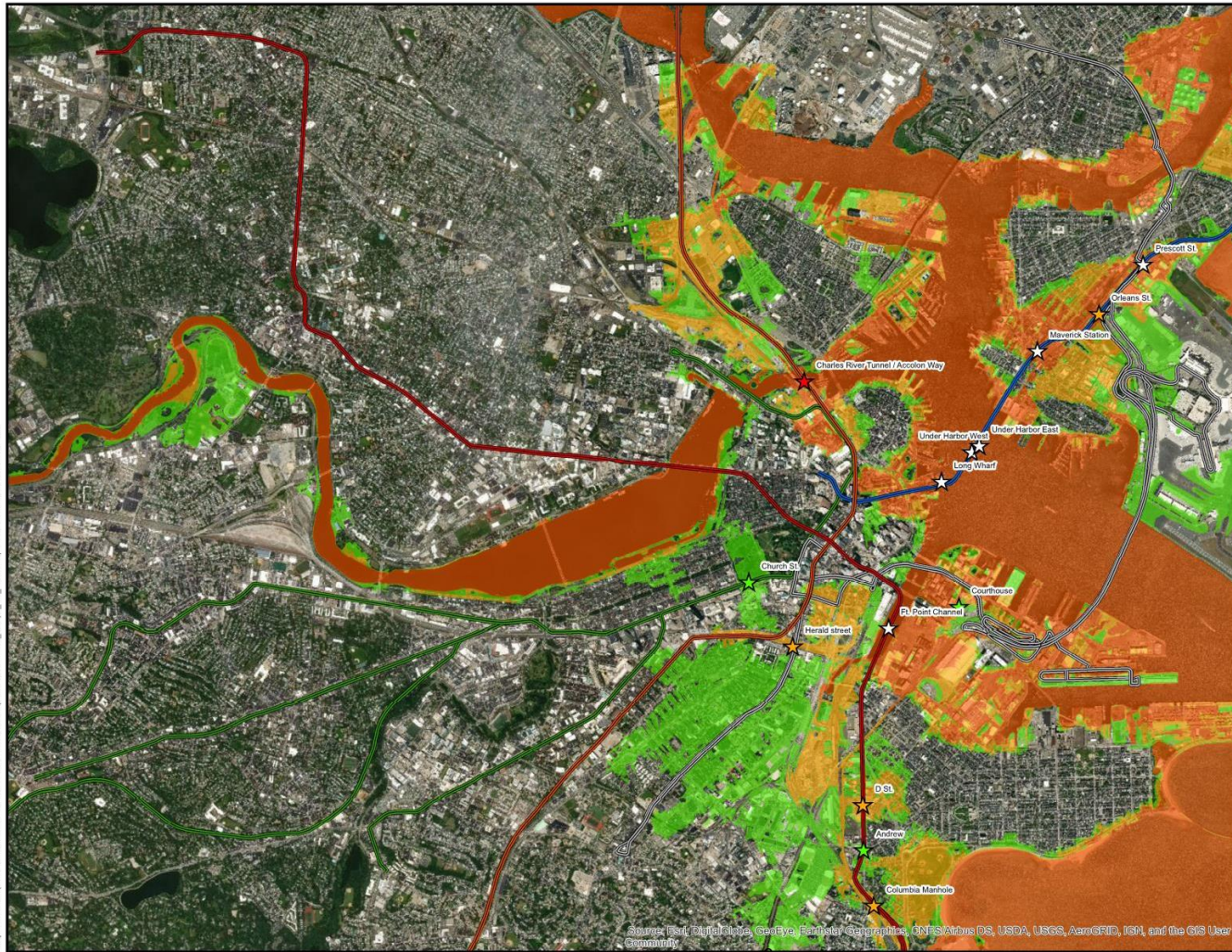
Flood Zone Designations

- A: 1% Annual Chance of Flooding, no BFE
- AE: 1% Annual Chance of Flooding, with BFE
- AE: Regulatory Floodway
- AH: 1% Annual Chance of 1-3ft Ponding, with BFE
- AD: 1% Annual Chance of 1-3ft Sheet Flow Flooding, with Depth
- VE: High Risk Coastal Area
- D: Possible But Undetermined Hazard
- X: 0.2% Annual Chance of Flooding
- X: 1% Drainage Area < 1 Sq. Mi.
- X: Reduced Flood Risk due to Levee
- Area Not Included
- Area with no DFRM - Paper FRMs in Effect
- BLUE LINE
- GREEN LINE
- ORANGE LINE
- RED LINE
- SILVER LINE



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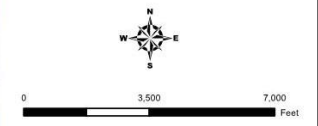


Source: Esri, DigitalGlobe, GeoEye, Earthstar* Imagery, CNRS/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

MBTA GREATER BOSTON AREA, MA PUMP RESILIENCY & CLIMATE CHANGE FUTURE FLOOD RISK MAP (BOSTON HARBOR FLOOD RISK MODEL)

Legend

- Pumps in 100-Yr Flood Zone (2019) (6)
- Pumps in 100-Yr Flood Zone with 9-in SLR (2030) (1)
- Pumps in 100-Yr Flood Zone with 21-in SLR (2050) (4)
- Pumps in 100-Yr Flood Zone with 36-in SLR (2070) (3)
- 100-Yr Flood Zone with 9-Inch Sea Level Rise (2030)
- 100-Year Flood Zone with 21-Inch Sea Level Rise (2050)
- 100-Year Flood Zone with 36-Inch Sea Level Rise (2070)
- BLUE LINE
- GREEN LINE
- ORANGE LINE
- RED LINE
- SILVER LINE




Mott MacDonald developed this map using publicly-available geospatial datasets from various sources, including but not limited to MassGIS, MassDOT, NMI, and USGS. MassGIS distributes datalayers developed by EOGEEA and its agencies, as well as data from Federal agencies. These datalayers include those developed by the agencies for the purpose of enforcing environmental regulations or in support of various types of environmental analyses. Responsibility for maintaining and updating these datalayers remains with the agencies that produced them, as indicated in the individual descriptions. Many of these datalayers were compiled at "Quasi" or larger scale and are suitable for spatial analysis using the MassGIS base map data. Mott MacDonald assumes no liability for the accuracy of the data displayed on this map.

