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Town of Fairhaven, Massachusetts

Sewer Pump Station Vulnerability and Adaptation Report

April 2021

Prepared for:

Town of Fairhaven, Massachusetts

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Acronyms

ACFEP	annual coastal flood exceedance probability
BFE	base flood elevation
BPW	Board of Public Works
BRIC	Building Resilient Infrastructure and Communities
DFE	design flood elevation
ENR CCI	Engineering News Record Construction Cost Index
EOEEA	Massachusetts Office of Energy and Environmental Affairs
FEMA	Federal Emergency Management Agency
HMGP	Hazard Mitigation Grant Program
MassDOT	Massachusetts Department of Transportation
MC-FRM	Massachusetts Coast Flood Risk Model
MVP	Municipal Vulnerability Preparedness
NFHL	National Flood Hazard Layer
NEIWPCC	New England Interstate Water Pollution Control Commission

1. Introduction

1.1 Background

The Town of Fairhaven, Massachusetts was the recipient of a Municipal Vulnerability Preparedness (MVP) planning grant from the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). The expanded scope of the Town's MVP planning grant included a task to conduct targeted vulnerability and adaptation assessments for up to five assets considered to be at high risk to impacts from natural hazards and climate change, as identified through the Town's MVP planning process. The Town's screening and selection process resulted in the identification of the following high-risk assets for the targeted assessment (see Figure 1):

- Abbey Street Pump Station;
- Boulder Park Pump Station;
- Manhattan Avenue Pump Station; and
- Pilgrim Avenue Pump Station (including a seawall at the pump station site).

This report summarizes the high-risk asset selection process, the vulnerability assessment conducted for the assets (as related to sea level rise and coastal flooding), identification of potential flood mitigation / adaptation measures, and recommended next steps regarding protection of these assets.

1.2 Limitations and Assumptions

The findings presented in this report reflect a high-level vulnerability assessment that was restricted by available project funding and limited to the use of best available data, and no structural assessments were performed. No design guidance is expressed or implied with respect to the flood mitigation / adaptation measures that are recommended for further consideration. It is assumed that the Town will conduct additional analyses and design efforts to refine the flood mitigation / adaptation measures that may ultimately be selected for implementation.

2. Selection of Top High-Risk Community Assets

2.1 MVP Planning Process

The Town of Fairhaven received an MVP planning grant from EOEEA which the Town used to conduct a participatory, community-based process to reduce risk and build resilience to climate change. This workshop-based planning process resulted in the identification of more than 50 possible community actions to improve resilience across six categories of community actions, including: local plans and regulations, structure and infrastructure projects, nature-based solutions, education and awareness, and emergency preparedness. Following a large group discussion on the highest priority actions, each workshop participant was given an opportunity to vote on the specific actions they felt should be among the top recommendations to improve resilience in Fairhaven. Results of the final voting exercise indicated that the following actions should be considered as the top overall recommendations for Fairhaven.

- Vulnerability and Adaptation Assessments for Sewer Pump Stations;
- Resilience Improvements for Critical Roadways;
- Salt Marsh Accretion Assessment;
- Review and Update of Town Bylaws for Resilience;
- Route 6 Culvert Upgrade; and
- Vulnerability and Viability Assessment for New Public Safety Complex.

Legend

PS Sewer Pump Station

Town Boundaries

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 1

Locus Map

0 2,500 5,000 Feet

1 inch = 5,000 feet

AECOM

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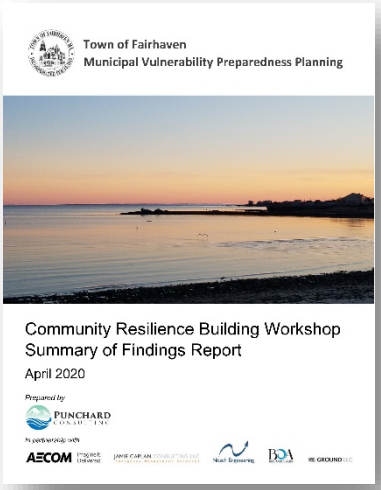
The MVP planning process and identification of the top overall recommendations is detailed in the Town's *Community Resilience Building Workshop Summary of Findings Report* (Punchard Consulting 2020).



Results from the MVP planning process were shared with the Town's MVP Steering Committee, and it was determined that the targeted vulnerability assessments would be conducted for the following high-risk assets.

- Four Sewer Pump Stations: The existing and future vulnerability of Fairhaven's sewer pump stations was a major concern for MVP workshop participants, particularly regarding older (pre-2000) pump stations and/or those located in identified coastal flood hazard areas. This concern was also identified in the Town's hazard mitigation plan which recommended site-specific vulnerability assessments for 10 specific pump stations considered at high-risk in the 2014 Technical Report *Climate Change Vulnerability Assessment and Adaptation Planning Study for Water Quality Infrastructure in New Bedford, Fairhaven and Acushnet* (Punchard Consulting 2018; SeaPlan 2014). MVP workshop participants expressed strong support for confirming these risk determinations and evaluating potential climate adaptation solutions that include but are not limited to backup power/redundancy plans, elevation, floodproofing, and other retrofits to ensure proper functionality and long-term resiliency for those pump stations identified as most critical and vulnerable.
- Route 6 Culvert: The existing culvert at the 260 block of Route 6 / Huttleston Avenue was considered to be undersized and in need of an upgrade or replacement to alleviate flooding issues at this location. The culvert is designed to convey water under Route 6 via a tributary to the Nasketucket River which flows between the Nasketucket Cemetery and G. Bourne Knowles & Company property, portions of which are located in high risk flood hazard areas. This concern was identified in the Town's hazard mitigation plan as a high priority action and described as follows: *"Identify and evaluate potential upgrades and alternatives to the existing culvert and flood control structures between 265 and 267 Huttleston Avenue to alleviate future flood hazard threats. Objective is to eliminate or reduce flooding across Route 6 (State-owned road) and further upstream at Bridge Street (Town-owned road)"* (Punchard Consulting 2018). MVP workshop participants were heavily in favor of this priority action item based on current hazard conditions and previous flood impacts. The action gained even more support when discussed in combination with concerns over future hazard conditions and the potential siting of the Town's new Public Safety Complex in the same vicinity.

2.2 Screening and Asset Selection Process

To inform selection of the four sewer pump stations to be evaluated through a targeted vulnerability assessment, a sewer pump station exposure matrix was prepared that included all of the Town's 17 sewer pump stations (see Appendix A). The matrix includes data for the Town's sewer pump stations from the 2014 SeaPlan report as well as updated data resulting from GIS mapping and analysis conducted by AECOM—including projected coastal flood data from the Massachusetts Department of Transportation (MassDOT)'s Massachusetts Coast Flood Risk Model (MC-FRM) (Bosma et al. in publication). The matrix was provided to the Town's Board of Public Works (BPW) Superintendent, Vinny Furtado, and the Town's Sewer Superintendent, Linda Schick, for review.

Based on the Town's historic knowledge of the Town's sewer system and pump stations and the information included in the exposure matrix, the Town selected the following four pump stations for vulnerability assessments (see Figure 1):

- Abbey Street Pump Station;
- Boulder Park Pump Station;
- Manhattan Avenue Pump Station; and
- Pilgrim Avenue Pump Station.

While the Pilgrim Avenue Pump Station was rebuilt in 2020, the Town selected it for inclusion in the vulnerability assessment in part due to the presence of a deteriorated seawall at the pump station site.

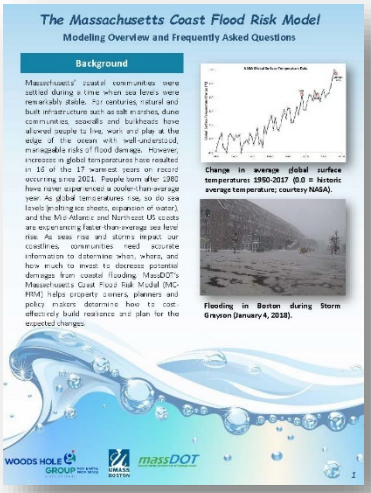
Regarding the Route 6 Culvert, input received from the Town's Highway Superintendent, John Charbonneau, during a meeting conducted with Town staff on March 10, 2020 led to a determination there is no real issue with the sizing or condition of the existing culvert. Rather, the localized flooding issues that have been experienced in the past are likely due to downstream blockage of the waterway caused by debris, sedimentation, and overgrown vegetation. The Town has implemented a brush clearing and trash collection program that has led to improved conditions at the site. Consequently, the Town determined that a vulnerability assessment for the Route 6 Culvert was not warranted and directed the AECOM team to proceed with conducting assessments for the four sewer pump stations identified above.

3. Vulnerability Assessment

While multiple natural hazards and climate stressors have the potential to impact the Town's sewer pump stations, the vulnerability assessment conducted for this project focused on assessing pump station vulnerability to sea level rise and coastal flooding—which were determined to be the greatest threats for the pump stations given their low-lying coastal locations. This section of the report identifies the data sources that were used to inform the vulnerability assessment, introduces the types of flood mitigation / adaptation measures that were considered, presents the assessment results, and identifies potential flood mitigation / adaptation measures for each pump station.

3.1 Data Sources and Key References

The Federal Emergency Management Agency (FEMA)'s National Flood Hazard Layer (NFHL) was utilized, which is a geospatial database that contains the current effective flood hazard data for the Town of Fairhaven and was used to determine the base flood elevation (BFE), which is the elevation of the 100-year (or 1% annual chance) flood.



The MC-FRM was used to assess exposure of the pump stations to coastal flooding for the Present Day, 2030, 2050, and 2070 planning horizons. MassDOT's MC-FRM is a dynamic model that includes processes associated with storm induced flooding and is calibrated to historical storm events that impacted Massachusetts (Bosma et al. in publication). The MC-FRM is the Commonwealth's standard for assessing current and future flood risk to coastal assets. It provides probability-based results that can be used to assess vulnerabilities and aid in prioritization and development of adaptation measures.

The standard MC-FRM data products used for this assessment include: 1) the probability of flooding for the Present Day, 2030, 2050, and 2070 planning horizons; and 2) the depth of flooding associated with the 1% (100-year) annual exceedance probability level for the same planning horizons. Additional MC-FRM data, such as water surface elevations for flood exceedance probabilities, was not available for use in the assessment.

Since MC-FRM water surface elevation data was not available, the latest edition of *Technical Report #16: Guides for the Design of Wastewater Treatment Works* (referred to as TR-16) was used to assign a design flood elevation (DFE) for each pump station site (NEIWPCC 2016). FEMA defines DFE as "the elevation of the highest flood (generally the BFE including freeboard) that a retrofitting method is designed to protect against" (FEMA 1999). TR-16 provides guidance for engineers responsible for designing wastewater treatment plants and related wastewater infrastructure, including pump stations. TR-16 was revised in 2016 to reflect resiliency and adaptation considerations in response to the changing climate in New England. It states that critical equipment should be protected against damage up to a water surface elevation that is 3 feet above the current FEMA 1% annual chance flood elevation. Thus, for the purpose of this vulnerability assessment, the DFE for each pump station is the FEMA 1% annual chance flood elevation plus 3 feet.

The Technical Report *Climate Change Vulnerability Assessment and Adaptation Planning Study for Water Quality Infrastructure in New Bedford, Fairhaven and Acushnet* was also referenced (SeaPlan 2014). This report conducted a high-level vulnerability assessment for water quality infrastructure in the Town of Fairhaven, including the Town's wastewater pump stations, and developed recommendations to prepare for storm events.

A site visit was conducted at each pump station site to confirm existing conditions and obtain photographs. Available plans and drawings for the pump stations were also obtained from the Town. One of the data limitations for the assessment was the lack of plans or drawings for the seawall located at the Pilgrim Avenue Pump Station site. No survey was conducted for this assessment. Elevations reported for the pump stations are from the drawings that were reviewed and were converted from NGVD 29 to NAVD 88 (using a conversion factor of minus 0.82 foot) to enable comparison to FEMA flood elevations.

3.2 Flood Mitigation and Adaptation Measures

A variety of flood mitigation and adaptation measures are available for the Town to minimize or avoid impacts to sewer pump stations associated with future flood events. These measures generally fall into the following four categories that are recommended for pump stations in the United States Environmental Protection Agency's guidance document *Flood Resilience: A Basic Guide for Water and Wastewater Utilities* (USEPA 2014):

1. Prevent pump stations from flooding (dry flood-proofing). Examples include temporary flood barriers and permanent physical barriers.
2. Protect critical components if pump stations do flood (wet flood-proofing). Examples include waterproofing or relocating/elevating electrical equipment.
3. Maintain pump station operations during loss of power. Examples include storing temporary or replacement pumps out of the flood zone and procuring generators or an alternative energy supply.
4. Maintain pumping operations during an emergency. Examples include maintaining a call-list of multiple vendors that can provide "pump around" services in an emergency or enter into an agreement with one and procuring portable pumps or specialized parts to repair damaged pumps.

Flood mitigation and adaptation measures from these categories were considered for the four pump stations included in this assessment.

A concept level construction cost estimate was performed for the flood mitigation and adaptation measures identified for this project. At the concept level, estimates are performed to establish the probable cost of a program budget. AECOM performs these "order-of-magnitude" estimates based on parametric units from historical information, judgment, and experience. Flood doors and flood louver dollar values were based on quotes from other similar projects. A 35% contingency was added to the total dollar value, and pricing is reported in today's dollar value with no escalation considered. All estimates are indexed using the Engineering News Record Construction Cost Index (ENR CCI).

The total estimated capital costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs for the facilities once designed. The final costs could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed. Estimated capital costs are presented in the following sections for the flood mitigation and adaptation measures, and detailed backup with line-item pricing is included in Appendix B.

3.3 Assessment Results

3.3.1 Abbey Street Pump Station

3.3.1.1 Exposure and Risk

According to FEMA's NFHL, the Abbey Street Pump Station (also referred to as the East Allen Pump Station on older Town records) is located entirely within a mapped Zone VE (see Figure 1 in Appendix C). This is an area subject to inundation by the 1% annual chance flood event with additional hazards due to storm-induced velocity wave action.

The Zone VE elevation for the site is Elevation 15 feet NAVD 88, which is 9.3 feet above the finished grade elevation of the site. The DFE used for this pump station is Elevation 18 feet NAVD 88 (i.e. 1% annual chance flood elevation plus 3 feet).

Figures 2 through 5 in Appendix C show the MC-FRM annual coastal flood exceedance probability (ACFEP) maps for the Present Day, 2030, 2050, and 2070 planning horizons for the Abbey Street Pump Station, and Figures 6 through 9 show the MC-FRM estimated flood depth maps for the 1% ACFEP for the same planning horizons. As summarized in Table 1, by the year 2070, the Abbey Street Pump Station is projected to have a 75% chance of flooding in any given year (under the assumed climatology used for the MC-FRM) and a 1% ACFEP flood depth of 12.5 feet.

Table 1: MC-FRM Annual Coastal Flood Exceedance Probability and Estimated Flood Depth Values for Pump Station Sites

	Annual Coastal Flood Exceedance Probability (ACFEP)[1]				Estimated Flood Depth (Feet)[2]				Operation During Flooding Events Required[3]
Pump Station	Present	2030	2050	2070	Present 1% ACFEP	2030 1% ACFEP	2050 1% ACFEP	2070 1% ACFEP	
Abbey Street	46%	65%	73%	75%	6.6	7.5	10.3	12.5	No
Boulder Park	52%	68%	74%	76%	6.9	7.8	10.4	12.7	No
Manhattan Avenue	4%	8%	24%	51%	2.7	3.6	6.2	8.5	No
Pilgrim Avenue	40%	79%	85%	100%	3.7	4.2	5.1	7.0	Yes

Notes:

1. ACFEP values range from 0.1% (otherwise known as the 1,000-year flood level) to 100%, which generally corresponds to the annual high-water value (1-year return period, not the average high tide).
2. Values reflect the estimated flood depths for the 1% ACFEP (100-year return period water surface elevation).
3. Source of designation: *Climate Change Vulnerability Assessment and Adaptation Planning Study for Water Quality Infrastructure in New Bedford, Fairhaven and Acushnet* (SeaPlan 2014).

3.3.1.2 Existing Conditions

The Abbey Street Pump Station has a prefabricated steel dry well that houses the pumps, with a diesel emergency generator and a masonry access building that was constructed in the 1970s (see Figure 2). The finished grade elevation at the site is Elevation 5.7 feet NAVD 88, and the building's first floor elevation is Elevation 12.0 feet NAVD 88. An underground fuel storage tank was originally constructed at the pump station, but it has been replaced with an above-ground storage tank. According to the Town, there has been no historic flooding reported at the Abbey Street Pump Station site.

The pump station would be inundated during a current 1% annual chance flooding event. Potential entry points for flood waters include the main entry door to the access building, louver openings for generator air intake and exhaust and pump room air intake, wet well access hatch, vent for the above ground storage tank, and a sump pump/drainage discharge pipe.

If the pump station flooded, the station's electrical equipment and emergency generator would likely suffer significant damage.

Note: Base flood elevation (BFE) and design flood elevation (DFE) lines are approximate and intended for illustrative purposes only.

Figure 2: Abbey Street Pump Station

3.3.1.3 Flood Mitigation / Adaptation Measures

The following flood mitigation / adaptation measures are recommended for further consideration for the Abbey Street Pump Station, with a total construction cost estimate of $173,000 (see Appendix B for cost details):

- Install a flood door;
- Install a watertight hatch for the wet well;
- Raise louvers, revise louvers/ductwork to use roof mounted penetrations, or install removable watertight flood panels over vents/louvers;
- Install bolted and gasketed manhole frames and covers; and
- Install watertight cap on emergency generator fuel fill.

3.3.2 Boulder Park Pump Station

3.3.2.1 Exposure and Risk

According to FEMA's NFHL, the Boulder Park Pump Station (also referred to as the James Street Pump Station on older Town records) is located entirely within a mapped Zone VE (see Figure 10 in Appendix C). The Zone VE elevation for the site is Elevation 15 feet NAVD 88, which is 10.2 feet above the finished grade elevation of the site. The DFE used for this pump station is Elevation 18 feet NAVD 88 (i.e. 1% annual chance flood elevation plus 3 feet).

Figures 11 through 14 in Appendix C show the MC-FRM ACFEP maps for the Present Day, 2030, 2050, and 2070 planning horizons for the Boulder Park Pump Station, and Figures 15 through 18 show the MC-FRM estimated flood depth maps for the 1% ACFEP for the same planning horizons. As summarized in Table 1, by the year 2070, the

Boulder Park Pump Station is projected to have a 76% chance of flooding in any given year and a 1% ACFEP flood depth of 12.7 feet.

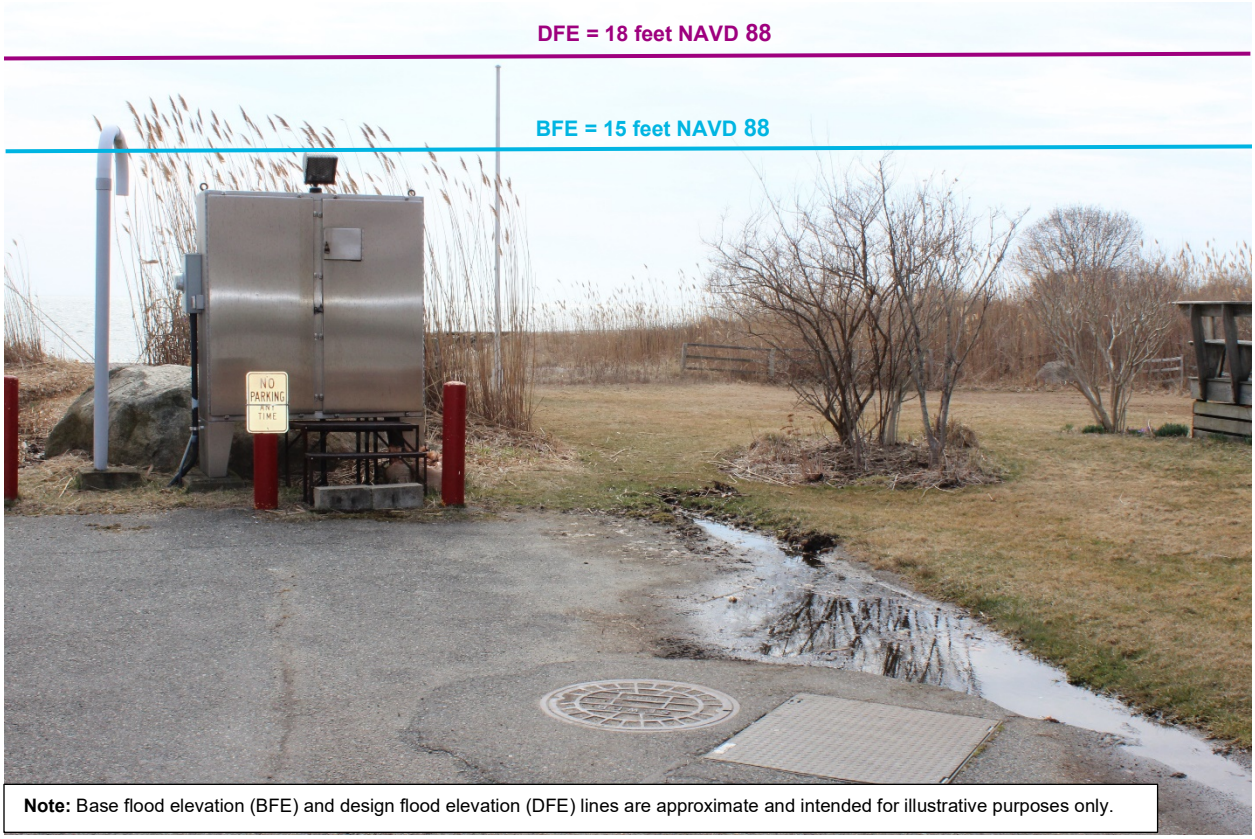
3.3.2.2 Existing Conditions

The Boulder Park Pump Station is an underground wet pit/dry pit pump station that was installed in the 1990s (see Figure 3). There is no above-grade building associated with the pump station, but there is an above-grade electrical control cabinet. The finished grade elevation of the watertight, gasketed hatch to the underground pump station is Elevation 4.8 feet NAVD 88, and the elevation of the wet well vent pipe opening is Elevation 13.2 feet NAVD 88. The drawings for the electrical control cabinet did not include elevation details, so the elevation of the bottom of this cabinet is not known. The pump station does not have a permanent emergency generator.

