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MEMORANDUM

TO:	Robert Vance, PE & Gail Payne, City of Alameda	DATE:	October 20, 2021
FROM:	Dan Schaaf, PE Ben Shick, PE	JOB #:	APWD.22.21
SUBJECT:	Northern Shoreline Adaptation Project – Interior Drainage Alternatives		

Introduction

The Downtown Oakland and City of Alameda Northern Shoreline Adaptation Project proposes to design and construct a levee and seawall along the northern shoreline of Alameda near the Posey/Webster Tubes. The levee and seawall system will protect the northern shoreline and Posey/Webster tubes from inundation during the 100-year coastal flood event and for expected sea level rise. However, the Posey/Webster tubes are still susceptible to flooding from interior drainage due to capacity limitations on the inboard side of the levee system.

The City of Alameda's Storm Drain Master Plan has highlighted deficiencies in the existing storm drain system's capacity for a 10-year storm event. Construction of a levee and seawall system along the shoreline may cutoff interior surface drainage from reaching the Bay and limit the capacity of the already deficient storm drain system. Storm water will need to be conveyed within a storm drain system to the Bay which will require pumping during high tides, large storm events, and the need for pumping will significantly increase with sea level rise.

The City is seeking ways to mitigate the storm drain system deficiencies through the use of green stormwater infrastructure such as multiuse detention basin facilities that can enhance public parks while also providing flood protection. This investment in green infrastructure should limit future spending on grey stormwater improvements such as pump stations and larger pipes.

Interior Drainage Alternatives

The drainage system within the Northern Shoreline project watershed and adjacent to the Posey/Webster tube openings is currently undersized to handle the 10-year storm event and will likely experience more frequent flooding with sea level rise (SLR). Flooding levels with the 10-year event and 24 inches of SLR are shown in Figure 1. A considerable amount of flooding occurs throughout the Northern Shoreline project watershed. The flooding limits with SLR for the 10-year event look similar to what FEMA has mapped for the 100-year event today. The storm improvements identified in the City's Storm Drain Master Plan (SDMP, 2011) are shown in Figure 2. These improvements do not account for SLR as the science and guidance on SLR was very cursory at the time the SDMP was developed in 2011.

