FINAL

Channel Maintenance Special Study – Mission Bay High School and Pacific Beach Drive/Olney

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JULY 2015

REVISED: OCTOBER 2015

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1 INTRODUCTION

The City of San Diego (City) developed the Master Storm Water System Maintenance Program (MMP) (City of San Diego 2011) to govern channel operation and maintenance activities in an efficient, economic, environmentally and aesthetically acceptable manner to provide flood control for the protection of life and property. A lawsuit was filed regarding the MMP (San Diegans for Open Government et al v. City of San Diego, San Diego Superior Court Case No. 37-2011-00101571), and the City entered into a settlement agreement (Settlement Agreement), which requires the City to conduct a special study (Channel Maintenance Special Study) to evaluate the purpose, need and alternatives to channel maintenance activities for each channel maintained during the first two years of MMP implementation in City Fiscal Years 2014-2015 and 2015-2016 (FY 14-15).

The current phase of the Mission Bay High School (MBHS) Channel and Pacific Beach Drive/Olney Street (PBO) Channel maintenance project includes the mechanized removal of sediment, vegetation, trash, and debris from a drainage channel in the Mission Bay watershed using heavy equipment. MBHS and PBO Channels area is displayed on MMP Maps 36 and 37: This special study fulfills Section 1.8 of the Settlement Agreement for channel maintenance activities occurring within the MBHS Channel and PBO Channel.

1.1 Background

The Channel Maintenance Special Study summarizes the suite of channel assessment and retrofit opportunities for channels maintained during FY 14–15. Within the framework of the MMP, channel assessment and retrofit evaluation requires consideration of a number of factors including maintenance practices, environmental avoidance and minimization measures, adjacent infrastructure, and project alternatives. Combined, these elements address the specific terms of the underlying legal agreement for each focal channel. Table 1 provides a summary of the channel assessment and retrofit opportunity elements addressed in this Channel Maintenance Special Study.

Table 1
Channel Maintenance Special Study Overview Based on Settlement Agreement Item 1.8

Settlement Agreement Requirements	Section of Special Study
Evaluate Current Maintenance Level	
Purpose of conveyance system location	2.1
Need for conveyance system	2.1
Need for maintenance at individual locations	2.2
Potential to modify maintenance practices	2.2

Table 1
Channel Maintenance Special Study Overview Based on Settlement Agreement Item 1.8