The Town noted that the site frequently floods during high tides, and during one recent storm event there was water up to the top of the second step of the platform that provides access to the electrical control cabinet. Power for the pump station is manually shut off in advance of significant storm events.

The effectiveness of the watertight hatch for the pump station is dependent on whether it has been closed properly and the condition of the gasket. If the hatch is not closed properly in advance of a flood event or is otherwise compromised, all equipment in the pump station would be inundated and would likely suffer damages.

The above-grade electrical control cabinet for the pump station would be completely inundated during a current 1% annual chance flooding event. Also, the opening for the wet well vent pipe would be submerged.



Note: Base flood elevation (BFE) and design flood elevation (DFE) lines are approximate and intended for illustrative purposes only.

Figure 3: Boulder Park Pump Station

3.3.2.3 Flood Mitigation / Adaptation Measures

The following flood mitigation / adaptation measures are recommended for further consideration for the Boulder Park Pump Station, with a total construction cost estimate of $85,700 (without below-grade emergency generator) or $195,000 (with below-grade emergency generator) (see Appendix B for cost details):

- Install a watertight hatch on the submersible station;
- Install a bolted and gasketed manhole frame and cover;
- Elevate electrical cabinet and wet well vent pipe above the DFE; and
- Install a below-grade emergency generator (if the Town determines this pump station needs to be powered in a flood event).

If the option of elevating the electrical cabinet above the DFE is not desired due to aesthetic impacts, the Town could consider relocating all electrical equipment to a new watertight below-grade chamber. The components related to this option are presented below, with a total construction cost estimate of $149,000 (without below-grade emergency generator) or $229,000 (with below-grade emergency generator) (see Appendix B for cost details):

- Install a watertight hatch on the submersible station;
- Install a bolted and gasketed manhole frame and cover;
- Install a below-grade watertight chamber with watertight access door/hatch to house electrical equipment;
- Elevate wet well vent pipe above the DFE; and
- Install a below-grade emergency generator (if the Town determines this pump station needs to be powered in a flood event).

3.3.3 Manhattan Avenue Pump Station

3.3.3.1 Exposure and Risk

According to FEMA's NFHL, the Manhattan Avenue Pump Station is located entirely within a mapped Zone VE (see Figure 19 in Appendix C). The Zone VE elevation for the site is Elevation 16 feet NAVD 88, which is 6.3 feet above the finished grade elevation of the site. The DFE used for this pump station is Elevation 19 feet NAVD 88 (i.e. 1% annual chance flood elevation plus 3 feet).

Figures 20 through 23 in Appendix C show the MC-FRM ACFEP maps for the Present Day, 2030, 2050, and 2070 planning horizons for the Manhattan Avenue Pump Station, and Figures 24 through 27 show the MC-FRM estimated flood depth maps for the 1% ACFEP for the same planning horizons. As summarized in Table 1, by the year 2070, the Manhattan Avenue Pump Station is projected to have a 51% chance of flooding in any given year and a 1% ACFEP flood depth of 8.5 feet.

3.3.3.2 Existing Conditions

The Manhattan Avenue Pump Station has a prefabricated steel dry well that houses the pumps, with a diesel emergency generator and a masonry access building that was constructed in the 1970s—similar to the Abbey Street Pump Station (see Figure 4). The finished grade elevation at the site is Elevation 9.7 feet NAVD 88, and the building's first floor elevation is Elevation 12.0 feet NAVD 88. An underground fuel storage tank was originally constructed at the pump station, but it has been replaced with an above-ground storage tank. According to the Town, there has been no historic flooding reported at the Manhattan Avenue Pump Station site.

The pump station would be inundated during a current 1% annual chance flooding event. Potential entry points for flood waters include the main entry door to the access building, louver openings for generator air intake and exhaust, wet well access hatch, vent for the above ground storage tank, and a sump pump/drainage discharge pipe.

Note: Base flood elevation (BFE) and design flood elevation (DFE) lines are approximate and intended for illustrative purposes only.

Figure 4: Manhattan Avenue Pump Station

3.3.3.3 Flood Mitigation / Adaptation Measures

The following flood mitigation / adaptation measures are recommended for further consideration for the Manhattan Avenue Pump Station, with a total construction cost estimate of $100,400 (see Appendix B for cost details):

- Install a flood door;
- Install a watertight hatch for the wet well;
- Raise louvers, revise louvers/ductwork to use roof mounted penetrations, or install removable watertight flood panels over vents/louvers;
- Install bolted and gasketed manhole frames and covers;
- Raise vent for fuel tank; and
- Install watertight cap on emergency generator fuel fill.

3.3.4 Pilgrim Avenue Pump Station and Seawall

3.3.4.1 Exposure and Risk

According to FEMA's NFHL, the Pilgrim Avenue Pump Station and seawall are located entirely within a mapped Zone AE (see Figure 28 in Appendix C). This is an area subject to inundation by the 1% annual chance flood event. The Zone AE elevation for the site is Elevation 6 feet NAVD 88, which is 1.8 feet above the finished grade elevation of the site. The DFE used for this pump station is Elevation 9 feet NAVD 88 (i.e. 1% annual chance flood elevation plus 3 feet).

Figures 29 through 32 in Appendix C show the MC-FRM ACFEP maps for the Present Day, 2030, 2050, and 2070 planning horizons for the Pilgrim Avenue Pump Station, and Figures 33 through 36 show the MC-FRM estimated flood depth maps for the 1% ACFEP for the same planning horizons. As summarized in Table 1, by the year 2070, the Pilgrim Avenue Pump Station is projected to have a 100% chance of flooding in any given year and a 1% ACFEP flood depth of 7.0 feet.

3.3.4.2 Existing Conditions

The Pilgrim Avenue Pump Station is a large cast in place wet pit/dry pit pump station with a diesel emergency generator and a masonry access building that was constructed in the 1970s and upgraded in 2020 (see Figure 5). The finished grade elevation at the site is approximated to be Elevation 4.2 feet NAVD 88 (detail was not clear on drawings available for review), and the building's first floor elevation is Elevation 8.2 feet NAVD 88. According to the Town, there has been no historic flooding reported at the Pilgrim Avenue Pump Station site.

The pump station would not be inundated during a current 1% annual chance flooding event. However, there are the following potential entry points for flood waters below the DFE for the pump stations: two entry doors to the access building and a wall mounted hydrant.

There is an existing seawall that supports the pump station site (see Figure 6). While the seawall does not provide flood protection to the site or surrounding area, it is critical for the integrity of the pump station site. The seawall is in poor condition and has been armored with large stones. It has been undercut by water, and the Town reported there was recently a sinkhole adjacent to the seawall that needed to be filled with soil and asphalt.

Note: Base flood elevation (BFE) and design flood elevation (DFE) lines are approximate and intended for illustrative purposes only.

Figure 5: Pilgrim Street Pump Station

Figure 6: Seawall at Pilgrim Street Pump Station Site

3.3.4.3 Flood Mitigation / Adaptation Measures

The following flood mitigation / adaptation measures are recommended for further consideration for the Pilgrim Avenue Pump Station, with a total construction cost estimate of $142,800 (see Appendix B for cost details):

- Install two flood doors;
- Raise lowest louver, revise louver/ductwork to use roof mounted penetration, or install removable watertight flood panels over louver;
- Install bolted and gasketed manhole frames and covers;
- Install watertight cap on emergency generator fuel fill; and
- Install additional rip rap in front of seawall.

4. Next Steps

The findings from this vulnerability assessment should be shared with BPW. The flood mitigation / adaptation measures recommended for further consideration should be evaluated in more detail as part of the design of pump station improvements that is included in BPW's capital improvement and compliance plan.

Additional data, such as additional pump station drawings and records, site survey elevations, findings from structural assessments (to determine if the masonry walls of the above grade structures could hold back the hydrostatic pressure of the water to the height of the flood protection level, or if structural reinforcement is required), and water

surface elevations from MC-FRM, will aid in the refinement of the DFEs used for the pump stations and selection of the flood mitigation / adaptation measures that are most appropriate to proceed with for each pump station.

The Town should consider seeking grant funds to complete more detailed vulnerability assessments and progress flood mitigation / adaptation measures from a concept level to design and ultimately implementation. Available funding programs include, but are not limited to, the following:

- Municipal Vulnerability Preparedness (MVP) Action Grant Program: Since the Town of Fairhaven has attained an "MVP Community" designation from the Massachusetts Executive Office of Energy and Environmental Affairs, it is eligible to receive funding from this grant program. The MVP Action Grant offers financial resources to municipalities that are seeking to advance priority climate adaptation actions to address climate change impacts resulting from extreme weather, sea level rise, inland and coastal flooding, severe heat, and other climate impacts. The municipality is required to match 25% of total project cost using cash or in-kind contributions (or a combination of the two). The MVP Action Grant Program is typically funded on an annual basis with a Request for Responses issued in the spring. Additional details are available on the MVP Action Grant Program website: https://www.mass.gov/service-details/mvp-action-grant.
- Coastal Resilience Grant Program: The Town is eligible for this program since it is a coastal community in Massachusetts. This grant program is managed by the Massachusetts Office of Coastal Zone Management and is used to advance local efforts to address coastal flooding, erosion, and sea level rise. The municipality is required to match 25% of total project cost using cash or in-kind contributions (or a combination of the two). The Coastal Resilience Grant Program is typically funded on an annual basis with a Request for Responses issued in the spring. Additional details are available on the Coastal Resilience Grant Program website: https://www.mass.gov/service-details/coastal-resilience-grant-program.
- FEMA Hazard Mitigation Assistance Grants: FEMA's hazard mitigation assistance provides funding for eligible mitigation measures that reduce disaster losses. The following two hazard mitigation assistance grant programs could be used:
  - Building Resilient Infrastructure and Communities (BRIC): This grant program supports implementation of hazard mitigation projects that reduce risks from disasters and natural hazards. BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the Pre-Disaster Mitigation program. It is anticipated that BRIC will be funded annually, with a Notice of Funding Opportunity issued in the fall. Applicants are required to match 25% of total project cost using cash or in-kind contributions (or a combination of the two). Additional details for BRIC is available on FEMA's website: https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities.
  - Hazard mitigation Grant Program (HMGP): This grant program assists in implementing long-term hazard mitigation planning and projects following a Presidential major disaster declaration. Applicants are required to match 25% of total project cost using cash or in-kind contributions (or a combination of the two). Additional details for HMGP is available on FEMA's website: https://www.fema.gov/grants/mitigation/hazard-mitigation.

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Appendix A

Sewer Pump Station Exposure Matrix

Town of Fairhaven: Sewer Pump Station Exposure Matrix

Location	Vulnerability to Sea Level Rise (NOAA Coastal Services Center Sea Level Rise Data)	Vulnerability to Flooding (Flood Zone) (FEMA National Flood Hazard Layer)	Hurricane Surge Inundation Zones (By Hurricane Category) (NOAA SLOSH Model)	Wildfire Hazard (SILVIS Lab wildland-urban interface 2010 data)	Massachusetts Coast Flood Risk Model (MC-FRM) Results												SeaPlan Prioritization Matrix (2014)					
					Annual Coastal Flood Exceedance Probability (ACFEP)				Estimated Flood Depth (Feet)													
					Present	2030	2050	2070	Present 1% ACFEP	Present 0.5% ACFEP	2030 1% ACFEP	2030 0.5% ACFEP	2050 1% ACFEP	2050 0.5% ACFEP	2070 1% ACFEP	2070 0.5% ACFEP	500 Year Flood Depth with Baseline Water Levels	500 Year Flood with 4' SLR	Inundation Risk[1]	Priority Ranking	Older Structure[2]	Not Operated During Flood Events[3]
Abbey Street	3 ft SLR	VE: High Risk Coastal Area	1	Not In Wildfire Hazard Zone	46%	65%	73%	75%	6.62	7.75	7.50	8.59	10.28	11.62	12.53	13.94	12.50	16.75	3	3		X
Bernese Street	Not within SLR	VE: High Risk Coastal Area	2	Medium Density Interface	10%	19%	39%	64%	3.73	4.86	4.58	5.66	7.14	8.44	9.46	10.83	8.73	12.59	3	6		X
Boulder Park	3 ft SLR	VE: High Risk Coastal Area	1	Not In Wildfire Hazard Zone	52%	68%	74%	76%	6.93	8.06	7.81	8.89	10.38	11.70	12.66	14.05	13.20	17.33	3	3		X
Camel Street	Not within SLR	AE: 1% Annual Chance of Flooding, with BFE	2	Medium Density Intermix	3%	7%	19%	47%	2.41	3.50	3.44	4.51	5.80	7.08	8.07	9.43	8.04	11.66	3	6		X
Causeway Road	Not within SLR	X: 0.2% Annual Chance of Flooding	3	Not In Wildfire Hazard Zone	0%	0%	2%	7%	0.00	0.00	0.00	0.50	1.62	2.86	3.91	5.21	3.93	7.66	3	6		X
Manhattan Avenue	Not within SLR	VE: High Risk Coastal Area	2	Not In Wildfire Hazard Zone	4%	8%	24%	51%	2.68	3.82	3.56	4.65	6.23	7.57	8.53	9.93	8.71	12.49	3	6		X
Marguerite Street	Not within SLR	Not in flood zone	Not in hurricane zone	Medium Density Interface	0%	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	1		
Pilgrim Avenue	1 ft SLR	AE: 1% Annual Chance of Flooding, with BFE	4	Not In Wildfire Hazard Zone	40%	79%	85%	100%	3.13	3.26	4.21	4.37	5.08	5.18	6.95	7.06	0.00	20.65	2	4	X	
Pine Grove Street	Not within SLR	Not in flood zone	Not in hurricane zone	Medium Density Intermix	0%	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	1		
Railroad Ave[4]	Not within SLR	X: 0.2% Annual Chance of Flooding	3	Low Density Interface	0%	0%	0%	1%	0.00	0.00	0.00	0.00	0.00	0.72	0.86	1.11	0.00	0.00	1	1		
Rocky Point Road	Not within SLR	VE: High Risk Coastal Area	2	Not In Wildfire Hazard Zone	4%	9%	22%	49%	2.15	3.19	3.10	4.10	5.24	6.43	7.61	8.87	7.44	11.25	3	3		X
Shannon Meadows	Not within SLR	Not in flood zone	Not in hurricane zone	Medium Density Intermix	0%	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	1		
Shore Drive	3 ft SLR	VE: High Risk Coastal Area	1	High Density Interface	57%	71%	74%	76%	7.14	8.26	8.17	9.26	10.62	11.93	12.86	14.24	12.18	15.98	3	6		X
South Street	Not within SLR	X: Reduced Flood Risk due to Levee	4	Not In Wildfire Hazard Zone	0%	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.74	2	8		
Sunrise Court[5]	Not within SLR	VE: High Risk Coastal Area	1	Medium Density Interface	3%	7%	19%	41%	1.99	2.95	2.89	3.99	5.42	6.75	7.66	9.06	12.81	16.59	3	6		X
Taber Street	4 ft SLR	AE: 1% Annual Chance of Flooding, with BFE	4	Not In Wildfire Hazard Zone	0%	4%	9%	78%	0.00	0.00	0.26	0.27	0.38	0.42	2.19	2.30	0.00	20.73	2	4	X	
Weybridge Road	3 ft SLR	VE: High Risk Coastal Area	1	Not In Wildfire Hazard Zone	40%	60%	72%	76%	6.27	7.40	7.13	8.22	9.67	10.96	11.99	13.36	12.59	16.40	3	6		X

Notes:

1. Red = High Inundation Risk, Orange = Medium Inundation Risk, Green = Low Inundation Risk.

2. Town has indicated that these pump stations, which are behind the hurricane barrier, may be older structures therefore more vulnerable in the event of flooding at that location.

3. This facility reportedly is not operated during flooding events. As a result, adaptations to allow pump station to operate during the flood events are likely not required. However, adaptations to these structures may still be required in order to protect key infrastructure in the facilities (e.g. motors and electrical service) and allow the facilities to be able to operate after the storm.

4. Referred to as "Arsene Street" pump station in 2014 SeaPlan report.

5. Referred to as "Seaview Avenue" pump station in 2014 SeaPlan report.

Selected by Town for targeted vulnerability assessment (Task 3 of MVP Planning Grant).

Appendix B

Construction Cost Estimates for Flood Mitigation / Adaptation Measures

10:48 AM

JOB #: 60617698.03
DATE: February 24, 2021
LOCATION: Fairhaven, MA
PREPARED BY: R. Mastrogiacomo
CHECKED BY: A. Weieneth

AECOM - Water
Pump Station & Seawall
Flood Protection
Construction Cost Estimate
****

CLIENT : Town of Fairhaven
PROJECT : Flood Protection
ACCURACY: ± 25 %
ENR CCI: 11628

G R A N D S U M M A R Y

PS No.	DESCRIPTION	MANHOURS	MATERIAL	LABOR	EQUIPMENT	O&P 25%	CONTINGENCY 35%	ESCALATION (not considered) 0.0%	TOTAL
1	Abbey St PS	284	$74,900	$25,999	$1,598	$25,624	$44,842	$0	$172,964
2a	Boulder Park PS (opt 2a)	535	$64,675	$48,967	$1,917	$28,890	$50,557	$0	$195,005
2b	Boulder Park PS (opt 2b)	774	$63,392	$70,846	$1,711	$33,987	$59,478	$0	$229,414
2c	Boulder Park PS (opt 2c)	173	$34,608	$15,837	$350	$12,699	$22,223	$0	$85,718
2d	Boulder Park PS (opt 2d)	521	$39,392	$47,685	$1,211	$22,072	$38,626	$0	$148,985
3	Manhattan Ave PS	128	$46,900	$11,718	$886	$14,876	$26,033	$0	$100,413
4	Pilgrim Ave PS	258	$57,940	$23,619	$3,063	$21,155	$37,022	$0	$142,799

ACCOUNT NO.	ESTIMATE BASIS			MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
	THIS CONSTRUCTION COST IS BASED ON:											
	1. 10% Concept											
	2. PRICING IS BASED ON 1st QUARTER 2021											
	3. CONTINGENCY SHOWN IS CONTRACTOR CONTINGENCY BASED ON LEVEL OF DESIGN, OWNER CONTINGENCY NOT INCLUDED											
	4. THE SOILS AT THE SITE ARE SUITABLE FOR STANDARD EXCAVATING METHODS FOR THE WORK.											
	5. ESCALATION NOT CONSIDERED											
	6. IN PROVIDING OPINION OF PROBABLE CONSTRUCTION COST, THE CLIENT UNDERSTANDS THAT AECOM HAS NO CONTROL OVER THE COST OR AVAILABILITY OF LABOR, EQUIPMENT OR MATERIALS OR OVER MARKET CONDITIONS OR THE CONTRACTOR'S METHOD OF PRICING. AECOM MAKES NO WARRANTY, EXPRESS OR IMPLIED THAT THE BIDS WILL NOT VARY FROM THIS ESTIMATE.											
	7. Average wage rate calculated from 2019 Means Labor rates for Construction Industry (ENR 11,183). Used New Bedford, MA ($71.33) escalated at 4.0% to the time of the estimate and added 23.4% for:											
	Social Security Tax	7.65%										
	Workers Comp Insurance	9.10%										
	Builders Risk	0.44%										
	Other Negotiated Fringe	1.60%										
	Federal Unemployment Insurance	0.14%										
	State Unemployment Insurance	2.93%										
	General Liability Insurance	1.57%										
	TOTAL	23.4%										
	AVERAGE Labor Rate ---->	**$91.55**										

JOB #: 60617698.03
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LOCATION: Fairhaven, MA
PREPARED BY: R. Mastrogiacomo

AECOM - Water
Pump Station & Seawall
Flood Protection
Construction Cost Estimate

CLIENT : Town of Fairhaven
PROJECT : Flood Protection
ACCURACY: ± 25 %
ENR. INDEX 11628