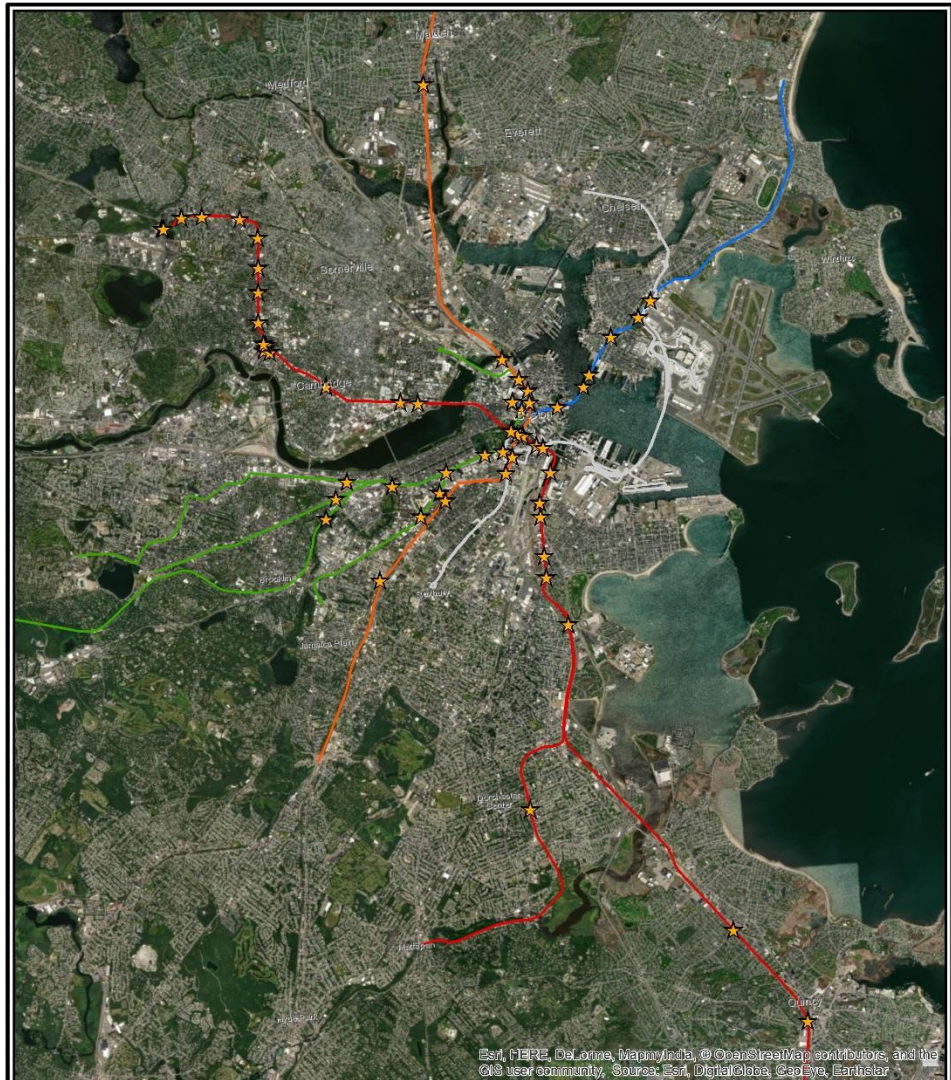


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Scope of Work

3 – Assess Existing
Conditions and Examine
Vulnerability Data

A decorative graphic on the right side of the slide consists of two overlapping circles. The top circle is white and the bottom circle is green, both set against a solid green background.