Settlement Agreement Requirements	Section of Special Study
Evaluate Current Maintenance Level	
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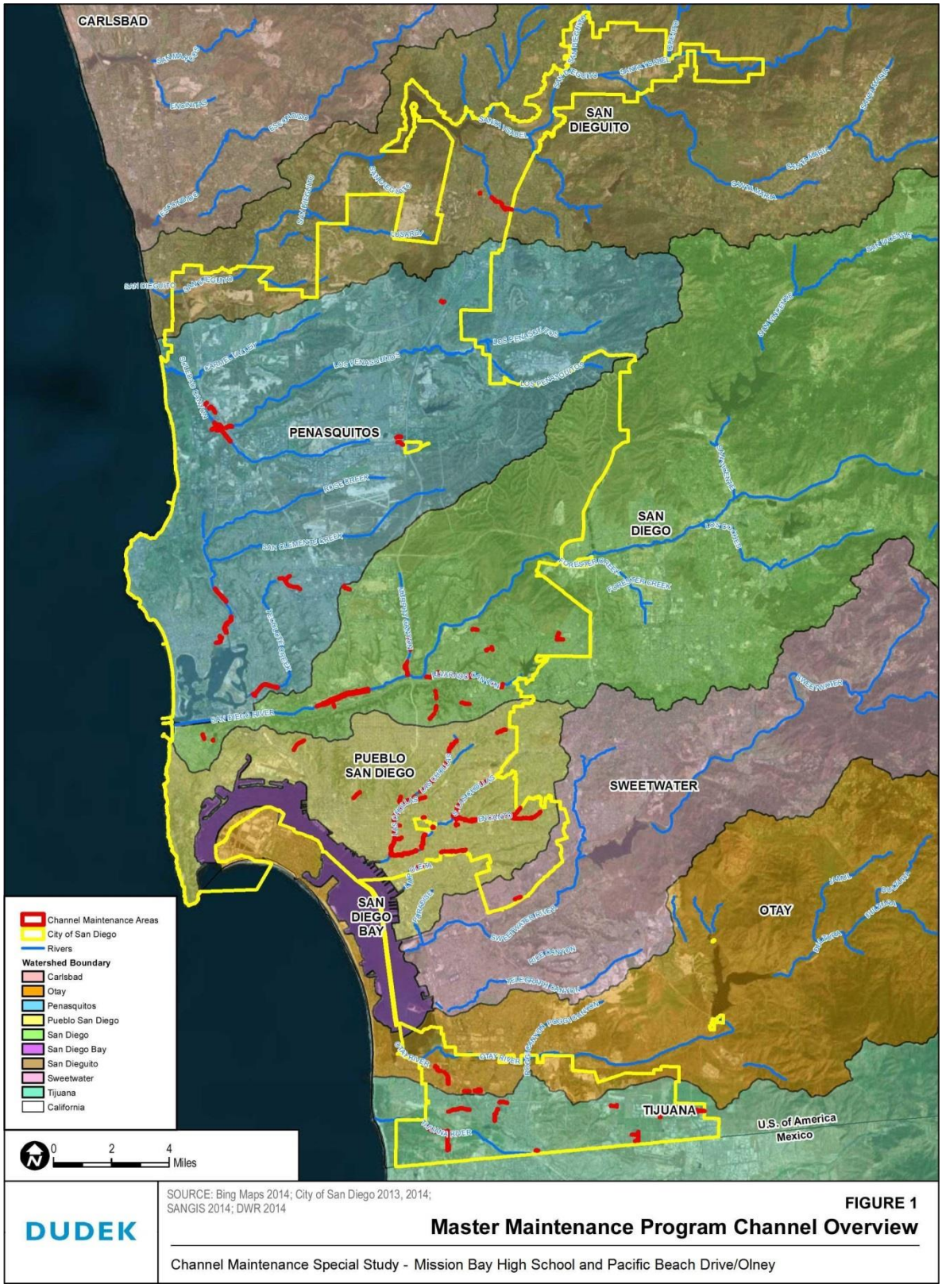
This Channel Maintenance Special Study evaluates the purpose, need and alternatives to channel maintenance activities in the MBHS Channel and PBO Channel.

1.2 Master Maintenance Program Overview

The MMP identifies a specific planning, impact assessment and mitigation process for channel maintenance activities within portions of the jurisdiction of the City (Figure 1). For each channel maintenance project, an Individual Maintenance Plan (IMP) and related Individual Technical Assessments (IAs) were prepared (City of San Diego 2011). The IMP identified the scope of work, maintenance methodology and procedures, equipment, and duration for maintenance activities planned in the channels. The IAs consist of an Individual Biological Assessment (IBA), Individual Historical Assessment (IHA), Individual Hydrologic and Hydraulic Assessment (IHHA), Individual Water Quality Assessment (IWQA), and Individual Noise Assessment (INA). The IMP also included a comprehensive list of best management practices (BMPs), maintenance protocols, and mitigation measures derived from the applicable permits and regulations that are being implemented to avoid, minimize, and/or mitigate potential environmental effects to sensitive resources.

Figure 1 Master Maintenance Program Channel Overview



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As part of the IMP process, the IHHA and IWQA provide data that allows for evaluation of the purpose, need and alternatives to channel maintenance activities and serve as a basis for this special study. The IWQA also provides a suite of water quality and soil monitoring activities that may be used to evaluate the potential water quality benefits of channel maintenance projects that remove sediment and pollutants from channel areas. The IMP and IAs were compiled into a Substantial Conformance Review (SCR) package for review and approval by the City's Development Services Department under the provisions identified in the MMP Programmatic Environmental Impact Report (PEIR).