PS NO.	DESCRIPTION	QUAN	UN	MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
1	***Abbey St PS***											
	Demolition											
	Demo Door	1	EA	8.00	8		0	$91.55	732		0	$732
	Demo Hatch	1	EA	4.00	4		0	$91.55	366		0	$366
	Demo Louvers	2	EA	12.00	24		0	$91.55	2,197		0	$2,197
	New											
	Flood Door (3' x 7')	1	EA	48.00	48	21,000	21,000	$91.55	4,394	420.00	420	$25,814
	Watertight Access Hatch (3' x 3')	1	EA	12.00	12	7,200	7,200	$91.55	1,099	144.00	144	$8,443
	Louvers (4' x 4')	2	EA	60.00	120	18,400	36,800	$91.55	10,986	368.00	736	$48,522
	Louvers (2' x 1')	1	EA	2.00	2	2,400	2,400	$91.55	183	48.00	48	$2,631
	Water Tight Frames & Covers	2	EA	12.00	24	1,000	2,000	$91.55	2,197		0	$4,197
	Water Tight Cap	1	EA	2.00	2	500	500	$91.55	183		0	$683
	Structural Wall Reinforecment	1	AL	40.00	40	5,000	5,000	$91.55	3,662	250.00	250	$8,912
	SUBTOTAL DIRECT COSTS				284		74,900		25,999		1,598	102,497
	GENERAL CONTRACTOR OVERHEAD&PROFIT	25.00%										$25,624
	SUBTOTAL GENERAL CONTRACTOR											$128,121
	ESTIMATE CONTINGENCY	35.00%										$44,842
	UNESCALATED CONSTRUCTION COST											**$172,963**

JOB #: 60617698.03
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AECOM - Water
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CLIENT : Town of Fairhaven
PROJECT : Flood Protection
ACCURACY: ± 25 %
ENR. INDEX: 11628

PS NO.	DESCRIPTION	QUAN	UN	MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
2a	***Boulder Park PS (opt 2a)***											
	Demolition											
	Demo Hatch	1	EA	4.00	4		0	$91.55	366		0	$366
	Frames & Covers	1	EA	4.00	4		0	$91.55	366		0	$366
	New											
	Watertight Chamber (8' x 6' x 8' precast)	1	EA	100.00	100	5,000	5,000	$91.55	9,155	1,000.00	1,000	$15,155
	Porous Asphalt Pavement (6" binder 2" wearing)	44	SY	0.20	9	24	1,067	$91.55	814	1.50	67	$1,947
	Watertight Access Hatch (19 inch x 33 inch)	1	EA	8.00	8	3,483	3,483	$91.55	732		0	$4,216
					-		0	$91.55	0		0	$0
	Water Tight Frames & Covers	1	EA	12.00	12	1,000	1,000	$91.55	1,099		0	$2,099
					-		0	$91.55	0		0	$0
	Raise (4"dia) wet well vent pipe 5'	5	LF	1.00	5	25	125	$91.55	458		0	$583
					-		0	$91.55	0		0	$0
	Elevate electrical cabinet approx. 11'	1	EA	100.00	100	25,000	25,000	$91.55	9,155	250.00	250	$34,405
					-		0	$91.55	0		0	$0
	Stairs	1	SET	40.00	40	5,000	5,000	$91.55	3,662	100.00	100	$8,762
					-		0	$91.55	0		0	$0
	Utility Vault	1	EA	28.00	28	2,000	2,000	$91.55	2,563	500.00	500	$5,063
	Utility Vault lights/power/fan/ducts	1	AL	60.00	60	2,000	2,000	$91.55	5,493		0	$7,493
	Below Grade Generator (5 KW) Gasolene?	1	AL	40.00	40	10,000	10,000	$91.55	3,662		0	$13,662
	Relocate Electrical for Generator	1	AL	125.00	125	10,000	10,000	$91.55	11,443		0	$21,443
	SUBTOTAL DIRECT COSTS				535		64,675		48,967		1,917	115,559
	GENERAL CONTRACTOR OVERHEAD&PROFIT	25%										$28,890
	SUBTOTAL GENERAL CONTRACTOR											$144,448
	ESTIMATE CONTINGENCY	35%										$50,557
	UNESCALATED CONSTRUCTION COST											**$195,005**

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AECOM - Water
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Flood Protection
Construction Cost Estimate

CLIENT : Town of Fairhaven
PROJECT : Flood Protection
ACCURACY: ± 25 %
ENR. INDEX: 11628

PS NO.	DESCRIPTION	QUAN	UN	MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
2b	***Boulder Park PS (opt 2b)***											
	Demolition											
	Demo Hatch	1	EA	4.00	4		0	$91.55	366		0	$366
	Frames & Covers	1	EA	4.00	4		0	$91.55	366		0	$366
					-		0	$91.55	0		0	$0
	New											
	Watertight Access Hatch (3' x 3')	1	EA	12.00	12	7,200	7,200	$91.55	1,099	144.00	144	$8,443
	Watertight Chamber (8' x 6' x 8' precast)	1	EA	100.00	100	5,000	5,000	$91.55	9,155	1,000.00	1,000	$15,155
	Porous Asphalt Pavement (6" binder 2" wearing)	44	SY	0.20	9	24	1,067	$91.55	814	1.50	67	$1,947
	Water Tight Frames & Covers	1	EA	12.00	12	1,000	1,000	$91.55	1,099		0	$2,099
	Raise (4"dia) wet well vent pipe 5'	5	LF	1.00	5	25	125	$91.55	458		0	$583
					-		0	$91.55	0		0	$0
	Relocate Electrical into Chamber	1	AL	250.00	250	20,000	20,000	$91.55	22,887		0	$42,887
	Relocated Chamber lights/power/fan/ducts	1	AL	125.00	125	5,000	5,000	$91.55	11,443		0	$16,443
					-		0	$91.55	0		0	$0
	Utility Vault	1	EA	28.00	28	2,000	2,000	$91.55	2,563	500.00	500	$5,063
	Utility Vault lights/power/fan/ducts	1	AL	60.00	60	2,000	2,000	$91.55	5,493		0	$7,493
	Below Grade Generator (5 KW) Gasolene?	1	AL	40.00	40	10,000	10,000	$91.55	3,662		0	$13,662
	Relocate Electrical for Generator	1	AL	125.00	125	10,000	10,000	$91.55	11,443		0	$21,443
					-		0	$91.55	0		0	$0
	SUBTOTAL DIRECT COSTS				774		63,392		70,846		1,711	135,949
	GENERAL CONTRACTOR OVERHEAD&PROFIT	25%										$33,987
	SUBTOTAL GENERAL CONTRACTOR											$169,936
	ESTIMATE CONTINGENCY	35%										$59,478
	UNESCALATED CONSTRUCTION COST											**$229,414**

PS NO.	DESCRIPTION	QUAN	UN	MANHOURS		MATERIAL		LABOR		EQUIPMENT		TOTAL DIRECT COST
				MHR/ UNIT	TOTAL MH	UNIT COST	TOTAL MATL	WAGE RATE	TOTAL LABOR	UNIT RATE	TOTAL EQUIP	
2c	***Boulder Park PS (opt 2c)***											
	Demolition											
	Demo Hatch	1	EA	4.00	4		0	$91.55	366		0	$366
	Frames & Covers	1	EA	4.00	4		0	$91.55	366		0	$366
	New											
	Watertight Access Hatch (19 inch x 33 inch)	1	EA	8.00	8	3,483	3,483	$91.55	732		0	$4,216
					-		0	$91.55	0		0	$0
	Water Tight Frames & Covers	1	EA	12.00	12	1,000	1,000	$91.55	1,099		0	$2,099
					-		0	$91.55	0		0	$0
	Raise (4"dia) wet well vent pipe 5'	5	LF	1.00	5	25	125	$91.55	458		0	$583
					-		0	$91.55	0		0	$0
	Elevate electrical cabinet approx. 11'	1	EA	100.00	100	25,000	25,000	$91.55	9,155	250.00	250	$34,405
					-		0	$91.55	0		0	$0
	Stairs	1	SET	40.00	40	5,000	5,000	$91.55	3,662	100.00	100	$8,762
					-		0	$91.55	0		0	$0
	SUBTOTAL DIRECT COSTS				173		34,608		15,837		350	50,796
	GENERAL CONTRACTOR OVERHEAD&PROFIT	25%										$12,699
	SUBTOTAL GENERAL CONTRACTOR											$63,495
	ESTIMATE CONTINGENCY	35%										$22,223
	UNESCALATED CONSTRUCTION COST											**$85,718**

JOB #: 60617698.03
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AECOM - Water
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Flood Protection
Construction Cost Estimate

CLIENT : Town of Fairhaven
PROJECT : Flood Protection
ACCURACY: ± 25 %
ENR. INDEX: 11628

PS NO.	DESCRIPTION	QUAN	UN	MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
2d	***Boulder Park PS (opt 2d)***											
	Demolition											
	Demo Hatch	1	EA	4.00	4		0	$91.55	366		0	$366
	Frames & Covers	1	EA	4.00	4		0	$91.55	366		0	$366
					-		0	$91.55	0		0	$0
	New											
	Watertight Access Hatch (3' x 3')	1	EA	12.00	12	7,200	7,200	$91.55	1,099	144.00	144	$8,443
	Watertight Chamber (8' x 6' x 8' precast)	1	EA	100.00	100	5,000	5,000	$91.55	9,155	1,000.00	1,000	$15,155
	Porous Asphalt Pavement (6" binder 2" wearing)	44	SY	0.20	9	24	1,067	$91.55	814	1.50	67	$1,947
	Water Tight Frames & Covers	1	EA	12.00	12	1,000	1,000	$91.55	1,099		0	$2,099
	Raise (4"dia) wet well vent pipe 5'	5	LF	1.00	5	25	125	$91.55	458		0	$583
					-		0	$91.55	0		0	$0
	Relocate Electrical into Chamber	1	AL	250.00	250	20,000	20,000	$91.55	22,887		0	$42,887
	Relocated Chamber lights/power/fan/ducts	1	AL	125.00	125	5,000	5,000	$91.55	11,443		0	$16,443
					-		0	$91.55	0		0	$0
					-		0	$91.55	0		0	$0
	SUBTOTAL DIRECT COSTS				521		39,392		47,685		1,211	88,288
	GENERAL CONTRACTOR OVERHEAD&PROFIT	25%										$22,072
	SUBTOTAL GENERAL CONTRACTOR											$110,360
	ESTIMATE CONTINGENCY	35%										$38,626
	UNESCALATED CONSTRUCTION COST											**$148,986**

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PS NO.	DESCRIPTION	QUAN	UN	MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
3	***Manhattan Ave PS***											
	Demolition											
	Demo Door	1	EA	8.00	8		0	$91.55	732		0	$732
	Demo Hatch	1	EA	4.00	4		0	$91.55	366		0	$366
	Demo Louvers	2	EA	12.00	24		0	$91.55	2,197		0	$2,197
	Frames & Covers	2	EA	4.00	8		0	$91.55	732		0	$732
	New											
	Flood Door (3' x 7')	1	EA	48.00	48	21,000	21,000	$91.55	4,394	420.00	420	$25,814
	Watertight Access Hatch (3' x 3')	1	EA	12.00	12	7,200	7,200	$91.55	1,099	144.00	144	$8,443
	Louvers (2' x 5')	1	EA	26.00	26	11,500	11,500	$91.55	2,380	230.00	230	$14,110
	Louvers (2' x 2')	1	EA	12.00	12	4,600	4,600	$91.55	1,099	92.00	92	$5,791
	Water Tight Frames & Covers	2	EA	12.00	24	1,000	2,000	$91.55	2,197		0	$4,197
	Raise (x"dia) Vent 4'	4	LF	1.00	4	25	100	$91.55	366		0	$466
	Water Tight Cap	1	EA	2.00	2	500	500	$91.55	183		0	$683
	SUBTOTAL DIRECT COSTS				128		46,900		11,718		886	59,504
	GENERAL CONTRACTOR OVERHEAD&PROFIT	25%										$14,876
	SUBTOTAL GENERAL CONTRACTOR											$74,380
	ESTIMATE CONTINGENCY	35%										$26,033
	UNESCALATED CONSTRUCTION COST											**$100,413**

JOB #: 60617698.03
DATE: February 24, 2021
LOCATION: Fairhaven, MA
PREPARED BY: R. Mastrogiacomo

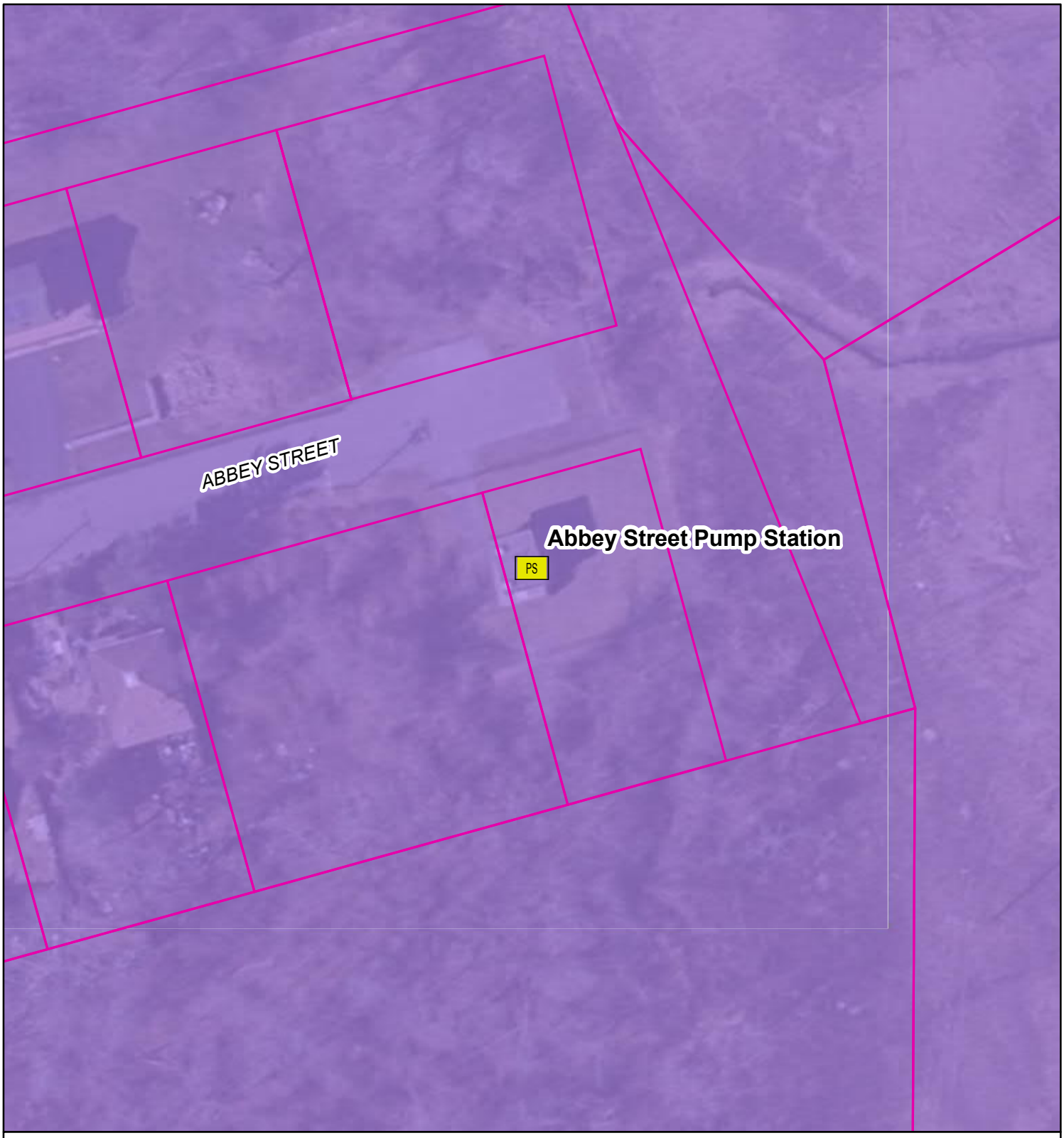
AECOM - Water
Pump Station & Seawall
Flood Protection
Construction Cost Estimate

CLIENT : Town of Fairhaven
PROJECT : Flood Protection
ACCURACY: ± 25 %
ENR. INDEX 11628

PS NO.	DESCRIPTION	QUAN	UN	MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
4	***Pilgrim Ave PS***											
	Demolition											
	Demo Door	2	EA	8.00	16		0	$91.55	1,465		0	$1,465
	Demo Hatch	-	EA	4.00	-		0	$91.55	0		0	$0
	Demo Louvers	1	EA	12.00	12		0	$91.55	1,099		0	$1,099
	Frames & Covers	2	EA	4.00	8		0	$91.55	732		0	$732
	New											
	Flood Door (3' x 7')	2	EA	48.00	96	21,000	42,000	$91.55	8,788	420.00	840	$51,628
	Watertight Access Hatch (4' x 4')		EA	28.00	-	12,800	0	$91.55	0	256.00	0	$0
	Louvers (3.3' x 3.3')	1	EA	24.00	24	10,350	10,350	$91.55	2,197	207.00	207	$12,754
	Water Tight Frames & Covers	2	EA	12.00	24	1,000	2,000	$91.55	2,197		0	$4,197
	Water Tight Cap	1	EA	2.00	2	500	500	$91.55	183		0	$683
	Remove Bituminous Drivway	1	AL	40.00	40	50	50	$91.55	3,662	250.00	250	$3,962
	Tree Removal	2	EA	6.00	12	0	0	$91.55	1,099	50.00	100	$1,199
	Silt Fence	200	LF	0.10	20	2	400	$91.55	1,831	0.33	66	$2,297
	Rip Rap	40	CY	1.00	40	66	2,640	$91.55	3,662	40.00	1,600	$7,902
	SUBTOTAL DIRECT COSTS				258		57,940		23,619		3,063	84,622
	GENERAL CONTRACTOR OVERHEAD&PROFIT	25%										$21,155
	SUBTOTAL GENERAL CONTRACTOR											$105,777
	ESTIMATE CONTINGENCY	35%										$37,022
	UNESCALATED CONSTRUCTION COST											**$142,799**

Appendix C

Massachusetts Coast Flood Risk Model Annual Coastal Flood Exceedance Probability and Estimated Flood Depth Figures for Pump Stations



Legend

PS Sewer Pump Station

Parcel Boundaries

FEMA National Flood Hazard Layer

Flood Zone Designations

VE: High Risk Coastal Area

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 1

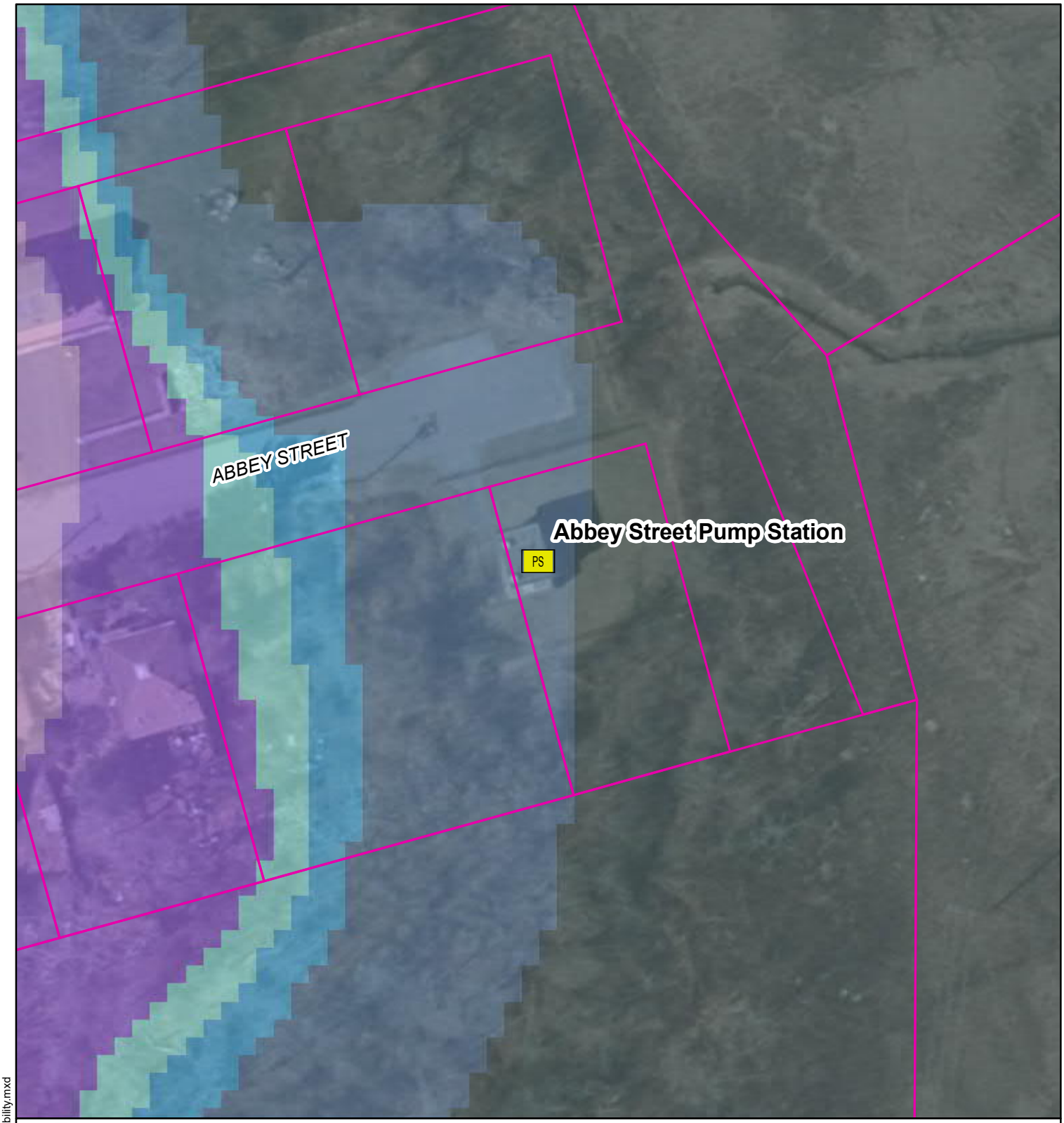
Abbey Street Pump Station
FEMA Hazard Zones