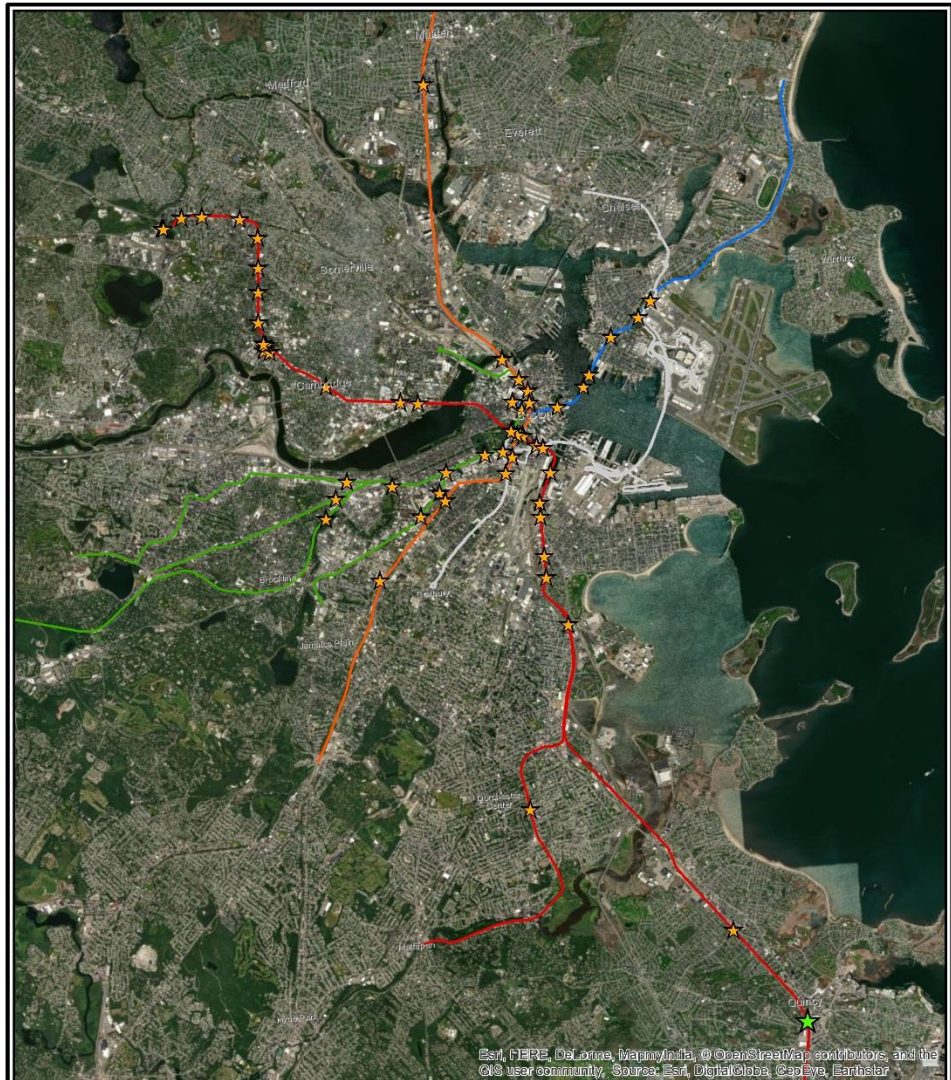


Surveyed

51

Total pump stations that are located on Green, Red, Orange, Blue, and Silver Lines

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the
CN user community. Source: Esri, DigitalGlobe, GeoEye, Earthstar



51

Total pump stations

9

Green Line

8

Blue Line

1

Silver Line

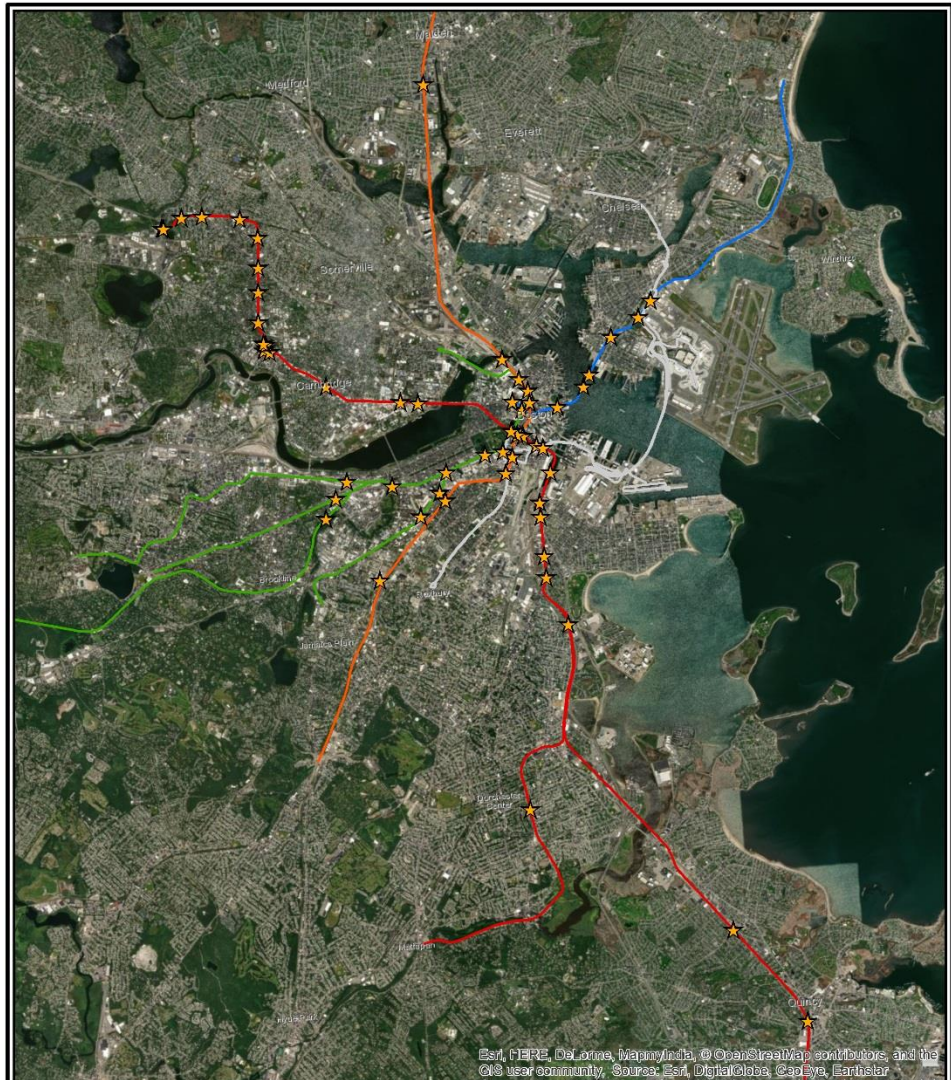
9

Orange Line

24

Red Line

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Total of

104

Pumps

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Scope of Work 4 – Capture Site Survey Information



Investigation Procedure

- Reviewed pump rooms
- Survey apps
- Collector app
- 360 photos



Survey123 App



- Survey123 is an app or website that you can fill out questions you'd like to answer during site visits/surveys
- Mott MacDonald used an iPad as collecting data tool
- Built in camera allows to take pictures to put in the forms

Survey123 Forms Consisted of



- Condition of drainage system (inlets, grating, pipe, etc.)
- Condition of discharge outlet structure/pipe (if location is known and visible).
- General condition of pipe, valves and electrical equipment.
- Signs condition of pipe, valves, and electrical equipment.
- Signs of excessive infiltration, structural defects or other apparent deficiencies
- Last recorded maintenance