In addition to the City's SCR process, the City also was also required to obtain permit authorization from the California Department of Fish and Wildlife (CDFW), San Diego Regional Water Quality Control Board (RWQCB), U.S. Army Corps of Engineers (ACOE), and California Coastal Commission (CCC) for approval under the terms and conditions of their respective regulatory authorities.

1.3 Project Channels

The two maintenance channels discussed in this report are the MBHS Channel and PBO Channel (Figure 2). Both channels are in southern San Diego County within the Mission Bay Watershed Management Area (WMA) in the Rose Canyon subwatershed. The Mission Bay WMA has a drainage area of approximately 64 square miles (Mission Bay Responsible Parties 2014). The MBHS Channel and PBO Channel are roughly bordered by Mission Bay Drive to the east and Pacific Beach Drive to the south (Figure 2). Both channels are west of Interstate 5 in the California Coastal Commission's Coastal Overlay Zone in the Pacific Beach community (IMP 2014).

The MBHS Channel flows from north to south, and drains highly urbanized flows from 27-inch reinforced concrete pipe (RCP) upstream of the channel, a 36-inch RP located 250 ft south of the upstream end, northerly parking lot areas of MBHS, the MBHS tennis courts, and MBHS baseball fields. The PBO Channel flows from east to west, and drains flows from the MBHS Channel, Lee Street, a 18-inch RCP located 245 ft west of its upstream end, the MBHS baseball and football fields, and portion of Campland on the Bay (Campland), a beachside campground, parking lot (SCR 2014).

Flows from the PBO Channel discharge to a 42-inch RCP projecting barrel culvert which discharges into a concrete vault known as the Mission Bay Sewage Interceptor System (MBSIS) box. In the early 1990s, the MBSIS box was installed as part of the City's efforts to divert dry weather flows into the sanitary sewer system (City of San Diego 2004). The MBSIS box diverts low flows to the sewer system; higher flows bypass the sewer diversion (City of San Diego 2013). The MBSIS box was installed to reduce bacteria discharges to Mission Bay during dry

weather conditions (City of San Diego 2004). Mission Bay is an environmentally sensitive area and has multiple beneficial use designations (RWQCB 2011).