0 25 50 Feet

1 inch = 50 feet

AECOM

C:\Work\60617698FHV\Maps\PumpStations_Flood.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

Present Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

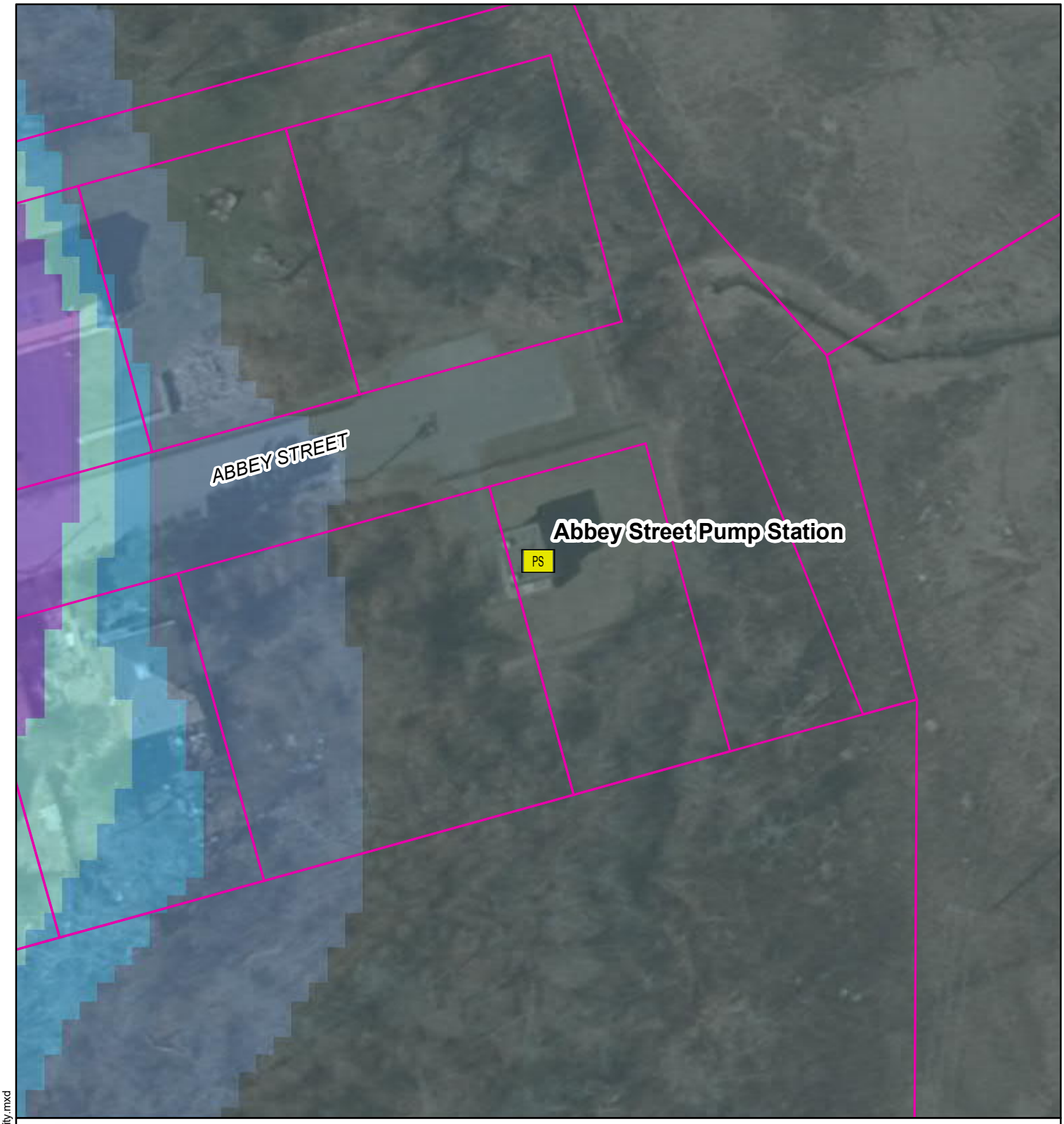
Figure 2

Abbey Street Pump Station
MC-FRM Present Day
Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

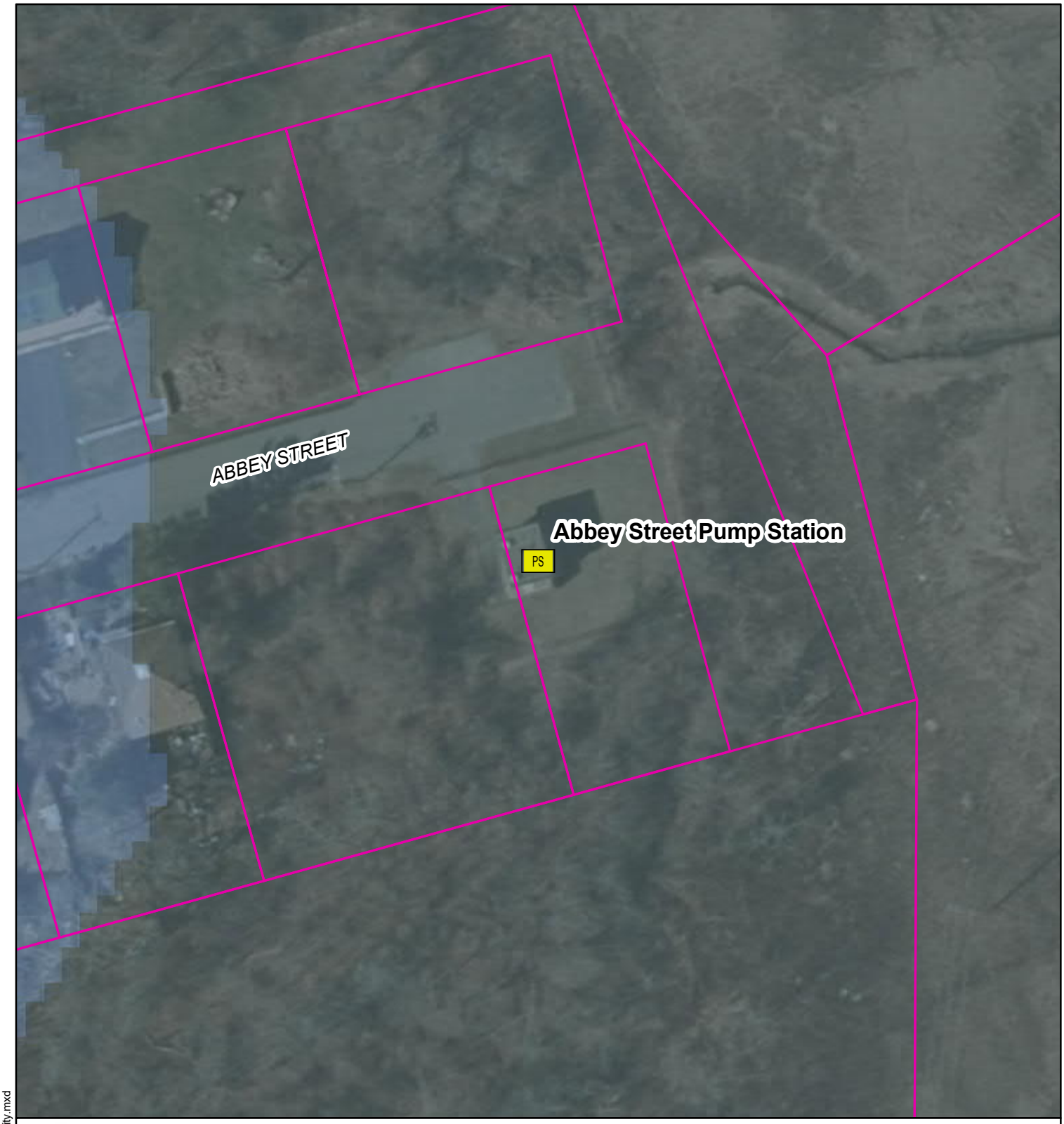
Figure 3

Abbey Street Pump Station
MC-FRM 2030 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2030_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2050 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 4

Abbey Street Pump Station
MC-FRM 2050 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2050_Probability.mxd

C:\Work\60617698FHV\Maps\PumpStations_2070_Probability.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

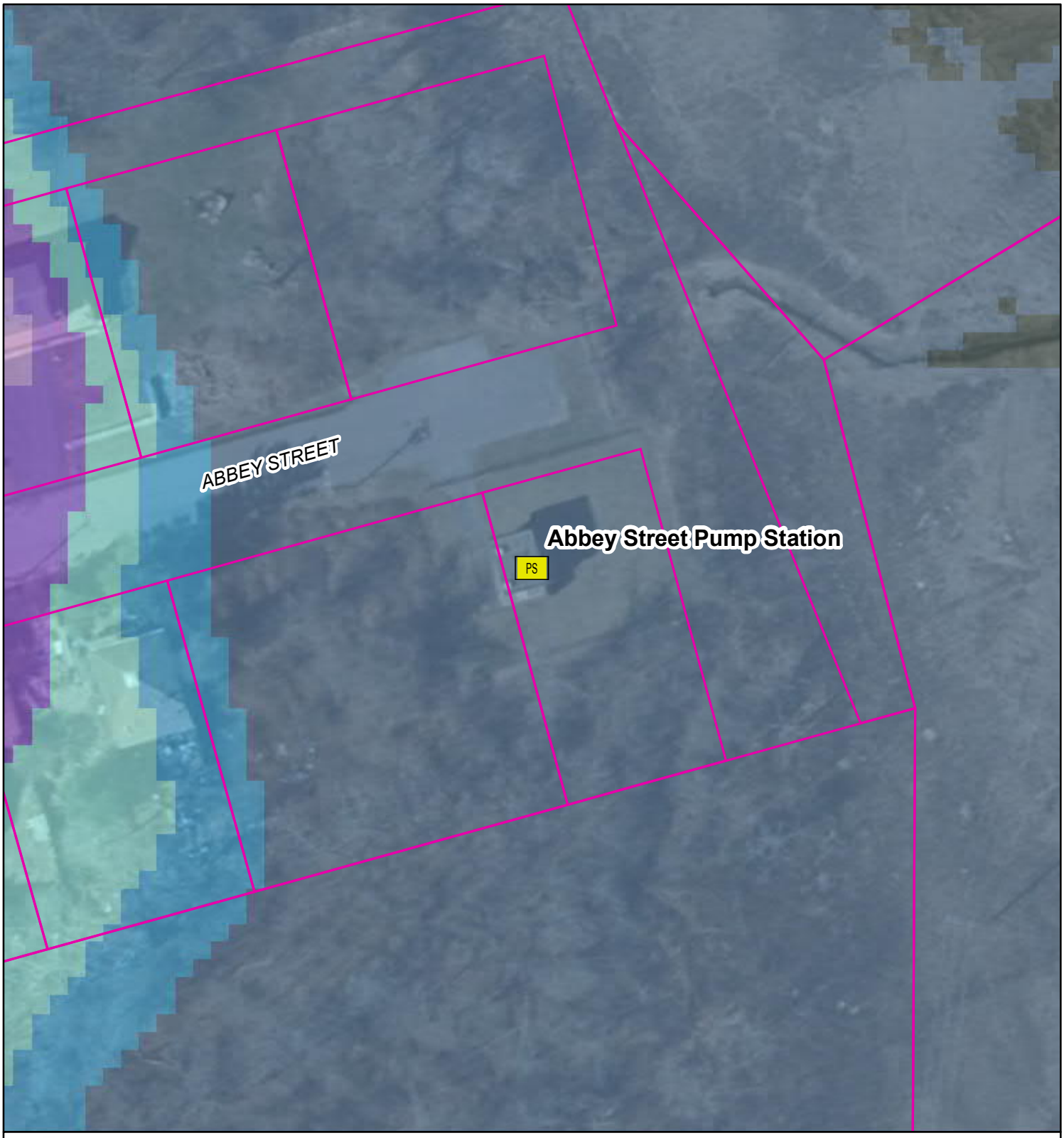
Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 5

Abbey Street Pump Station
MC-FRM 2070 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

Present Day 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

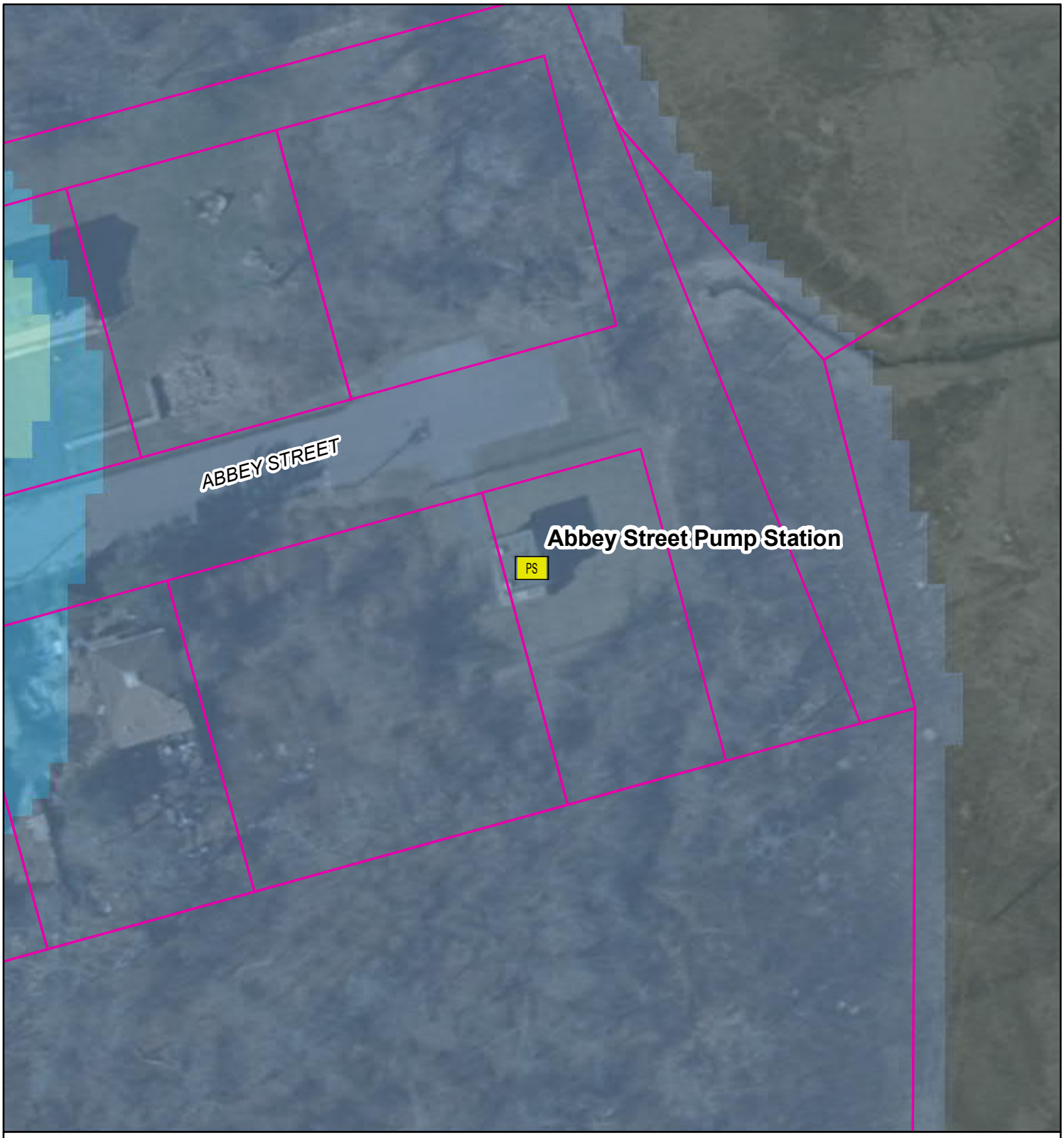
Figure 6

Abbey Street Pump Station
MC-FRM Present Day 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_1pct_Inundation.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 7

Abbey Street Pump Station
MC-FRM 2030 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

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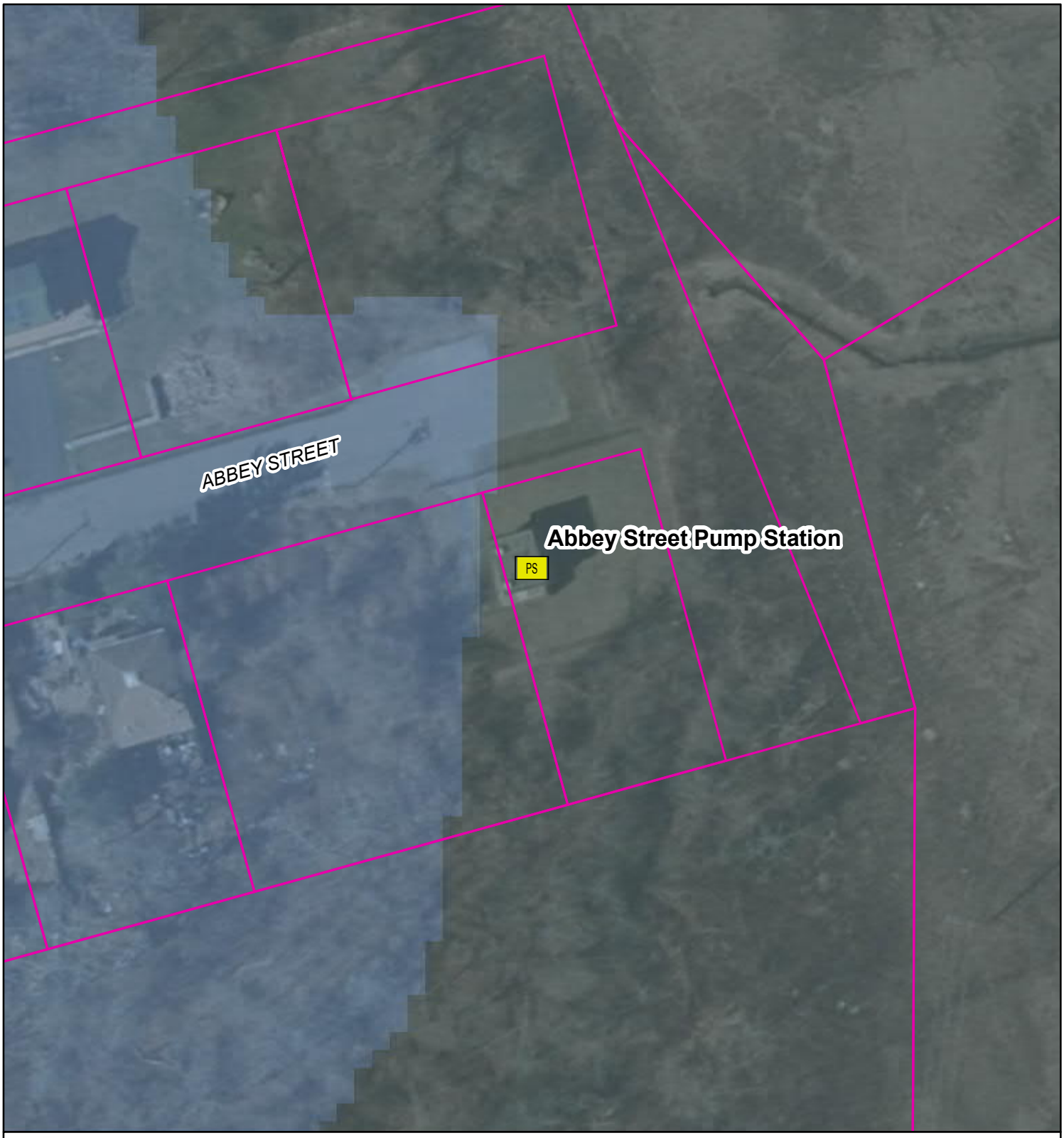

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Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2050 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