Survey123 Forms Consisted of



- Pump discharge locations and backflow protection based on visual observation and available record drawings.
- Record electrical equipment type and location likely impacted during flooding.
- Record pump control panel location.
- Identify where possible backup/standby power supply can be located.
- Record rated pump capacities, manufacturer, model, motor HP, voltage

Survey123 Forms Consisted of

- Inventory vulnerability data for MBTA's drainage pumping system assets such as:
 - Station or facility served and pump location
 - Approximate elevation of assets (pumps, motors, electrical equipment, controls, SCADA, etc.)
 - Resiliency of assets (type of equipment, impact from submergence)
 - Age of assets
 - Any existing flood protection measures
 - Role of pump(s)
 - Sources of water influent to the pump station (drainage pipes, culverts, surface, infiltration)
 - Pump discharge location and backflow protection



360 photos

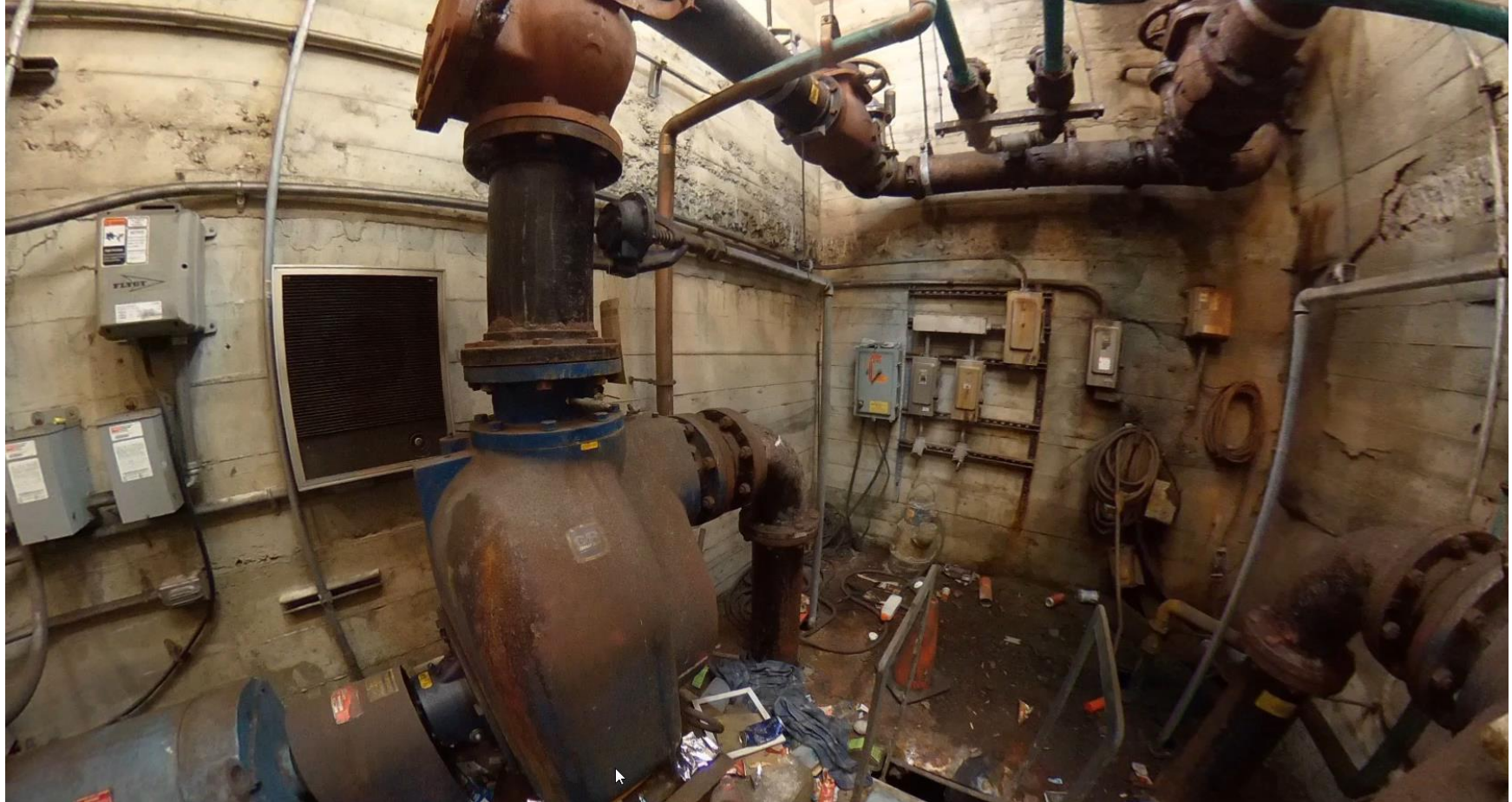


- Used 360 camera
- Wi-fi compatible to enable us to use it through iPad
- Gives advantages to “re-visit” the pump rooms and examine the details in 360



Prudential in **Green Line**
Nearest station: Copley Station.

Enter by riding the green line and getting off at the pump room in the tracks.



Symphony in **Green Line**
Nearest station: Symphony

400ft down the ROW platform. Enter through a single door on the ROW



Harvard Station in Red Line
Nearest station: Harvard Station

Located below abandoned station. Enter through maintenance area across outbound tracks and through cable bundle.