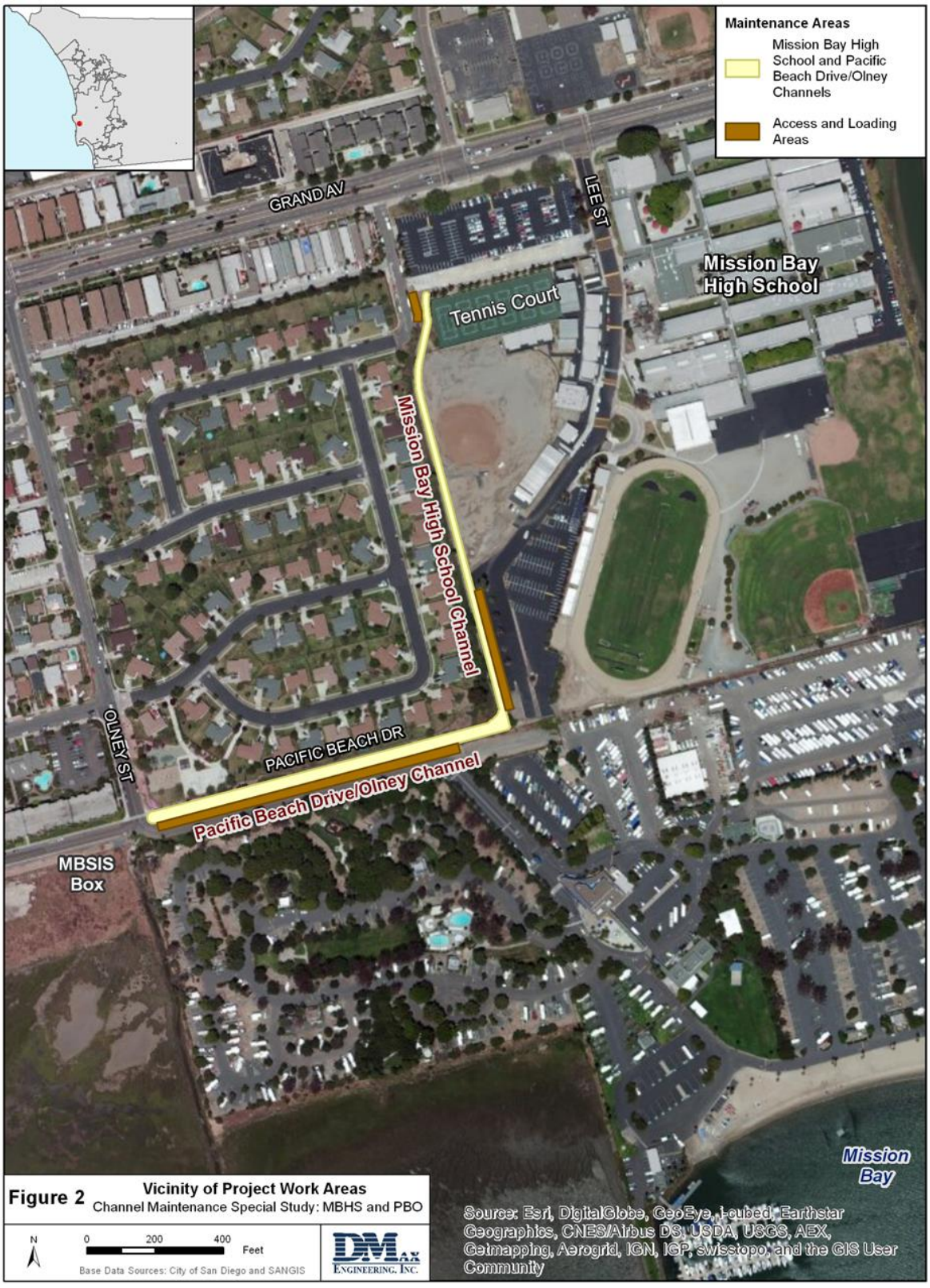
As a result of National Pollution Discharge Elimination System (NPDES) regulatory and other drivers, the City has prepared both jurisdictional and watershed scale plans that detail operational, administrative and structural activities for compliance with requirements. In 2015, the City updated its Jurisdictional Runoff Management Plan (JRMP) and is working collaboratively with stakeholders in the San Diego River to complete a watershed plan, known as Water Quality Improvement Plan (WQIP). The City's dual responsibility for water quality management and operation and maintenance of the storm drain system are integrated by implementation of the MMP, JRMP and WQIP. The City therefore performs operation and maintenance activities in the Murphy Canyon Channel within the context of the integrated water quality improvement and flood control risk management approach identified in the MMP, JRMP and WQIP documents.

1.4 Maintenance Activity

The MBHS Channel and PBO Channel maintenance project IMP and IA package received a Notice of Decision approving the SCR on November 20, 2014. Appropriate environmental permits were also issued by the CDFW, RWQCB, ACOE, and the CCC in 2013 and 2014.

The current MBHS Channel and PBO Channel maintenance project consists of excavating accumulated vegetation, sediment, trash, and debris that restricts the capacity of the channels to convey storm flows. The City is permitted to use heavy equipment to remove 150 cubic yards of material in the MBHS Channel, and 250 cubic yards of material in the PBO Channel (IMP 2014). Collectively, the project area includes up to approximately 1.55 acres in the channel maintenance areas (IBA 2014).