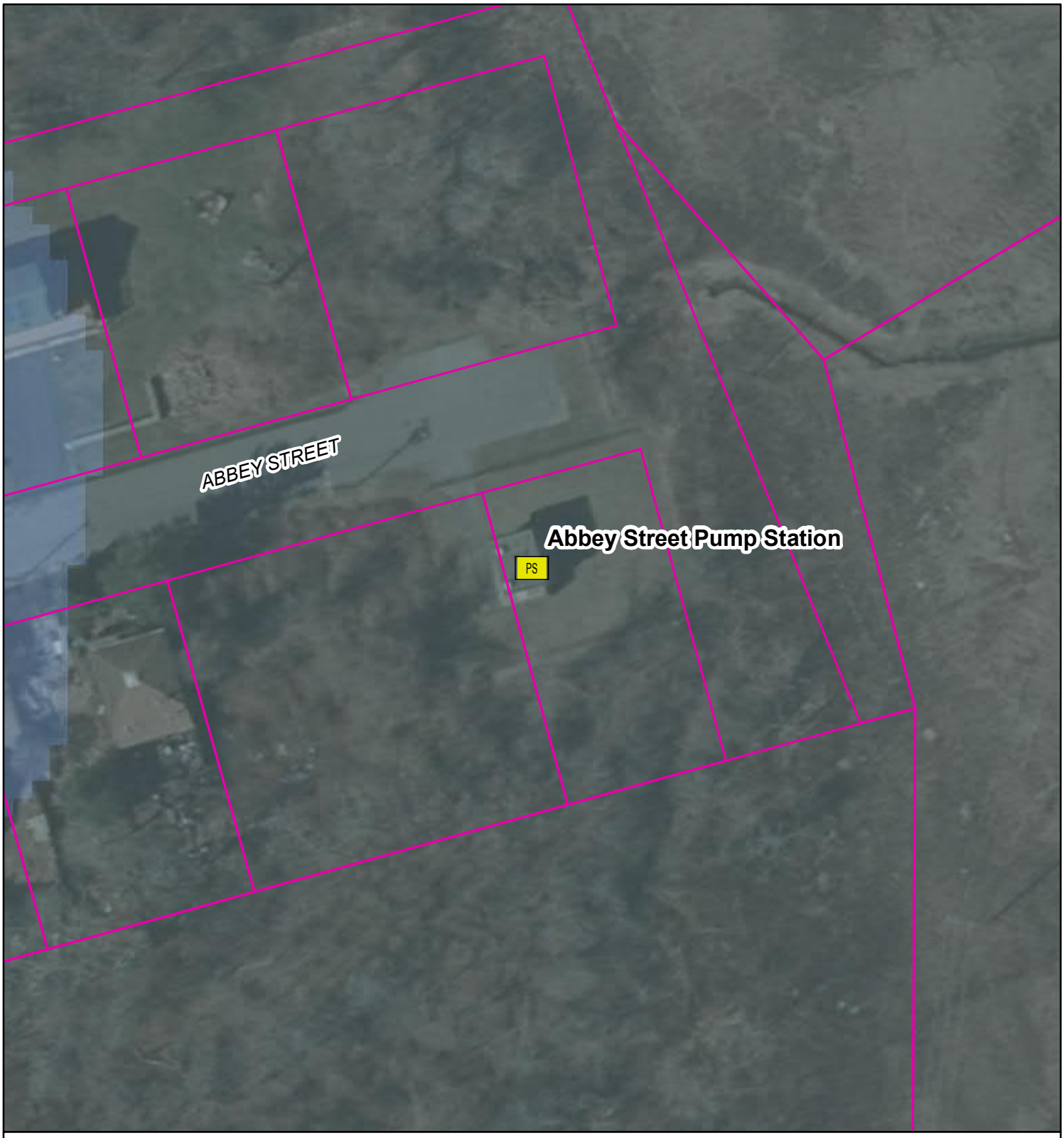
Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 8

Abbey Street Pump Station
MC-FRM 2050 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

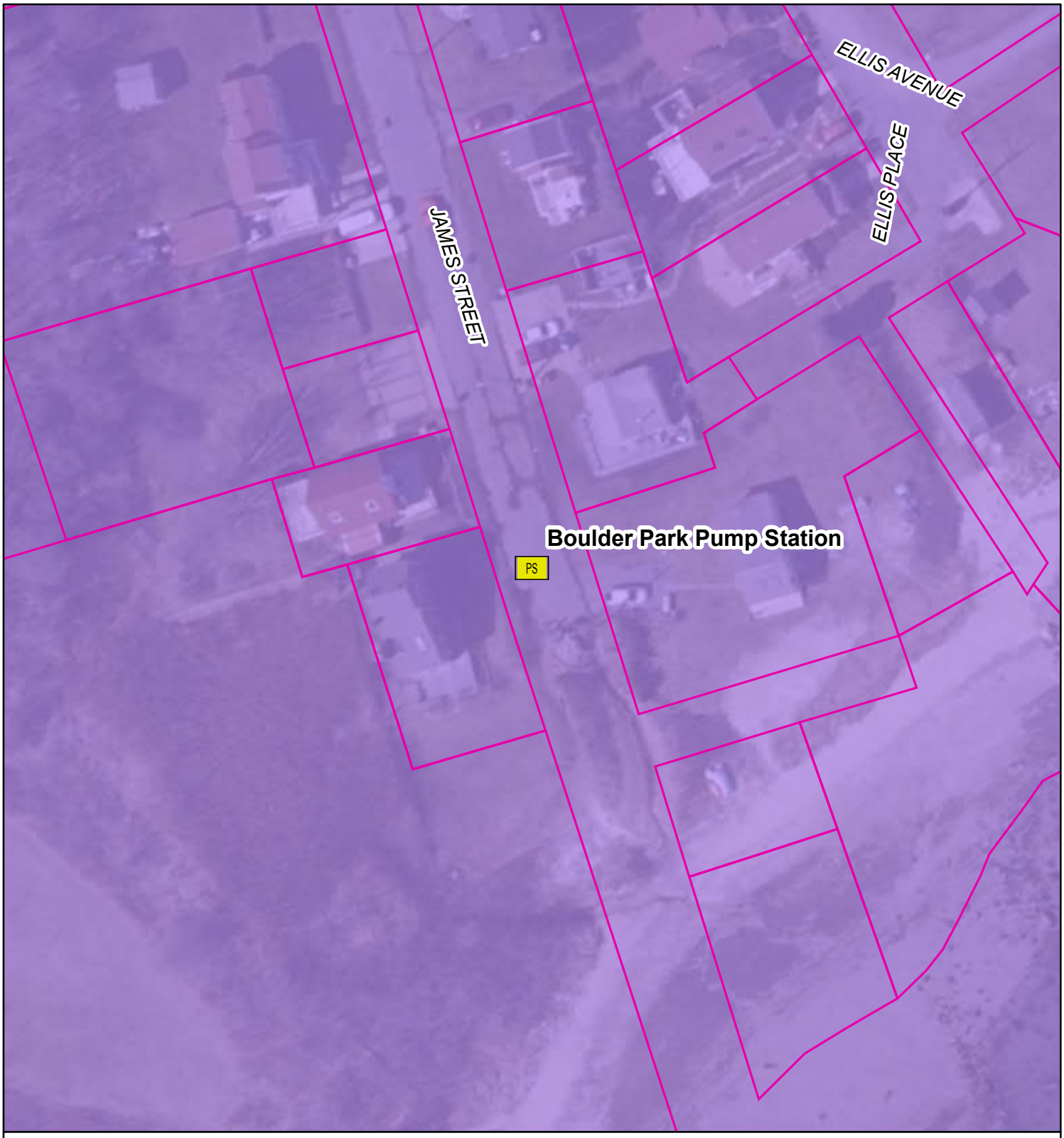
Figure 9

Abbey Street Pump Station
MC-FRM 2070 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2070_1pct_Inundation.mxd



Legend

PS Sewer Pump Station

Parcel Boundaries

FEMA National Flood Hazard Layer

Flood Zone Designations

VE: High Risk Coastal Area

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 10

Boulder Park Pump Station
FEMA Hazard Zones

0 25 50 Feet

1 inch = 50 feet

AECOM

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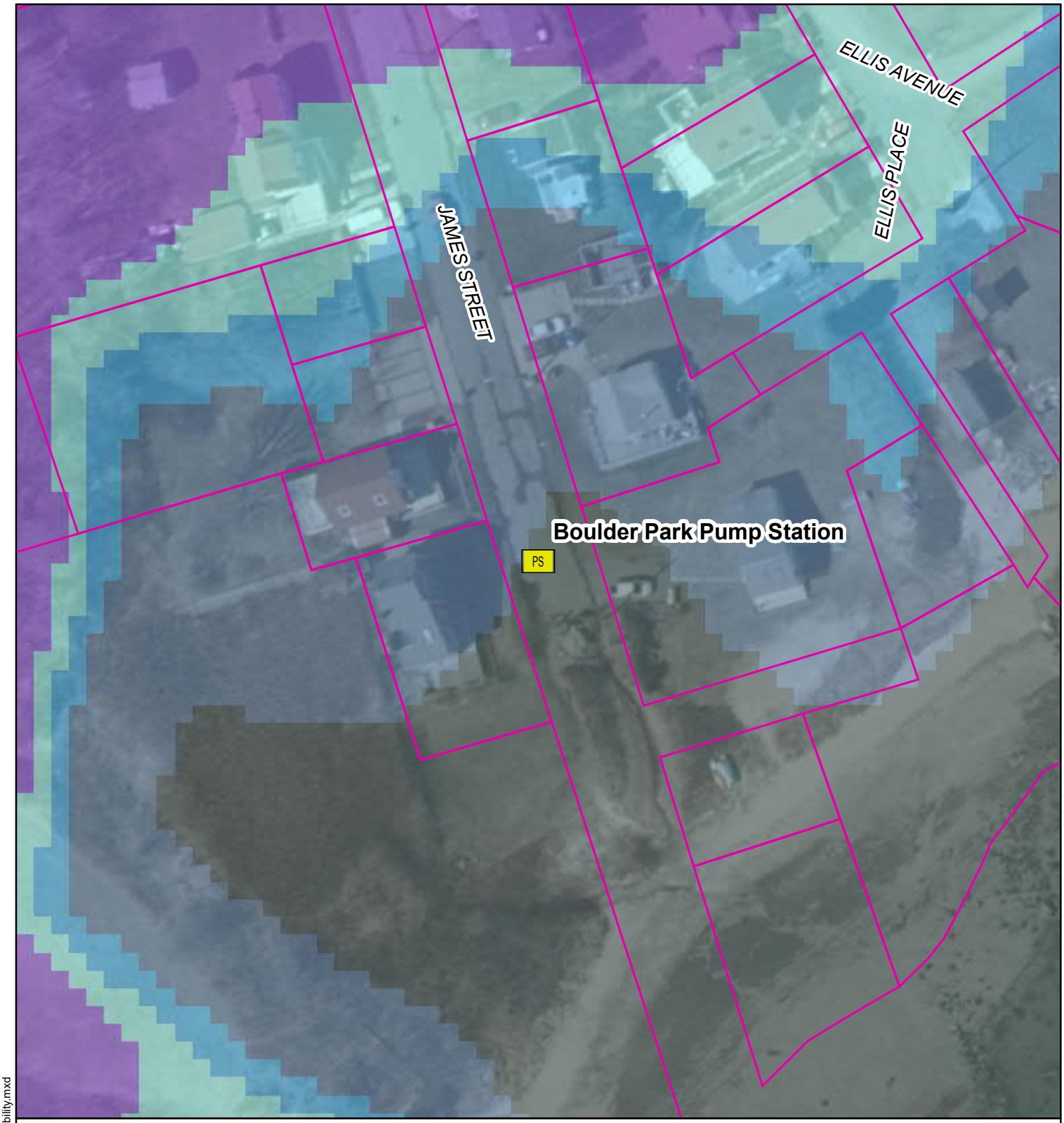


Legend

- PS — Sewer Pump Station
- Parcel Boundaries

Present Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability Preparedness Planning Grant

Figure 11

Boulder Park Pump Station
MC-FRM Present Day
Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_Probability.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 12

Boulder Park Pump Station
MC-FRM 2030 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2030_Probability.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2050 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 13

Boulder Park Pump Station
MC-FRM 2050 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2050_Probability.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

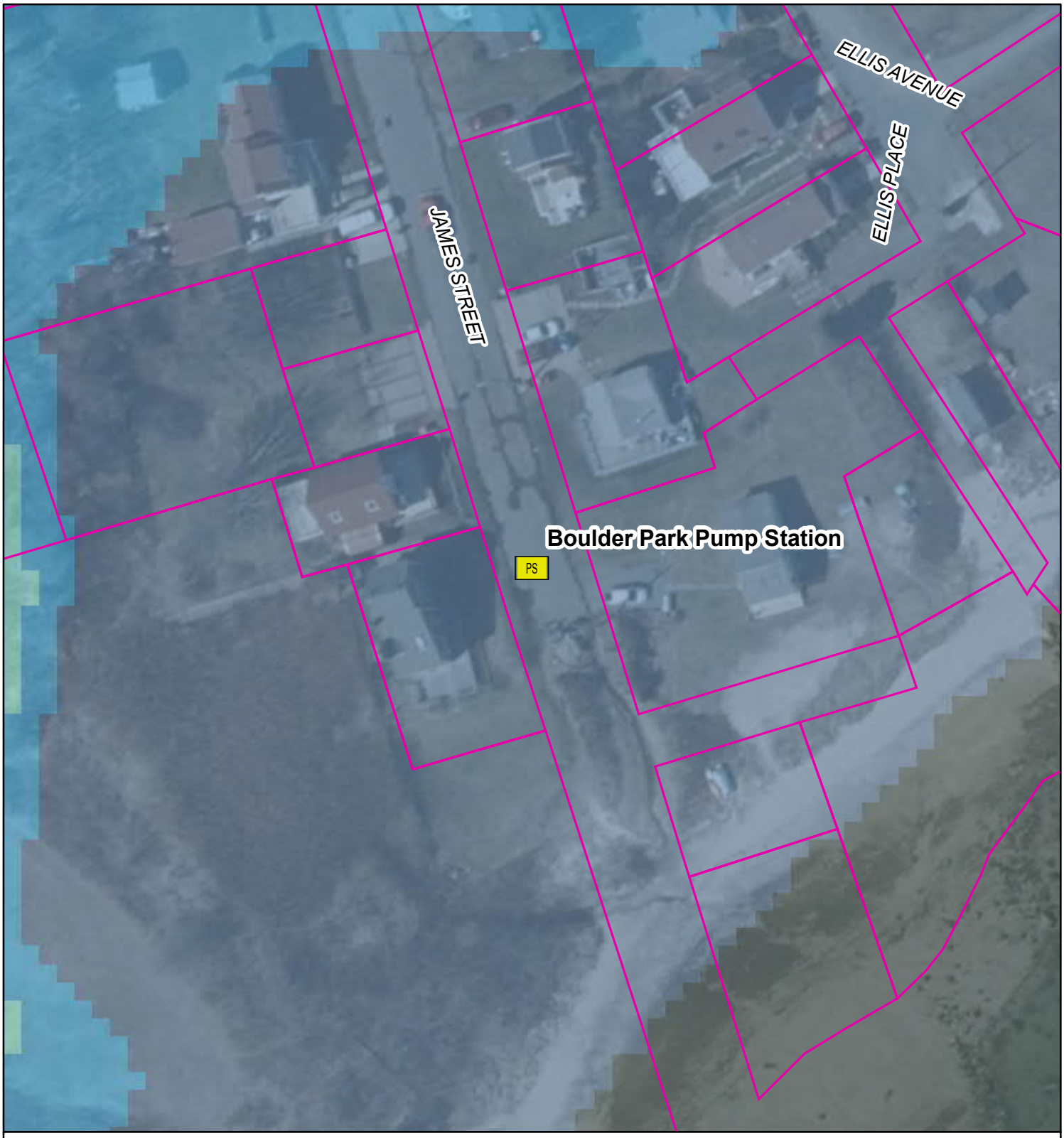
Figure 14

Boulder Park Pump Station
MC-FRM 2070 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2070_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

Present Day 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 15

Boulder Park Pump Station
MC-FRM Present Day 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_1pct_Inundation.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 16

Boulder Park Pump Station
MC-FRM 2030 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2030_1pct_Inundation.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2050 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 17

Boulder Park Pump Station
MC-FRM 2050 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2050_1pct_Inundation.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

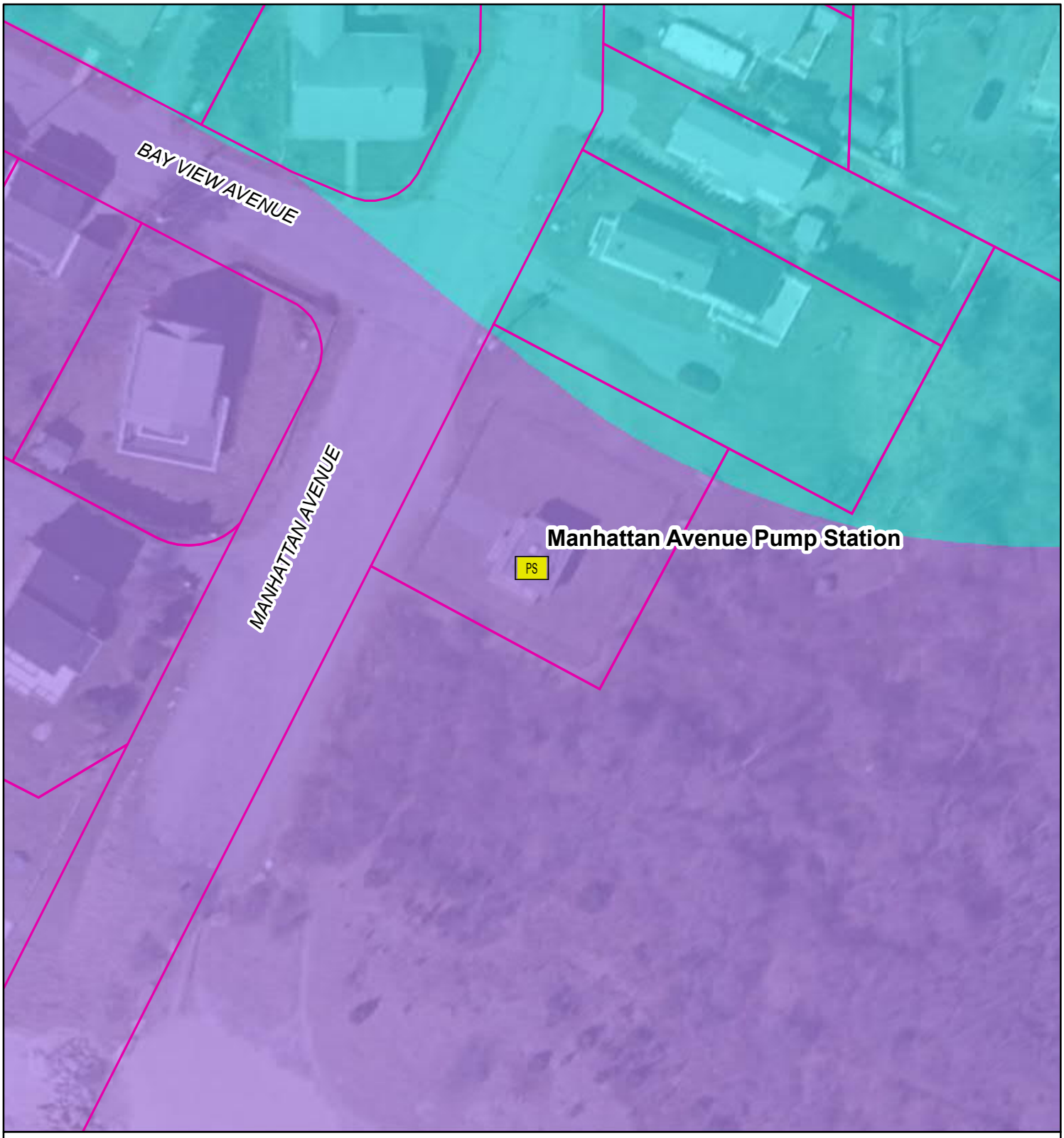
Figure 18

Boulder Park Pump Station
MC-FRM 2070 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHVMaps\PumpStations_2070_1pct_Inundation.mxd



Legend

PS Sewer Pump Station

Parcel Boundaries

FEMA National Flood Hazard Layer

Flood Zone Designations

AE: 1% Annual Chance of Flooding, with BFE

VE: High Risk Coastal Area

Town of Fairhaven, Massachusetts
Municipal Vulnerability Preparedness Planning Grant