Findings and Recommendations

Survey Results

Condition State 1 (Good)	Condition State 2 (Fair)	Condition State 3 (Poor)	Condition State 4 (Severe)	Condition State 5 (Undefined)
<ul style="list-style-type: none"> All pumps function with no leaks, vibrations, unusual noises. Little to no corrosion present. No notable equipment distresses 	<ul style="list-style-type: none"> All pumps function with minimal noise, vibrations, and leaks. Some corrosion present. Check or gate valve failed. Issue with accessibility 	<ul style="list-style-type: none"> At least one installed pump functions. Presence of noise, vibrations, and leaks High levels of corrosion Pump nearing end of life. 	<ul style="list-style-type: none"> Pumps not present or not in operable state. Severe leaks present. 	<ul style="list-style-type: none"> Pump room site under construction or not accessible at all.
Total: 0	Total: 4	Total: 27	Total: 18	Total: 2



E-Report

4 Survey Results

4.1 Condition State One

Condition State	Line	Pump Room Name	Condition Summary	Survey Forms	360 Pics	Final Recommendation and Findings
1 Good Condition	NA	NA	NA	NA	NA	NA

4.2 Condition State Two

Condition State	Line	Pump Room Name	Condition Summary	Survey Forms	360 Pics	Final Recommendation and Findings
2 Fair Condition	Blue	Under Harbor East	Pumps in good condition, noise present	6.2.3.7	6.3.3.7	5.1.1
	Orange	Haymarket		6.2.2.6	6.3.2.6	5.1.2
	Red	Mass Ave	Pumps in fair condition, noise present, minor corrosion	6.2.4.17	6.3.4.17	5.1.3
	Red	Welles Ave	Pumps in fair condition, noise present, leaks present, and shaking	6.2.4.23	6.3.4.23	5.1.4

4.3 Condition State Three

Condition State	Line	Pump Room Name	Condition Summary	Survey Forms	360 Pics	Final Recommendation and Findings
3 Poor Condition	Blue	Government Center	Pump 1 did not operate	6.2.3.1	6.3.3.1	5.2.1
	Blue	Prescott St	Pump 2 is corroded	6.2.3.6	6.3.3.6	5.2.2
	Blue	Under Harbor West	Both pumps in poor condition, rusted and corroded	6.2.3.8	6.3.3.8	5.2.3
	Green	Beacon St	Both pumps operate, but very corroded and leaks present.	6.2.1.1	6.3.1.1	5.2.4
	Green	Church St	Pump 1 is very corroded but operates. Pump 2 does not operate because motor is not hooked up	6.2.1.2	6.3.1.2	5.2.5
	Green	Copley Station	Pump 1 did not operate. Both pumps in poor condition.	6.2.1.4	6.3.1.4	5.2.6

Condition State	Line	Pump Room Name	Condition Summary	Survey Forms	360 Pics	Final Recommendation and Findings
Green	Muddy River		Both pumps very corroded, loud noise present.	6.2.1.7	6.3.1.7	5.2.7
Orange	Charles River/Accolon Way		Pump 2 did not operate. Both pumps in poor condition.	6.2.2.2	6.3.2.2	5.2.8
Orange	Follen St.		Pump 3 did not operate.	6.2.2.4	6.3.2.4	5.2.9
Orange	Gurney St.		Pump 1 did not operate, unusual noise present	6.2.2.5	6.3.2.5	5.2.10
Orange	Medford Underpass		All pumps run, but pump 2 is in very poor condition.	6.2.2.8	6.3.2.8	5.2.11
Red	A St.		Pump 2 did not operate.	6.2.4.1	6.3.4.1	5.2.12
Red	Andrew		Pump 1 did not operate. Motor runs but not engaging with pump	6.2.4.2	6.3.4.2	5.2.13
Red	Central		Both pumps are very corroded. Pump 2 is missing motor	6.2.4.3	6.3.4.3	5.3.14
Red	Clifton St		Pump 1 did not operate.	6.2.4.4	6.3.4.4	5.2.15
Red	D St.		Both pumps operate, but pump 1 is in very poor condition.	6.2.4.6	6.3.4.6	5.2.16
Red	East of Kendall		Both pumps operate, but they're nearing their end life.	6.2.4.8	6.3.4.8	5.2.17
Red	Garfield		Pumps and motors are all in poor condition. Wire on the ground with water, very dangerous	6.2.4.10	6.3.4.10	5.2.18
Red	Granite		Both pumps operate, but they're in poor condition. Very corroded	6.2.4.11	6.3.4.11	5.2.19
Red	Harvard Busway		Pump 1 severely corroded. Both pumps in very bad condition	6.2.4.12	6.3.4.12	5.2.20
Red	Harvard Station		Pump 2 does not operate, very poor condition and out of place.	6.2.4.14	6.3.4.14	5.2.21
Red	Hawley St.		Pump 2 does not operate, both pumps in severe condition	6.2.4.15	6.3.4.15	5.2.22
Red	Porter Station		Pump 2 did not operate	6.2.4.19	6.3.4.19	5.2.23
Red	Route 2N&S		Pump 1 did not operate. Other pumps in poor condition, corroded	6.2.4.20	6.3.4.20	5.2.24
Red	South Station		Pumps in fair condition, minor corrosion. One of pumps not in operation.	6.2.4.21	6.3.4.21	5.2.25
Red	West Kendall		Pump 2 did not operate. Pump 1	6.2.4.24	6.3.4.24	5.2.26

5 Recommendations and Findings

5.1 Condition State 2 recommendations

5.1.1 Under Harbor East – Blue Line

5.1.1.1 Environmental and Permitting Scope

- TBD

5.1.1.2 Civil Scope

- Record drawings available (M-A-25044 through 25047). East Pump station 321+25 discharges to 6" pipe to station 309+27 then up to SMH structures on Marginal Street. See [Appendix 6.5.3.7](#)

5.1.1.3 Pump room Scope

- Doors shall be provided with a lock
- New check and gate valves shall be provided
- New belts shall be provided
- Discharge system seal shall be provided
- Upgrade the control system and provide remote monitoring and control
- Pump room need structural repairs.

5.1.2 Haymarket – Orange Line

5.1.2.1 Environmental and Permitting Scope

- TBD

5.1.2.2 Civil Scope

- Record plans for review not available.

5.1.2.3 Pump Room Scope

- Provide new gate valves
- New belts shall be provided
- Upgrade the control system and provide remote monitoring and control

5.1.3 Mass Ave – Red Line

5.1.3.1 Environmental and Permitting Scope

- TBD

5.1.3.2 Civil Scope

- No drawings provided. See [Appendix 6.5.4.17](#)

5.1.3.3 Pump Room Scope

- Replace/repair pump room access door
- Provide link seal to the vent pipe.
- Provide new check valves and belts.
- Vent pipe to wet well shall be replaced.
- Upgrade controls to provide remote monitor/control.