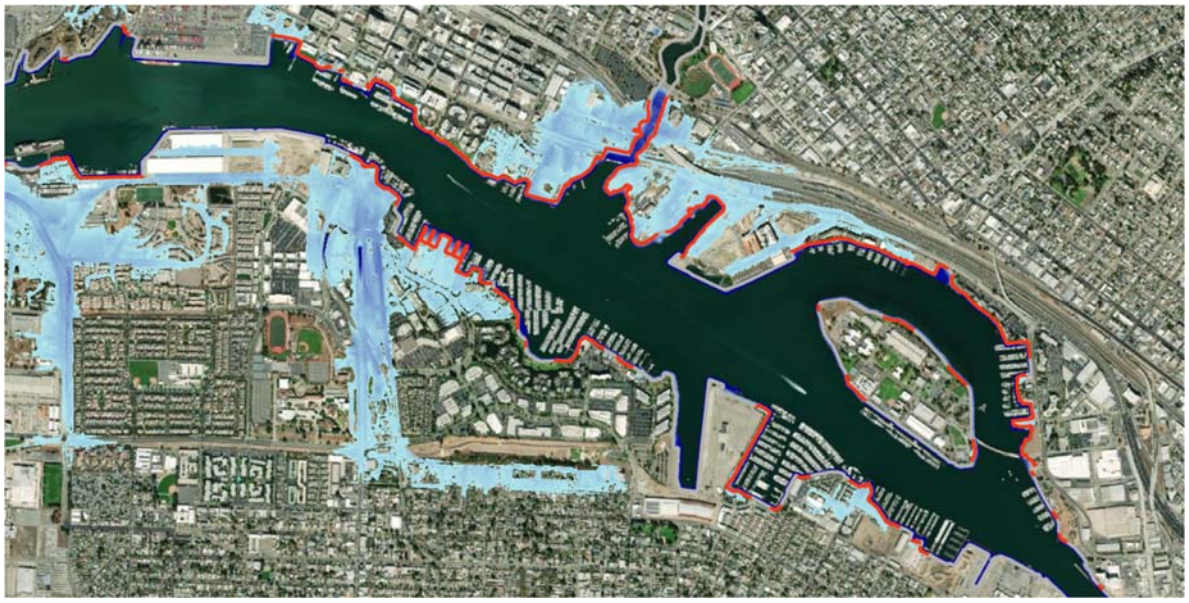

Figure 1: 10-Year Flood with 24-inches of SLR

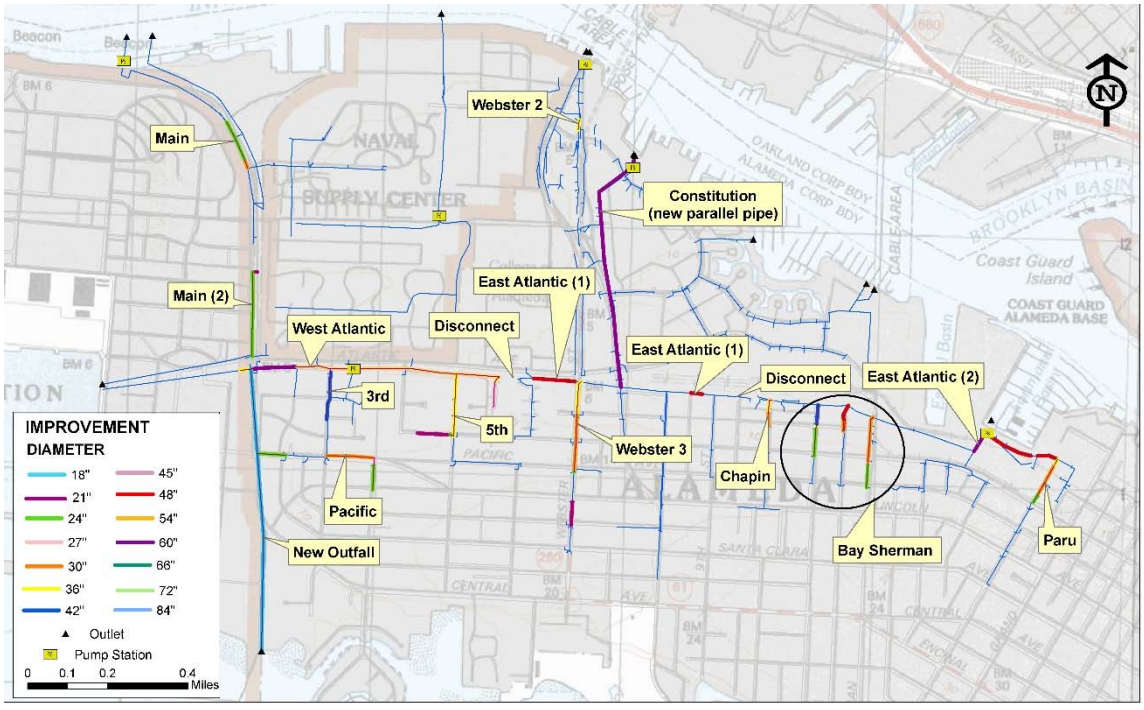

Figure 2: 10-Year Storm Drain Improvements, not including SLR

Fortunately, there is a regional effort looking at SLR impacts on the shorelines along Alameda. Most of the improvements include some form of a levee to hold back both current and future rising tides. As part of the FEMA levee accreditation process an interior drainage analysis will need to be performed. Areas to be removed from the FEMA floodplain will need to have an average depth of less than one-foot during the joint probability of the 100-year runoff and 100-year tidal flood.

Storm drain infrastructure improvements required to alleviate flooding during the 100-year event and to accommodate expected sea level rise are significant. The required improvements include a combination of new storm drain systems, upsizing existing pipes, and increasing the capacity of existing pump stations. The improvements need to be designed to accommodate the peak runoff; therefore, alternatives that reduce the peak discharge rate from the watershed should be considered and evaluated.