Figure 19

Manhattan Avenue Pump Station
FEMA Hazard Zones

0 25 50 Feet

1 inch = 50 feet

AECOM

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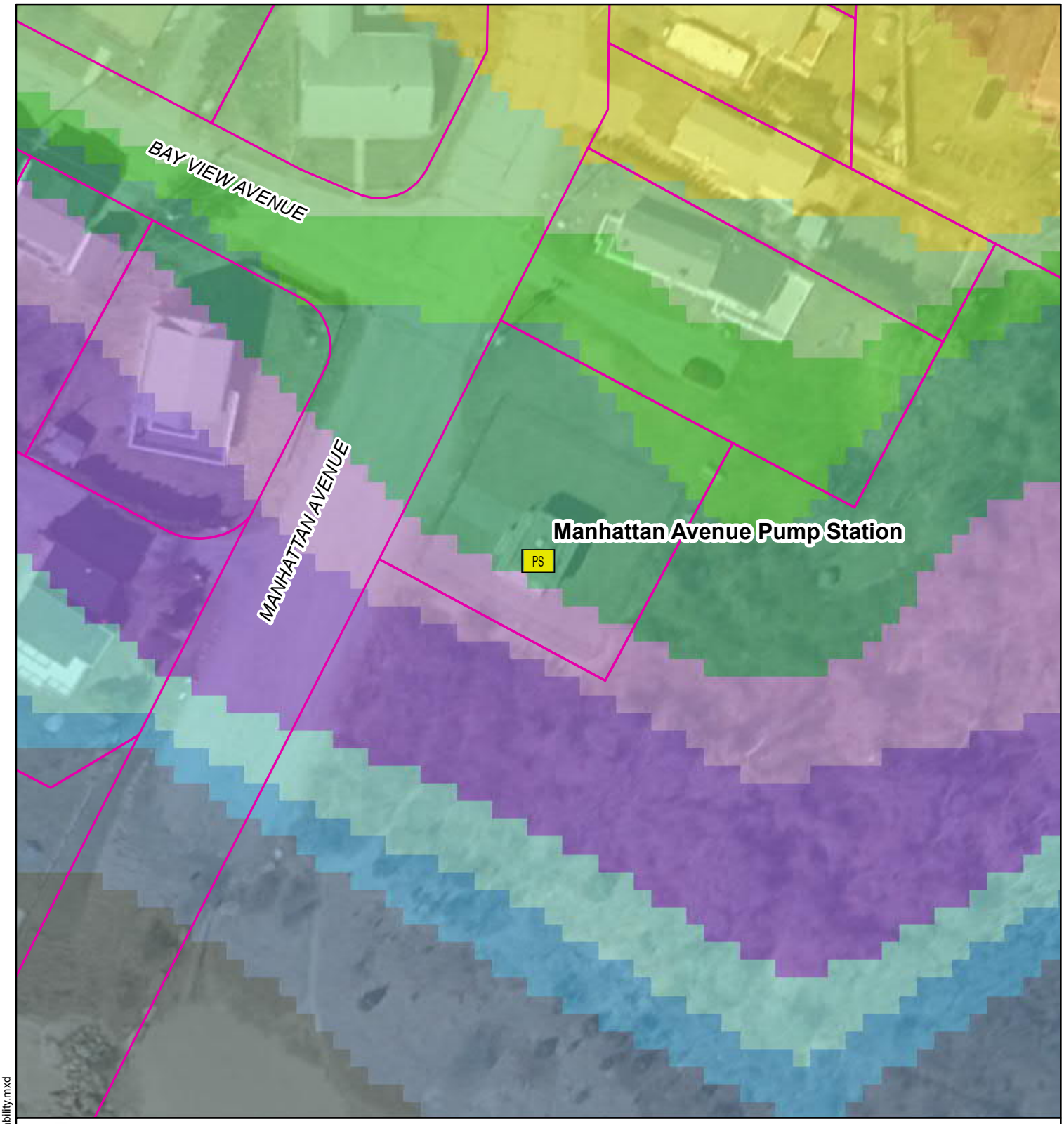


Legend

PS Sewer Pump Station

Parcel Boundaries

Present Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

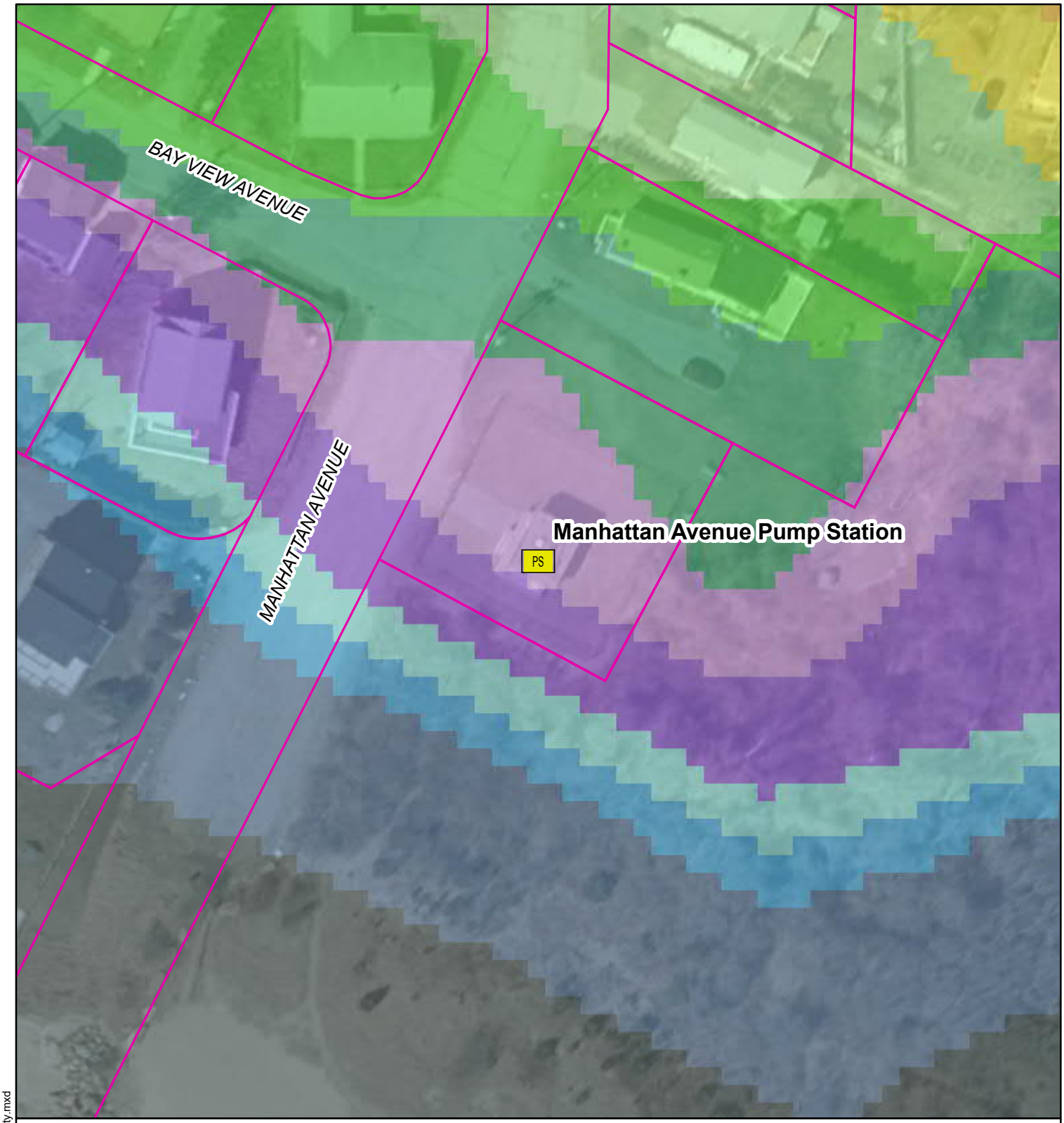
Figure 20

Manhattan Avenue Pump Station
MC-FRM Present Day
Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

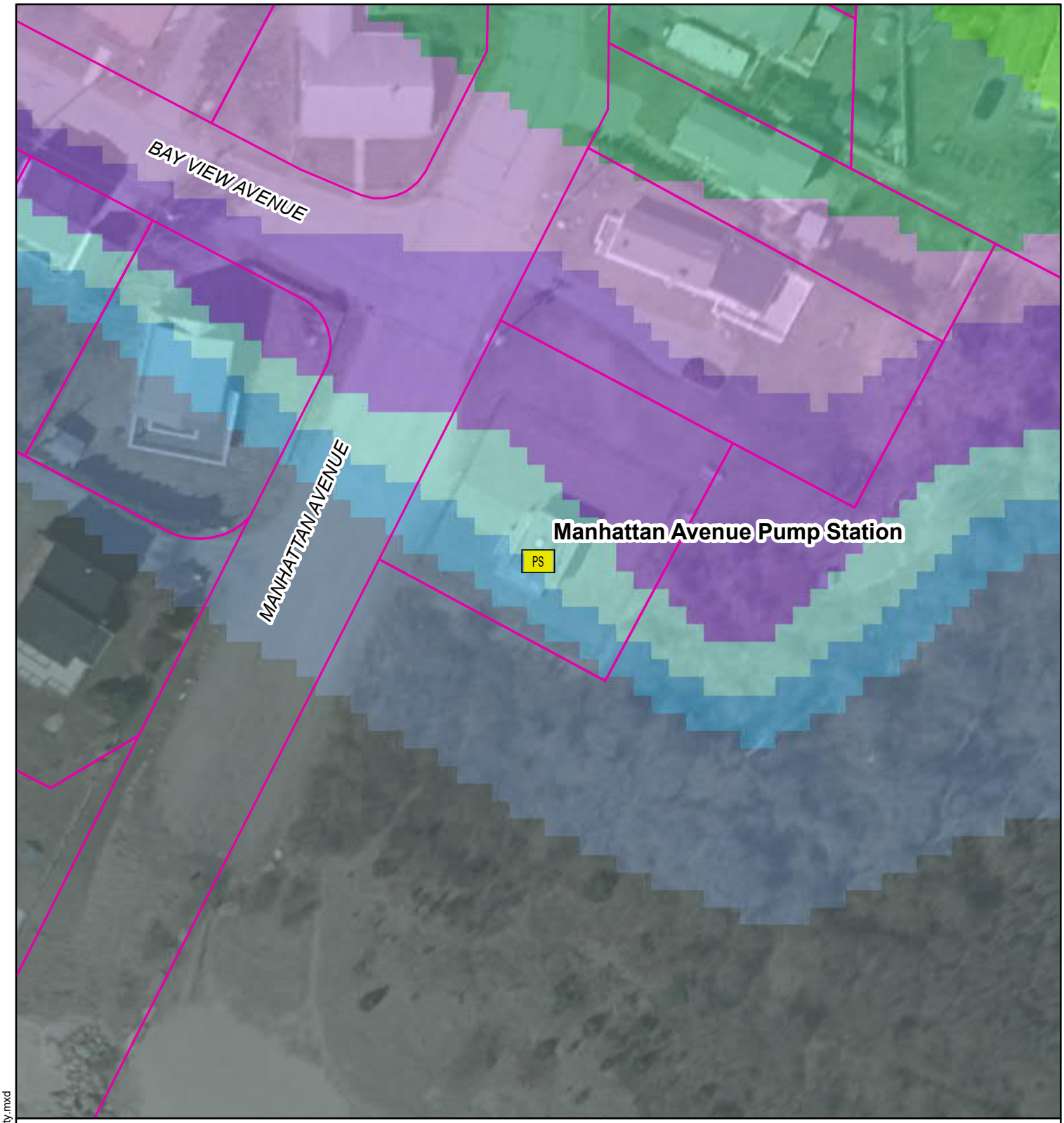
Figure 21

Manhattan Avenue Pump Station
MC-FRM 2030 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2030_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2050 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

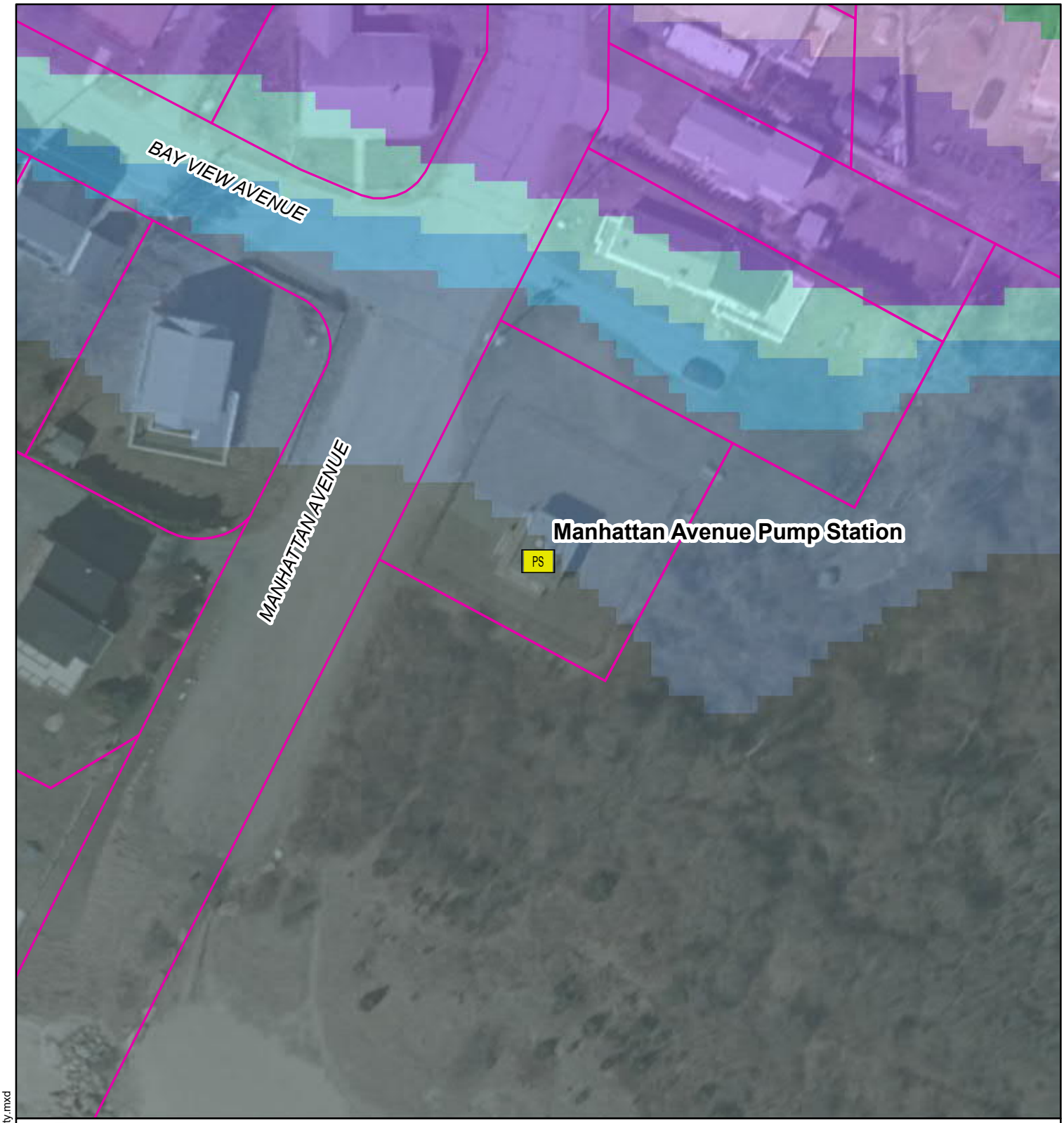
Figure 22

Manhattan Avenue Pump Station
MC-FRM 2050 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2050_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

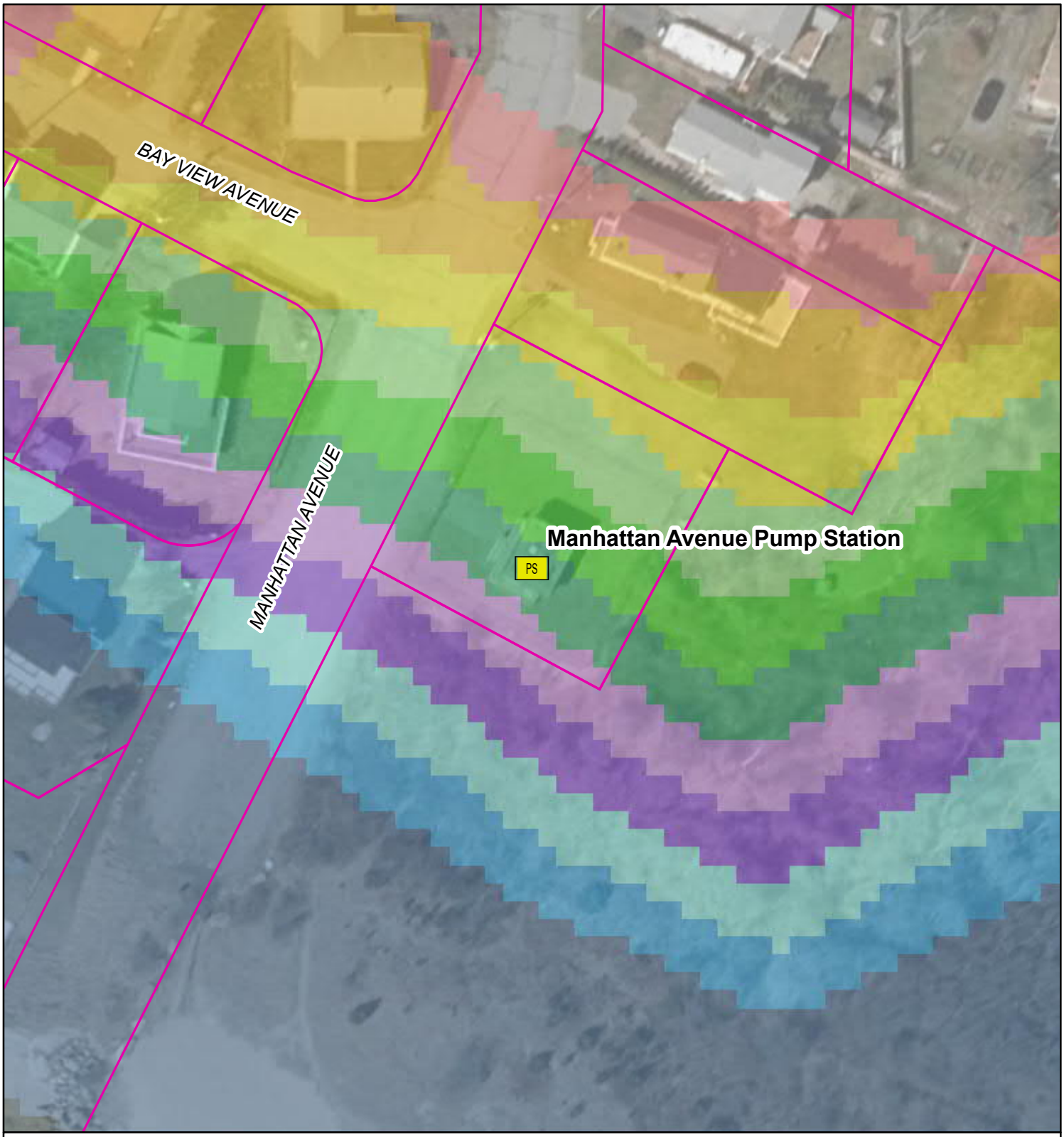
Figure 23

Manhattan Avenue Pump Station
MC-FRM 2070 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2070_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

Present Day 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

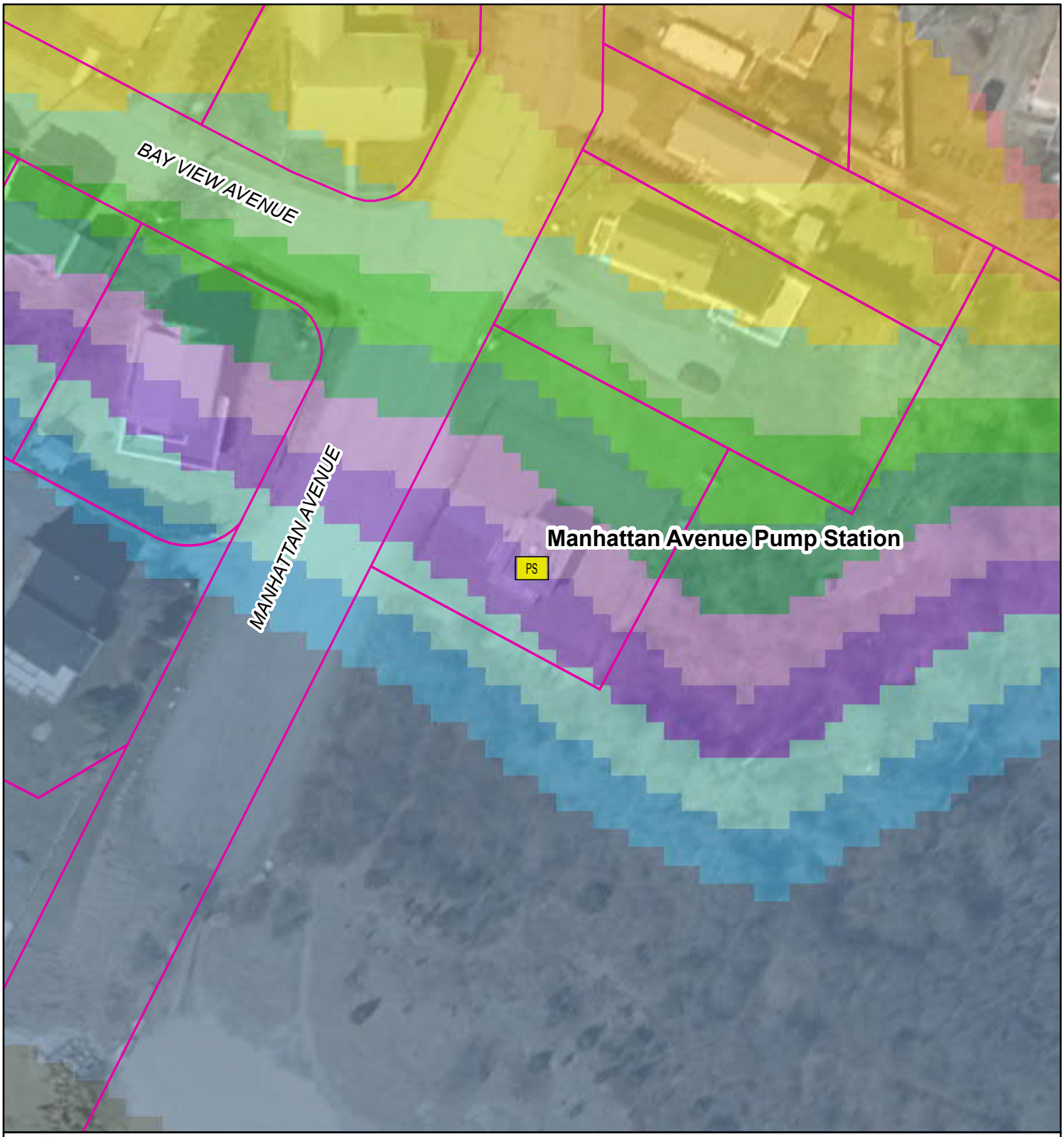
Figure 24

Manhattan Avenue Pump Station
MC-FRM Present Day 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_1pct_Inundation.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