5.1.4 Welles Ave. – Red Line

5.1.4.1 Environmental and Permitting Scope

- TBD

5.1.4.2 Civil Scope

- Per DRT Section 3, Plan No. 18190, 2-10" WI pump discharges directed out of pump well to DMH in Wells Ave. (inv.=155.00) with 18" SD outlet (inv.=154.90). 1-10" WI pump discharges directed out of pump well to DMH in Wells Ave. with 10" VC SD outlet (inv.=153.80). See [Appendix 6.5.4.23](#)

5.1.4.3 Pump Room Scope

- Repair leakage.
- Maintain pump and change belts and check bearings. Pump may have some cavitation.
- Structural repair shall be provided.
- Upgrade controls to provide remote monitor/control

5.2 Condition State 3 Recommendations

5.2.1 Government Center – Blue Line

5.2.1.1 Environmental and Permitting Scope

- TBD

5.2.1.2 Civil Scope

- Record drawings available sheet nos. 1, 2, 156, 157, 19, 54, 66F, 304-314, 371,376, of 401. 18" DI Class 55 discharge pipe shown on Sheet No. 54 passes through Durham Street. The continuation discharged pipe missing possibly shown on Sheet Nos. 51-53. See [Appendix 6.5.3.1](#)

5.2.1.3 Pump Room Scope

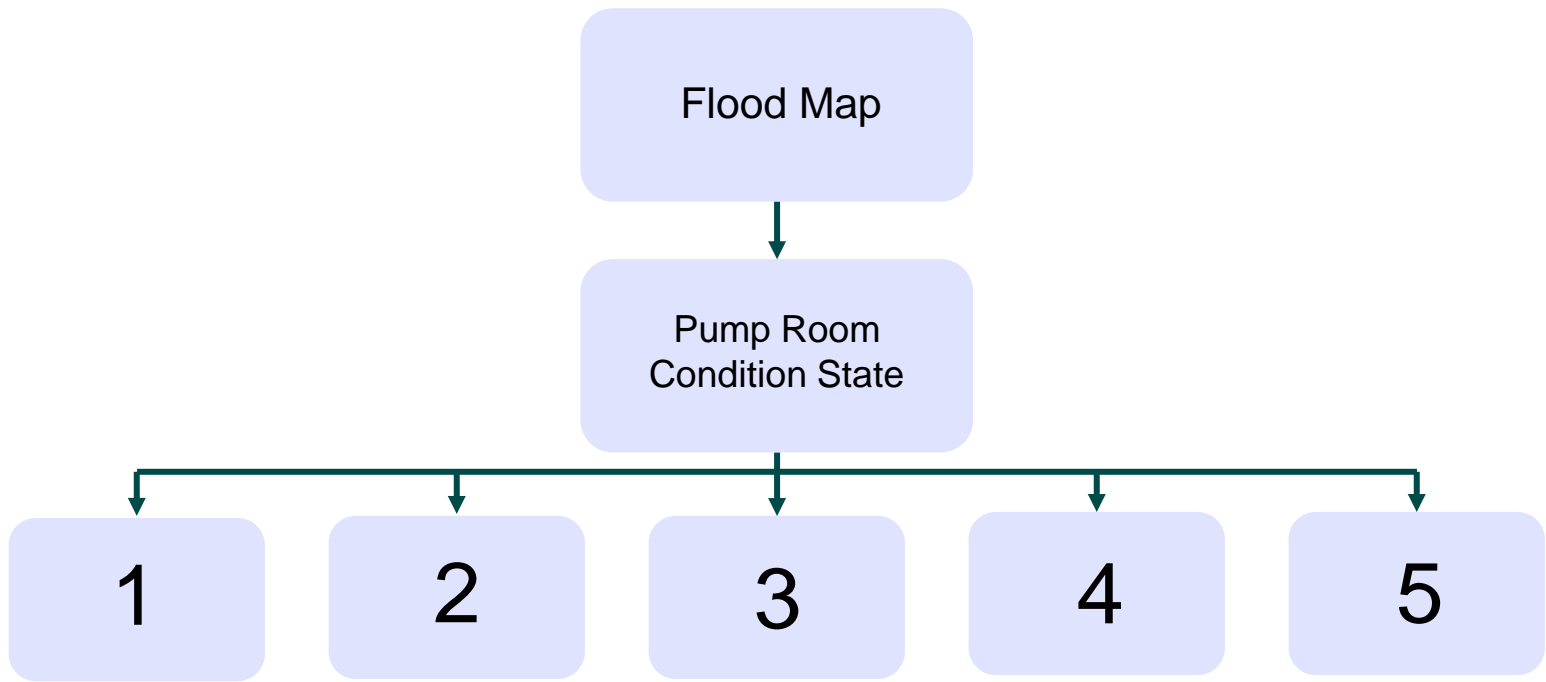
- One of the pumps needs to be investigated and replaced.
- Pipe penetrations requires seals.
- Pipes need to be replaced due to corrosion
- Upgrade the control system and provide remote monitoring control (future upgrade)
- Structural repair shall be provided.

E-Report Navigation





Next Step?



Note: Equipment is nearing end life.