Detention Basin Alternatives

Detention basins can be constructed within or adjacent to a storm drain system to store and attenuate runoff during significant rain events. Detention basins strategically located and designed can significantly reduce the peak runoff from the watershed, which may have the following benefits:

- Reduced flooding during large storm events
- Reduced storm drain infrastructure improvements to accommodate 10-year and 100-year storm events and sea level rise
- Reduced energy consumption to pump storm water to the Bay
- Reduced peak discharge rates to the Bay

Detention basins can also function to remove trash, debris, sediment, and pollutants. Detention basins can be designed for multiuse (recreation, park, open space, etc.) since they typically only store water during large storm events for a finite amount of time. Examples of a multiuse detention basins are shown in Figure 3.

Figure 3: Multiuse Detention Basin Examples

The City has identified open space areas within the watershed that have the potential to provide multi benefits to flood control, public spaces, and water quality. Potential locations include Jean Sweeny Open Space Park (Basin 1) and the former railroad line east of Mariners Square Drive (Basin 2), as shown in Figure 4.

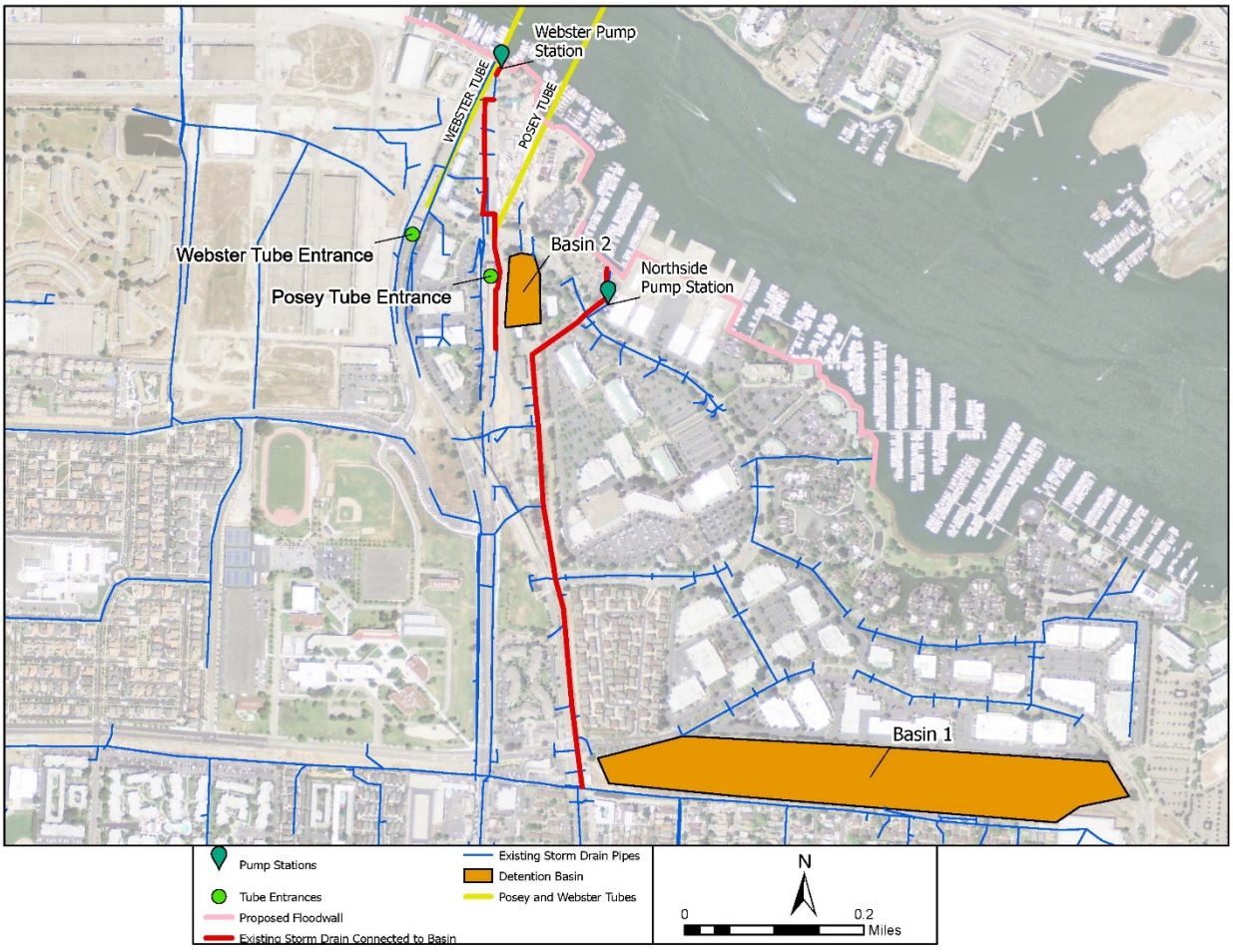

Figure 4: Potential Locations for Detention Basins

A detention basin adjacent to Mariners Square (Basin 2) could reduce peak flows to the Webster Pump Station and reduce flooding in the area adjacent to the Posey Tube entrance. The existing Webster Pump Station has a capacity of roughly 15 cfs. The basin could be utilized for local green infrastructure goals and pollutant load reductions while providing overflow volume in large storm events. The basin could be up to 1.8 acres in area with a depth dependent on grading and groundwater limitations. This basin would hold peak flows and slowly discharge them back into the system once the storm subsides. Depending on soil conditions, vegetation and hydraulics, water may infiltrate and reduce pollutant impacts to the Bay.

A detention basin within Jean Sweeny Open Space Park (Basin 1) could reduce flows to the Northside Pump Station which drains a considerable portion of the island and has a capacity of approximately 122 cfs. If the pump station is overwhelmed, the drainage network can spill and cause flooding to the Posey Tube entrance. This 22-acre park's long linear nature give it high potential for the use of green