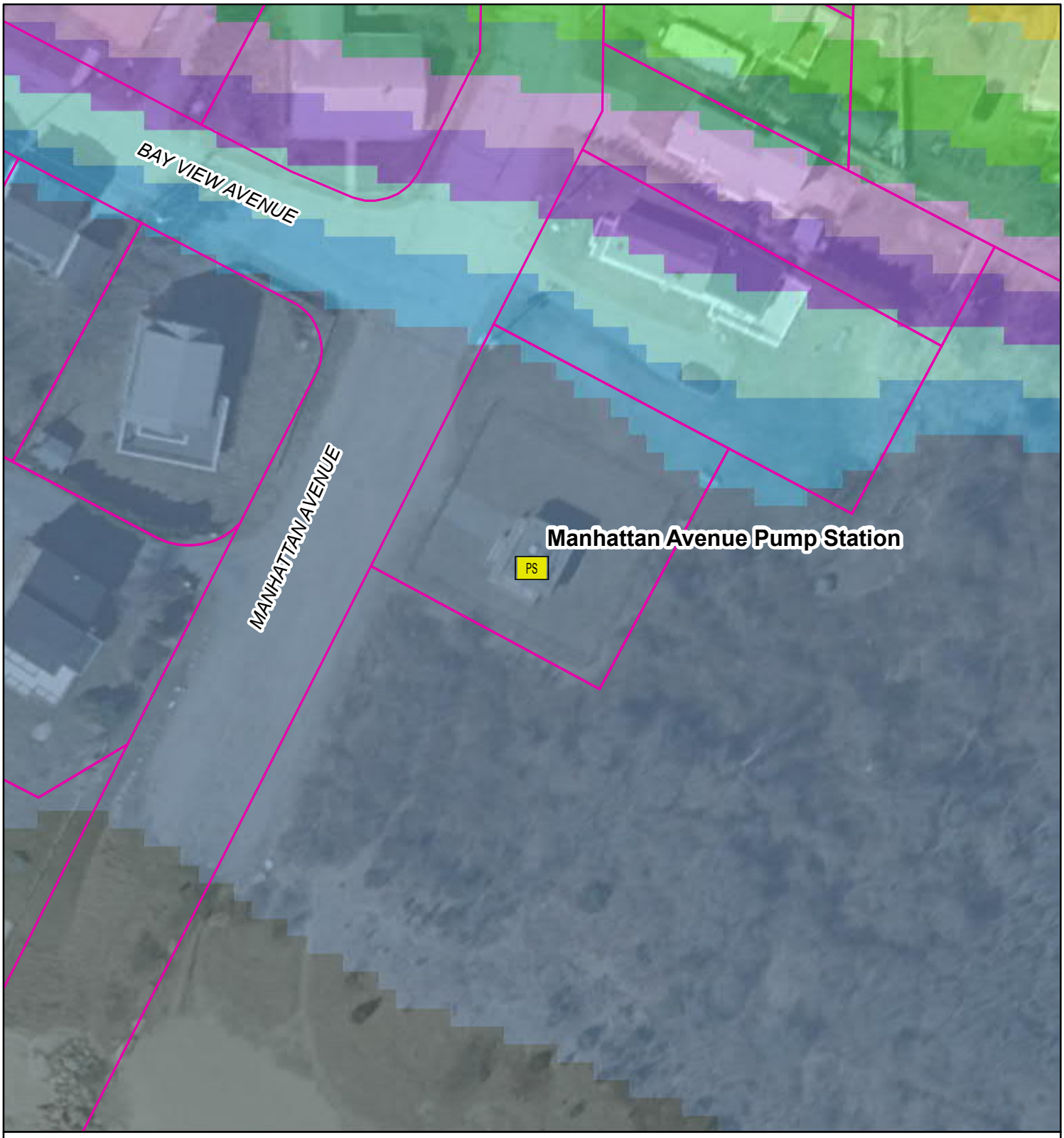
Figure 25

Manhattan Avenue Pump Station
MC-FRM 2030 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2030_1pct_Inundation.mxd



Legend

PS Sewer Pump Station

Parcel Boundaries

2050 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
Municipal Vulnerability
Preparedness Planning Grant

Figure 26

Manhattan Avenue Pump Station
MC-FRM 2050 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2050_1pct_Inundation.mxd

Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

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Municipal Vulnerability Preparedness Planning Grant

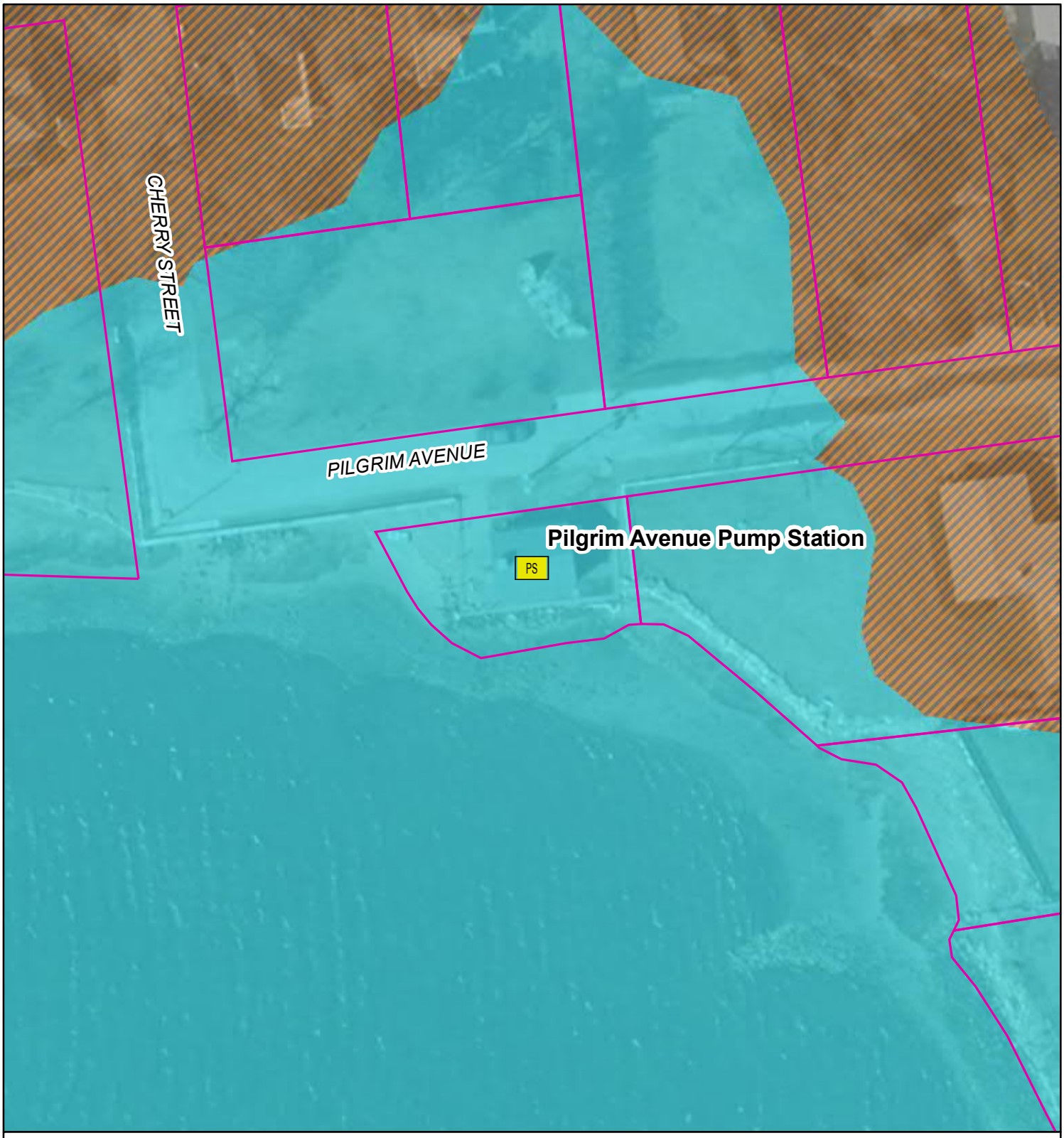
Figure 27

Manhattan Avenue Pump Station
MC-FRM 2070 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2070_1pct_Inundation.mxd



Legend

PS Sewer Pump Station

Parcel Boundaries

FEMA National Flood Hazard Layer

Flood Zone Designations

AE: 1% Annual Chance of Flooding, with BFE

X: Reduced Flood Risk due to Levee

Town of Fairhaven, Massachusetts
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Figure 28

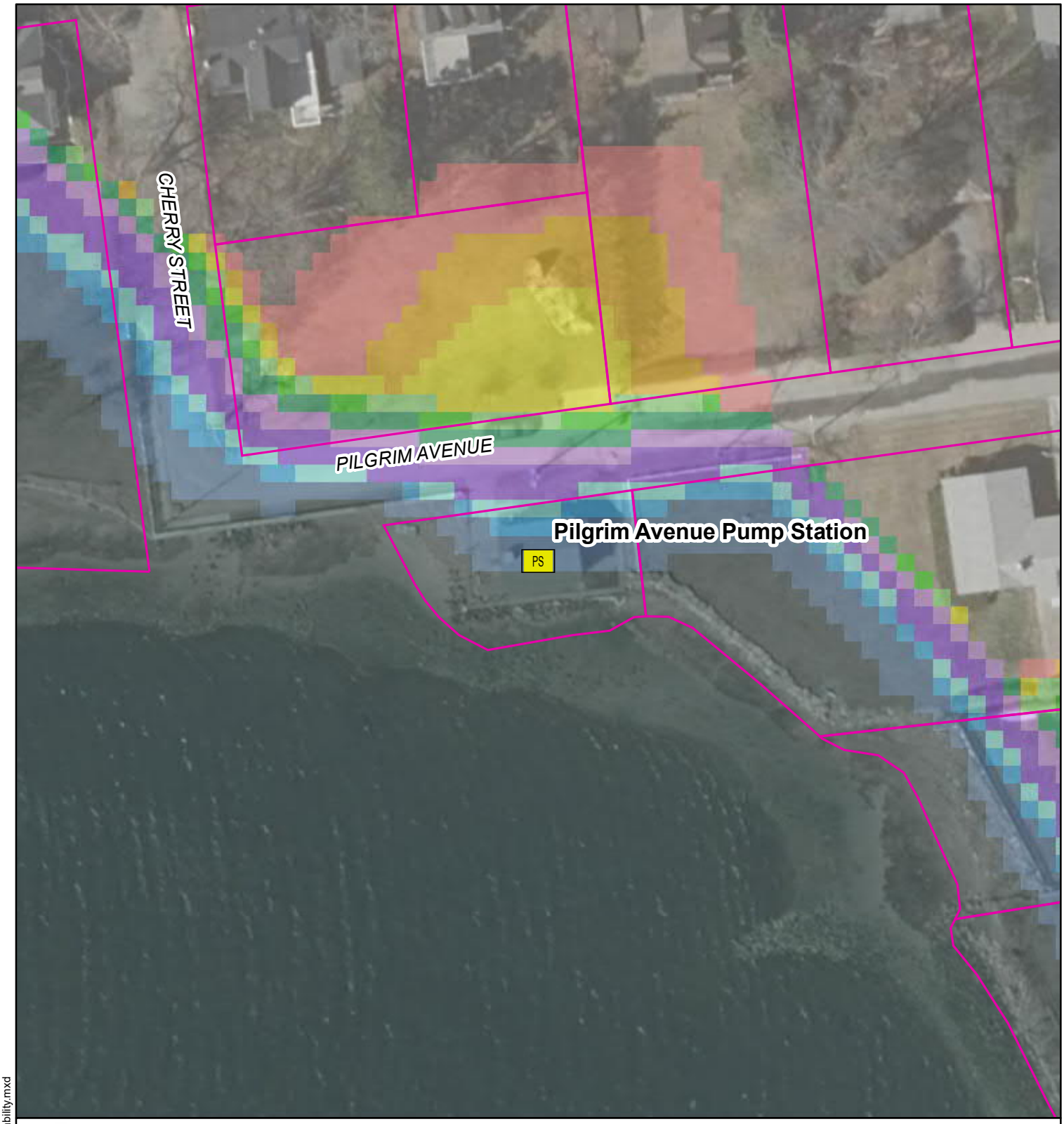
Pilgrim Avenue Pump Station
FEMA Hazard Zones

0 25 50 Feet

1 inch = 50 feet

AECOM

C:\Work\60617698FHV\Maps\PumpStations_Flood.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

Present Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

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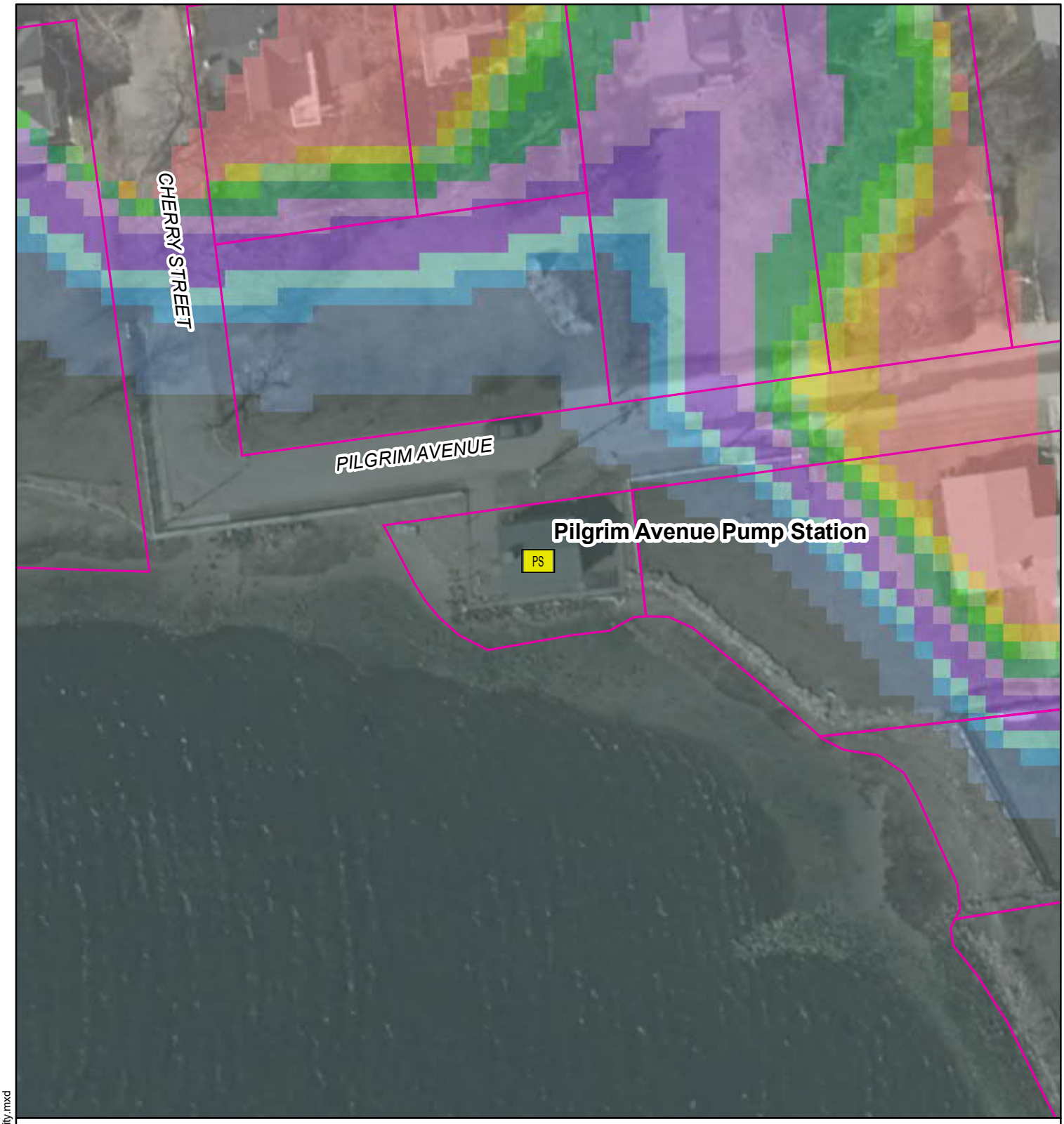
Figure 29

Pilgrim Avenue Pump Station
MC-FRM Present Day
Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

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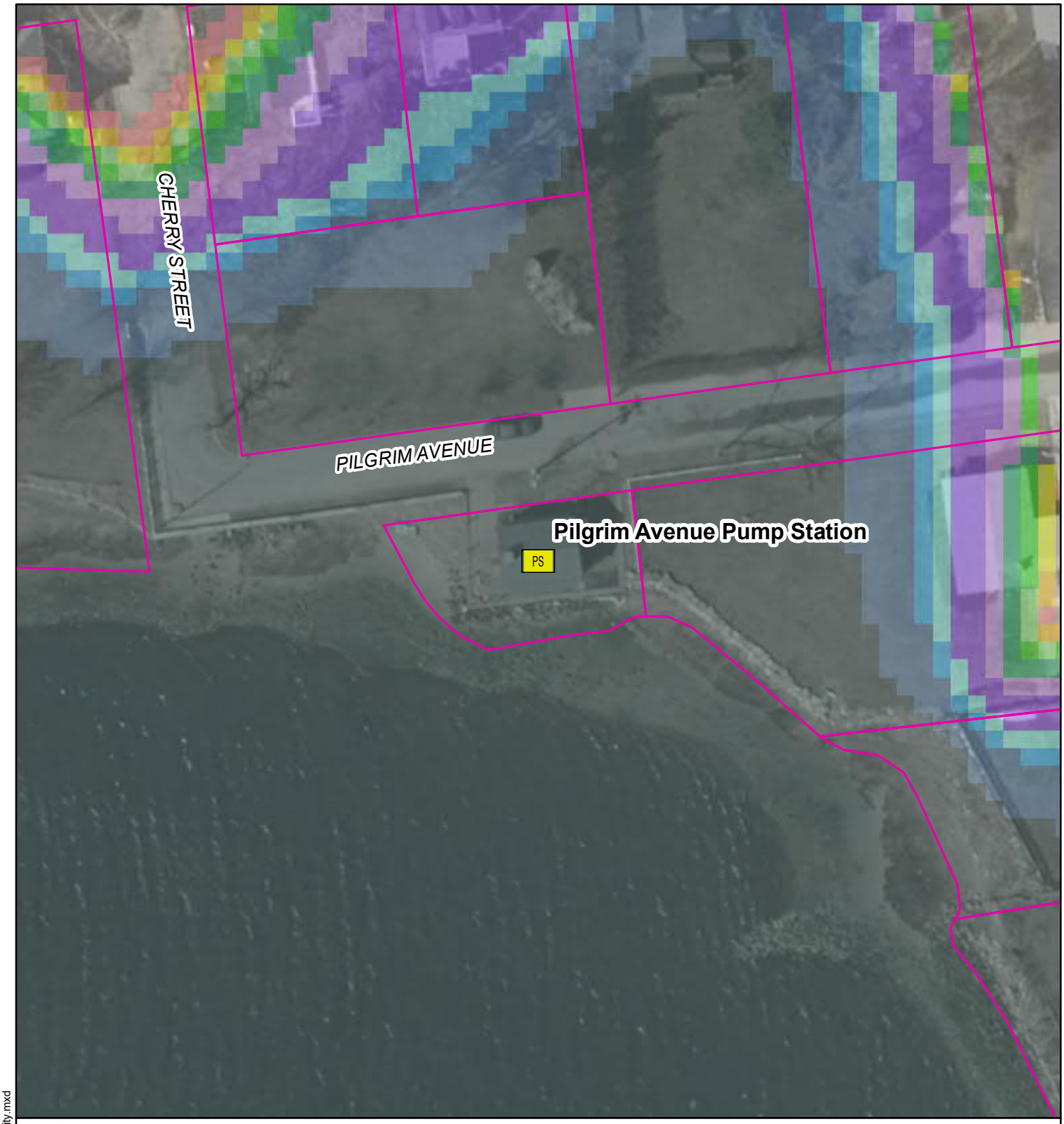
Figure 30