Maintenance activities

Design and construction

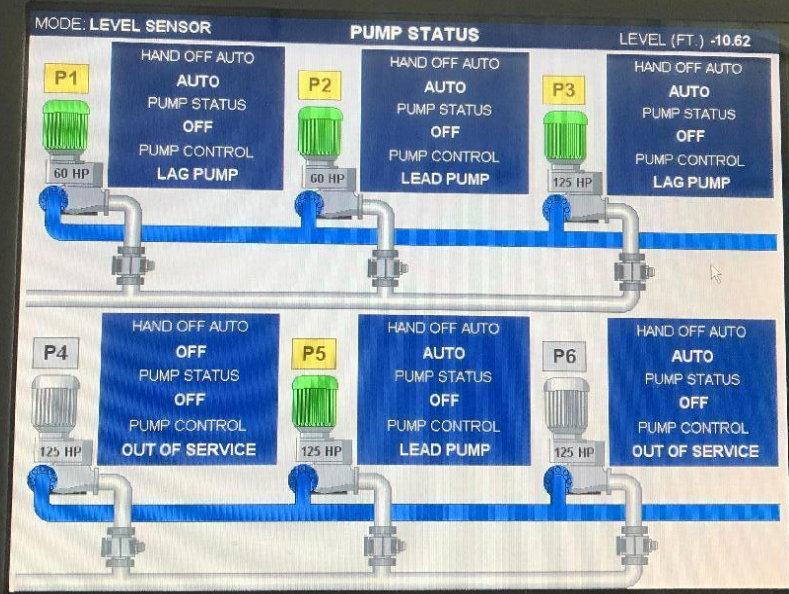
Global Recommendations

- GIS map
- Remote control/monitor
- Security
- Asset Database

Gurney St.

- Orange Line
- Nearest Station: Roxbury Crossing
- Enter through a hatch located next to parking lot on street level.