infrastructure such as banked bioretention areas that overflow in a stepwise manner or a vegetated swale basin that could reduce both peak flows and volume at the Northside Pump Station. This would reduce the risk of the interior drainage system being overwhelmed and spilling into the Posey Tubes. The park is in the upper reaches of the watershed and may have potential for infiltration and would be less likely to be impacted by rising groundwater.

Green Infrastructure

As previously mentioned, green infrastructure can be incorporated into the design of detention basins and provide multiple benefits to the community. Green infrastructure can also be implemented throughout the watershed where feasible to improve water quality and reduce runoff through attenuation and infiltration. Green infrastructure, such as bioswale shown in Figure 4 below can be designed for smaller storm events to capture the pollutants located in the "first flush" of a storm event. Ideally, these smaller green infrastructure features are placed upstream of the detention basins.

Figure 5: Roadside Bioswale Example

The City has green infrastructure targets to meet pollutant load reductions listed in the municipal regional permit (MRP 2.0). Many of these targets will be met through green streets such as the one shown in Figure 5 and other green infrastructure retrofits with new and redevelopment. The multiuse benefits also have the potential to assist the City in achieving some pollutant load reductions.

Summary

Some form of coastal barrier is required to protect the City of Alameda from the current 100-year tide and future sea level rise. These coastal barriers need to take into consideration the interior drainage impacts and future impacts due to climate change. The Northern Shoreline Adaptation project and the associated interior drainage improvements will be significantly impacted by these anticipated future scenarios. The traditional solution to drainage insufficiencies is increasing pipe and pump station capacity. The City would like to explore a greener solution and investigate mitigation measures that use green

infrastructure design concepts to slow down runoff, reduce peak volumes, and provide water quality benefits. The City has identified two locations for multi benefit storm water detention basins that could provide both flood protection and green infrastructure benefits. Both basins are located in open space which can be designed to have a community benefit by providing a local park or ball field.