Pilgrim Avenue Pump Station
MC-FRM 2030 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2030_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2050 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

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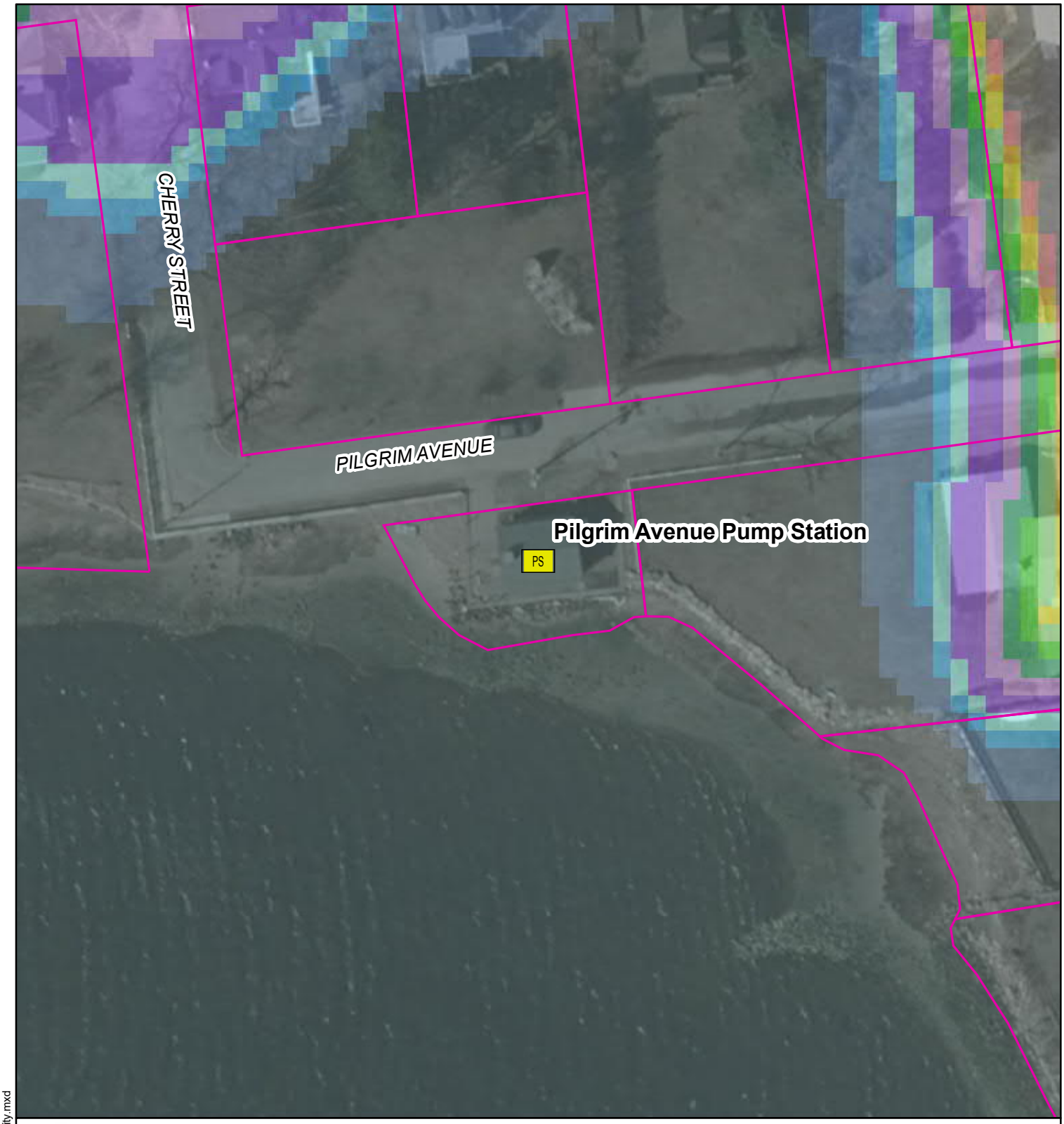
Figure 31

Pilgrim Avenue Pump Station
MC-FRM 2050 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2050_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 Coastal Flooding Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

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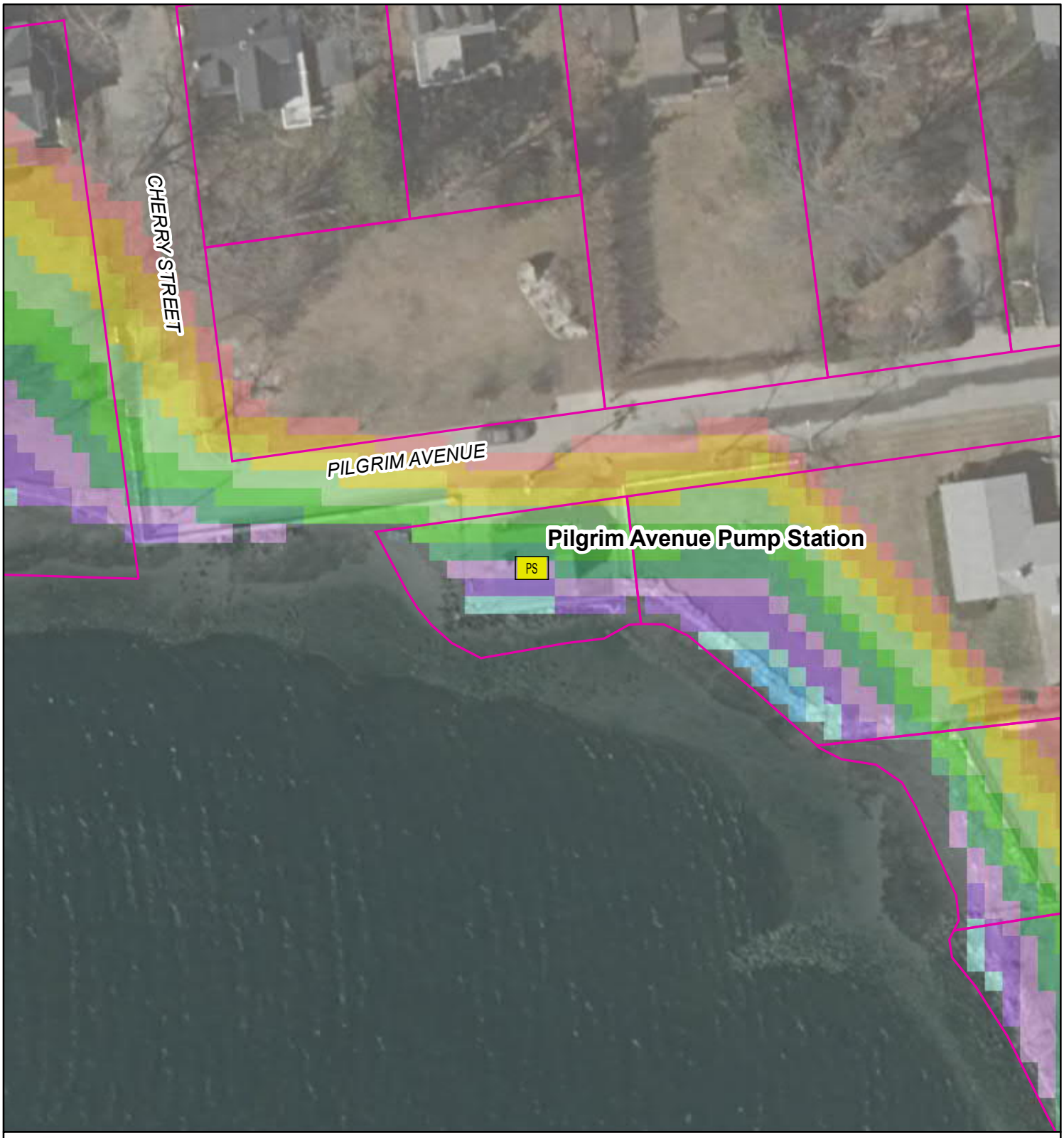
Figure 32

Pilgrim Avenue Pump Station
MC-FRM 2070 Coastal Flooding Probability

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_2070_Probability.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

Present Day 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

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Municipal Vulnerability
Preparedness Planning Grant

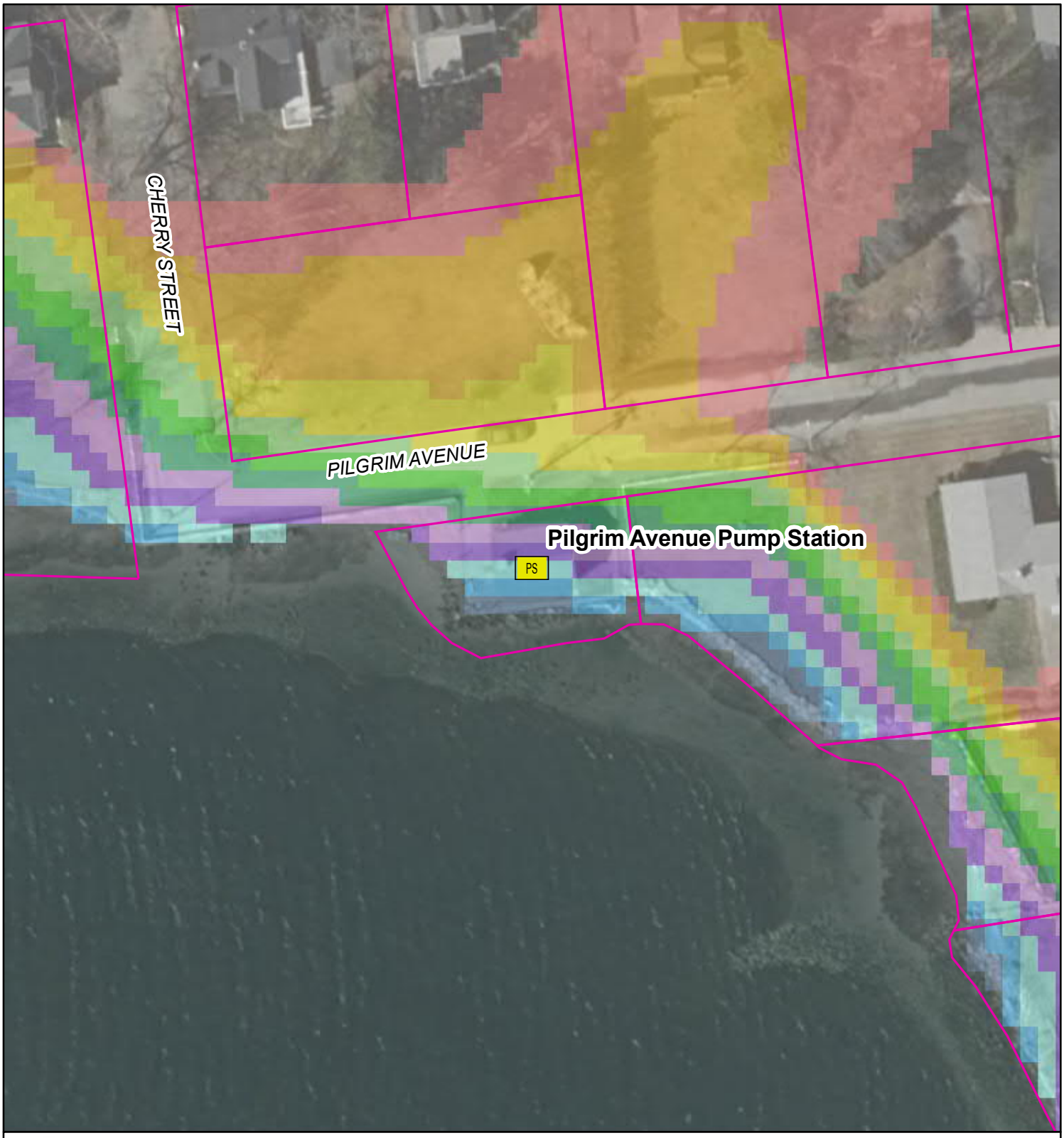
Figure 33

Pilgrim Avenue Pump Station
MC-FRM Present Day 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHV\Maps\PumpStations_Present_1pct_Inundation.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2030 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

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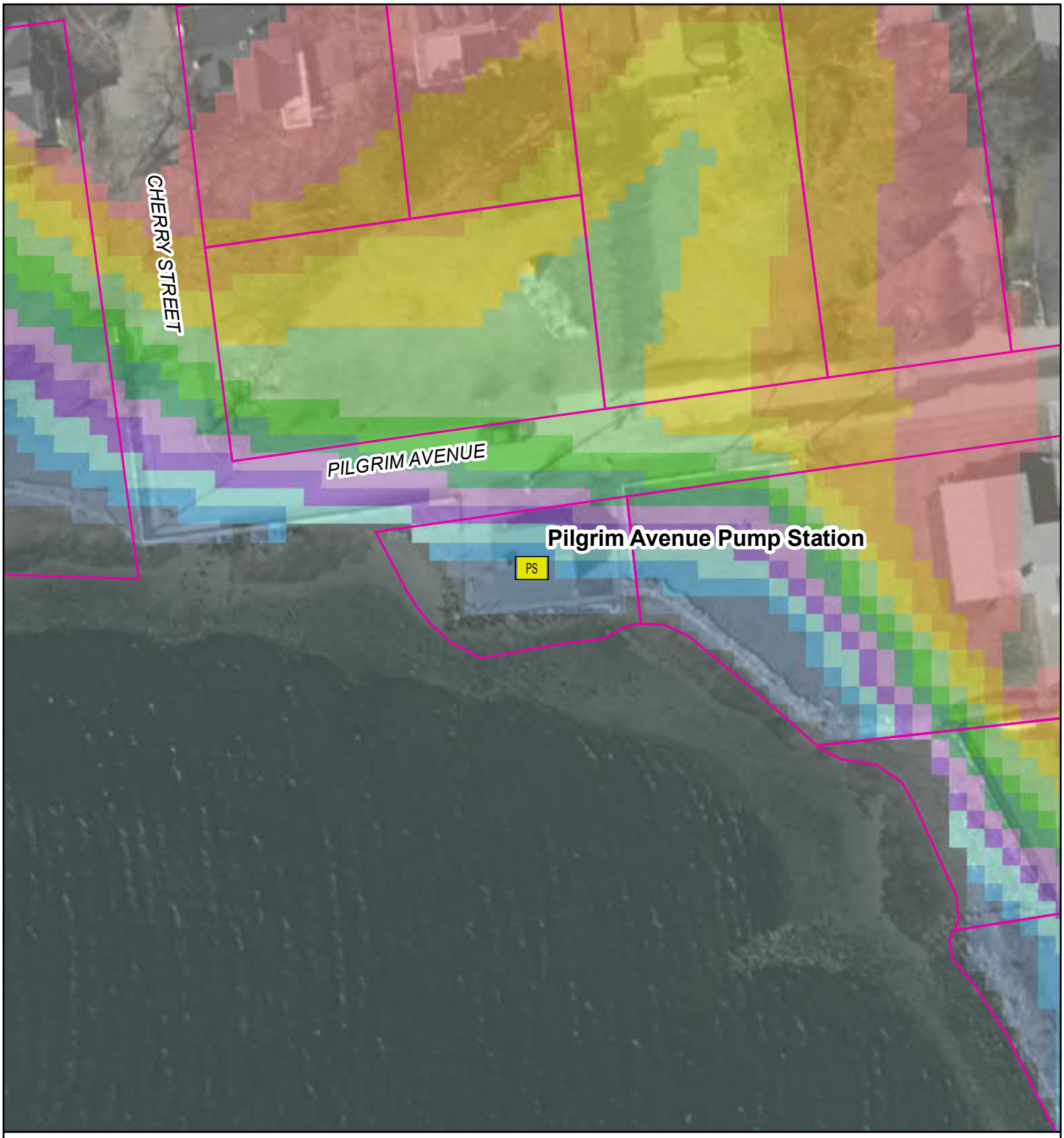
Figure 34

Pilgrim Avenue Pump Station
MC-FRM 2030 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHVMaps\PumpStations_2030_1pct_Inundation.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2050 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
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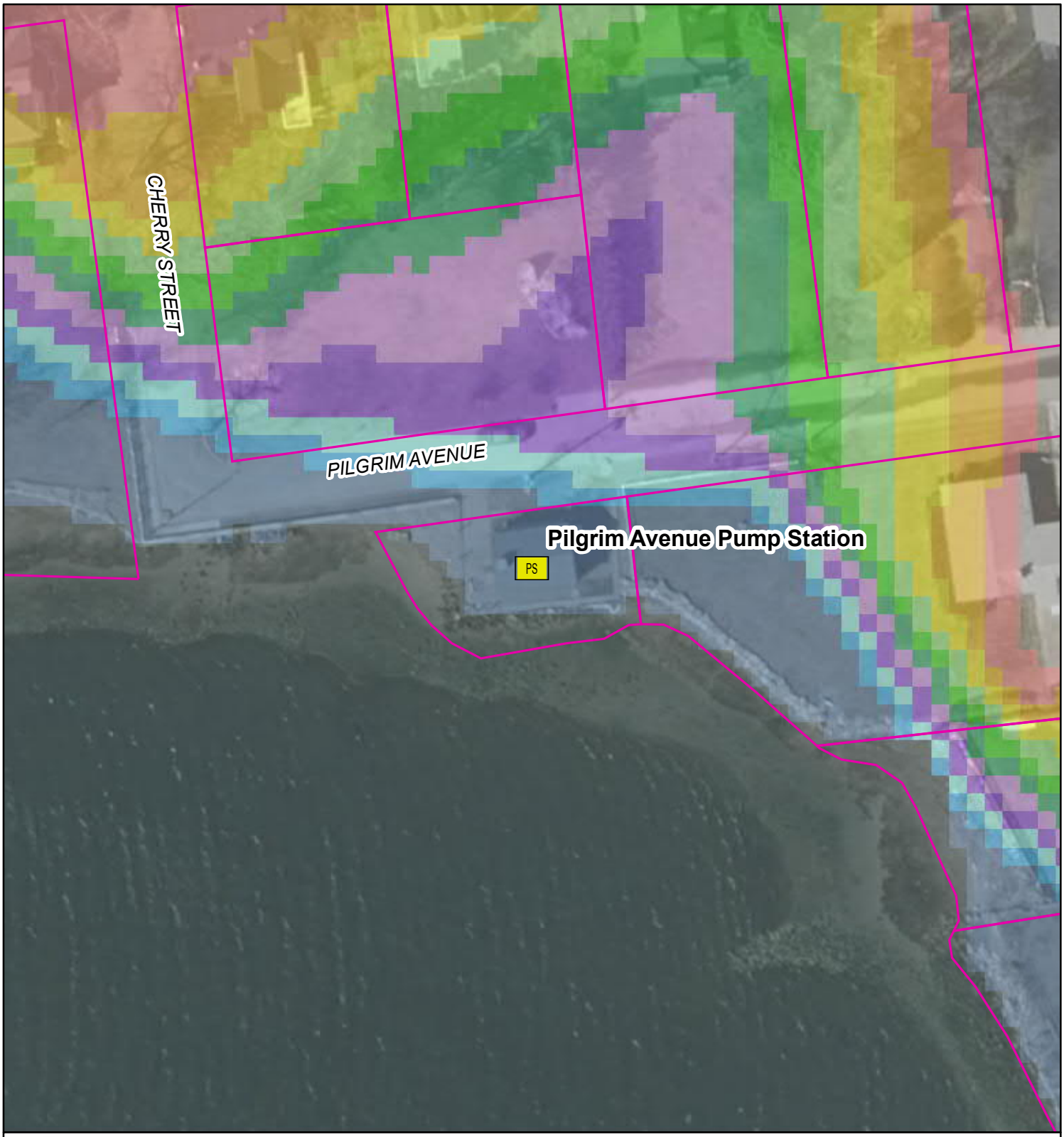
Figure 35

Pilgrim Avenue Pump Station
MC-FRM 2050 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHVMaps\PumpStations_2050_1pct_Inundation.mxd



Legend

- PS — Sewer Pump Station
- Parcel Boundaries

2070 1% Inundation Depth

- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- 2.5 ft
- 3 ft
- 3.5 ft
- 4 ft
- 4.5 ft
- 5 ft
- 10 ft
- >10 ft

Town of Fairhaven, Massachusetts
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Figure 36

Pilgrim Avenue Pump Station
MC-FRM 2070 1% Inundation Depth

0 25 50 Feet

1 inch = 50 feet

C:\Work\60617698FHVMaps\PumpStations_2070_1pct_Inundation.mxd