MODE: LEVEL SENSOR

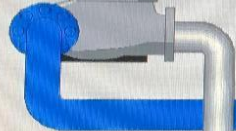
PUMP 1 STATUS

LEVEL (FT.) -10.60

PUMP 1



60 HP

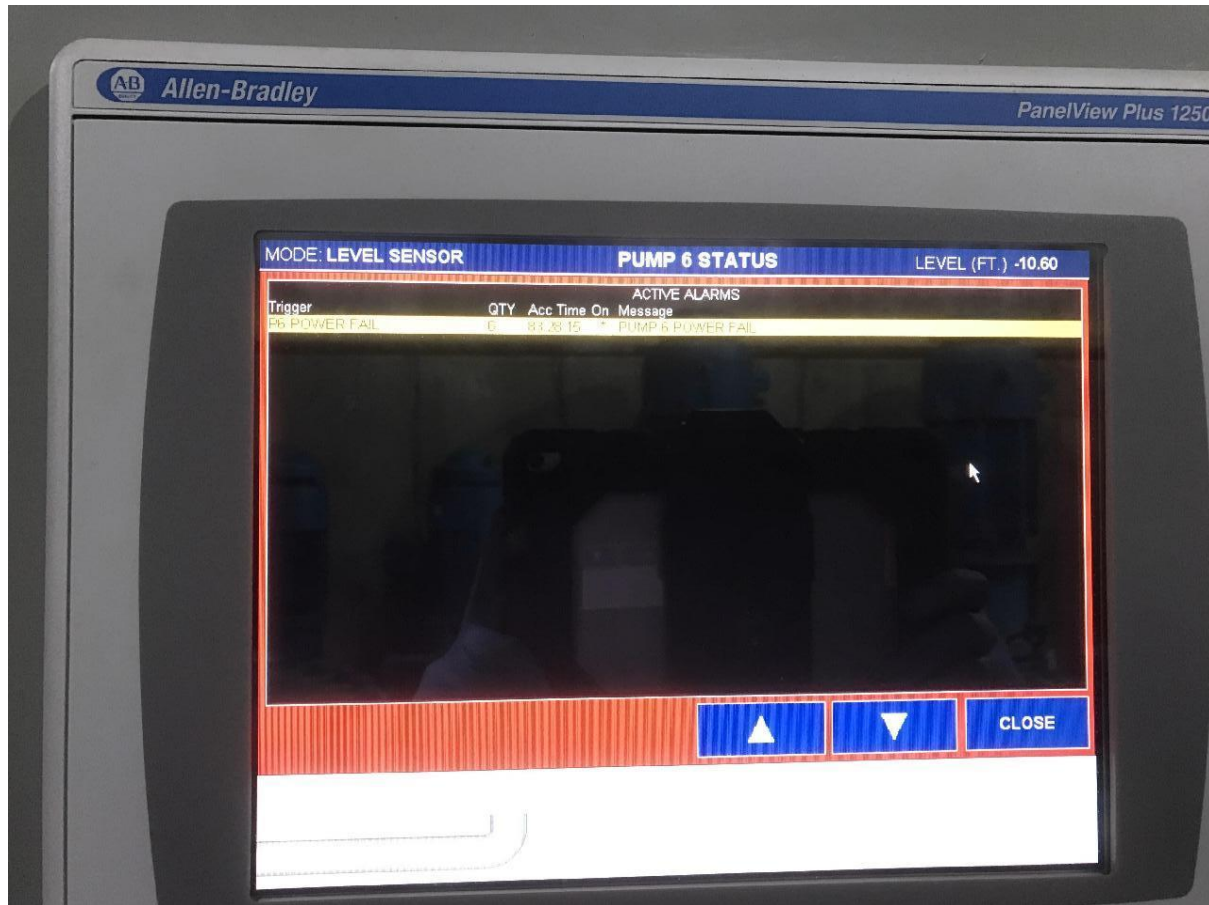


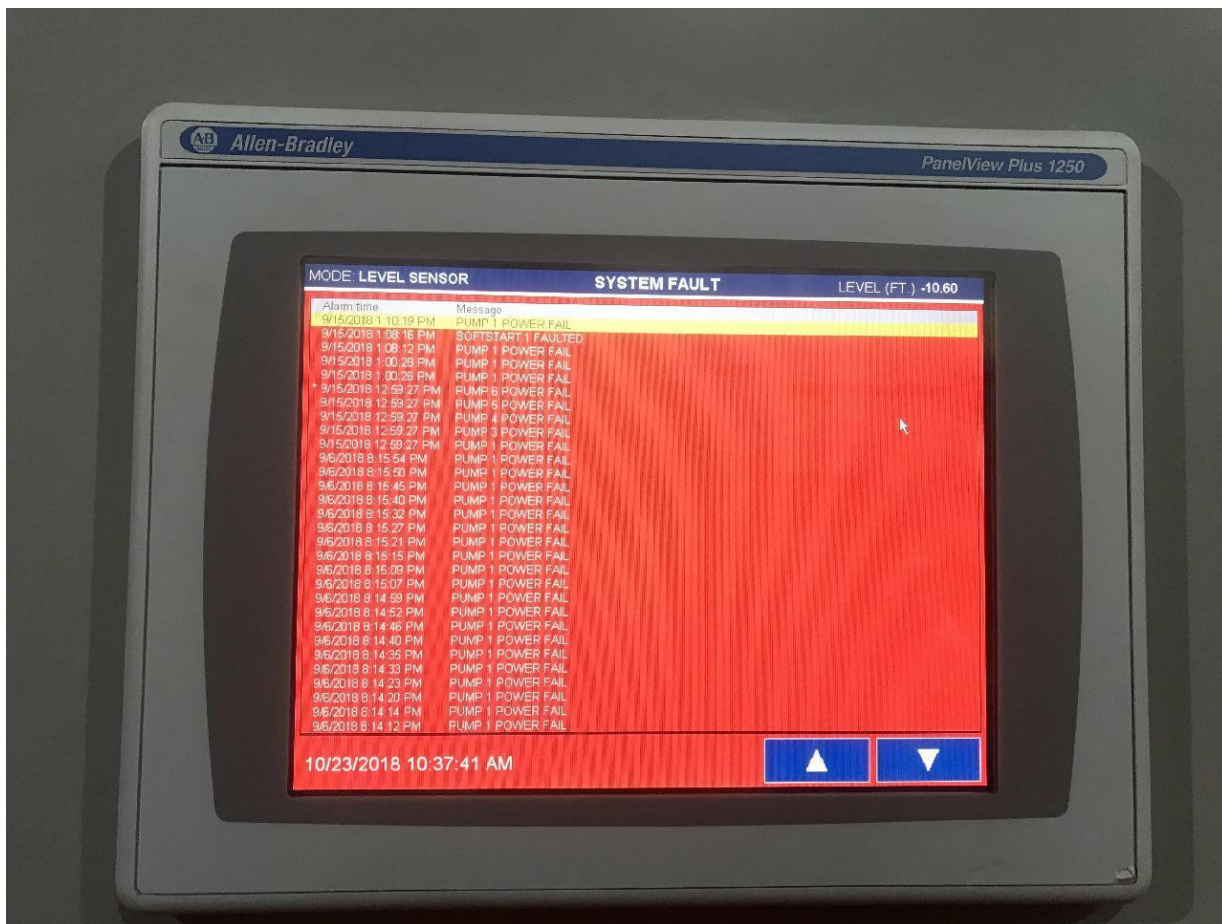
PUMP 1 FAULT HISTORY		
Alarm time	Acknowledging time	Message
9/15/2018 1:10:19 PM		PUMP 1 POWER FAIL
9/15/2018 1:08:16 PM		SOFTSTART 1 FAULTED
9/15/2018 1:08:12 PM		PUMP 1 POWER FAIL
9/15/2018 1:00:26 PM		PUMP 1 POWER FAIL
9/15/2018 1:00:26 PM		PUMP 1 POWER FAIL
9/15/2018 12:59:27 PM		PUMP 1 POWER FAIL
9/8/2018 8:15:54 PM		PUMP 1 POWER FAIL
9/8/2018 8:15:50 PM		PUMP 1 POWER FAIL
9/8/2018 8:15:45 PM		PUMP 1 POWER FAIL
9/8/2018 8:15:40 PM		PUMP 1 POWER FAIL
9/8/2018 8:15:33 PM		PUMP 1 POWER FAIL
9/8/2018 8:15:27 PM		PUMP 1 POWER FAIL
9/8/2018 8:15:21 PM		PUMP 1 POWER FAIL



PUMP 1 STATUS: 60 HP

HAND OFF AUTO PUMP STATUS PUMP CONTROL
AUTO OFF LAG PUMP



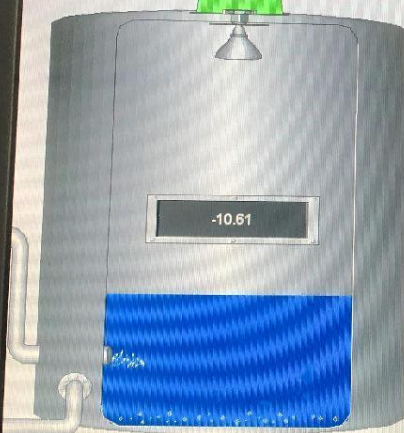


MODE: LEVEL SENSOR

LEVEL STATUS

LEVEL (FT.) -10.61

LEVEL MODE



LEVEL SENSOR

- 4.25 HIGH LEVEL ALARM
- 5.25 125 HP LAG / LAG ON LEVEL
- 7.25 125 HP LAG / LAG OFF LEVEL
- 5.75 125 HP LAG ON LEVEL
- 8.00 125 HP LAG OFF LEVEL
- 6.75 125 HP LEAD ON LEVEL
- 11.30 125 HP LEAD OFF LEVEL
- 7.75 60 HP LAG LEVEL ON
- 12.30 60 HP LAG LEVEL OFF
- 8.25 60 HP LEAD LEVEL ON
- 13.30 60 HP LEAD LEVEL OFF
- 14.50 LOW LEVEL ALARM

BACKUP FLOAT

- 3.75 HIGH FLOAT BACKUP
- 6.75 LAG FLOAT BACKUP
- 8.25 LEAD FLOAT BACKUP
- 13.25 OFF FLOAT BACKUP
- 14.50 LOW FLOAT BACKUP



Thank you