Figure 2 Vicinity of Project Work Areas



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2 CHANNEL ASSESSMENT

This section summarizes current maintenance practices, avoidance and minimization measures, and existing adjacent infrastructure and constraints for the MBHS Channel and PBO Channel.

2.1 Current Maintenance Level

The MBHS Channel and PBO Channel are located in a low-lying plain adjacent to Mission Bay. Flooding occurs in the MBHS Channel and surrounding areas due to a number of factors such as topography and channel design. The PBO Channel is located downstream of the MBHS Channel, and flooding conditions are primarily a result of the flat topography of the surrounding area. Consequently, the MBHS Channel will have downstream flooding issues regardless of the levels of maintenance (IHHA 2014).

2.1.1 Past Maintenance

The IHHA was conducted in order to assess whether the maintenance of the MBHS Channel and PBO Channel was necessary based on hydrologic and hydraulic assessment of the channel areas. The MBHS Channel frequently backs up and floods portions of the MBHS school bus loading\unloading zone. Mission Bay High School officials have reported that large portions of the northerly parking lot are flooded during the rainy season which forces the school to relocate the bus loading/unloading zone. According to the IHHA, "the MBHS Channel has been reduced down to a level that it is nearly inoperable." Dry weather flows had been obstructed from moving freely through the MBHS Channel due to the accumulated vegetation and sediment in the channel. Two sites visits were conducted in 2012 and 2013. During the site visits vegetation was observed obstructing a 27-inch RCP, which discharges into MBHS Channel. The vegetation was removed to alleviate flooding in the bus loading/unloading zones at MBHS. After the vegetation removal, dry weather flows were still backing up in this area, which indicated that vegetation removal alone does not remediate flooding in the proposed project area (IHHA 2014).

2.1.2 Purpose and Location

The MBHS Channel is located between an extensively developed area between MBHS and residential development (Figure 2). The PBO Channel is bordered by residential development, Campland, and the Kendall-Frost Mission Bay Marsh Reserve to the southwest. The purpose of periodic maintenance of the MBHS Channel and PBO Channel is to restore capacity to the channels to minimize flooding of the surrounding areas by removing accumulated sediment, trash, and debris prior to transport downstream to Mission Bay. Currently, channel maintenance work is the City's primary means of managing these inputs so that the channels can function to convey storm water flows.

The MBHS Channel is a trapezoidal concrete channel that is approximately two feet deep, with a ten foot top width, four foot bottom width, and is approximately 1,075 feet long. The channel has a nearly flat longitudinal slope (0.25%). The current peak average flow rates for the MBHS Channel is 58 cubic feet per second (cfs) in the 5-year storm, 70 cfs for the 10-year storm, and 80 cfs for the 25-year storm (IHHA 2014). Modeling data indicates that the pre-maintenance capacity of the MBHS Channel was able to convey approximately 30% of the 1-year storm (Table 2). The southern half of the MBHS Channel, and the southerly MBHS areas, are particularly prone to flooding due to the channel system elevation in relation to its surrounding elevations. The capacity of the MBHS Channel will be improved through maintenance and will approach the design capacity for the 2-year storm (IHHA 2014).

Table 2
Mission Bay High School Channel and Pacific Beach Drive/Olney Channel Conveyance Capacity Summary

Channel	Storm Event	Estimated Storm Event Flow Rate (cfs)	Calculated Design Capacity[1] (cfs)	Pre-Maintenance Capacity (cfs)
Mission Bay High School	1-year	33	43	<10
	2-year2	43	433	<10
Pacific Beach Drive/Olney	2-year	59	594	59

Source: Data derived from IHHA 2014

1 Based on MMP channel dimensions (i.e., post-maintenance condition)

2 As the channel has a maximum capacity to convey a 2-year storm, it would not be able to sustain a 5-year storm; therefore, only the 2-year event data is shown in Table 2.

3 This storm flow corresponds to approximately the 2-year storm.

4 The calculated design capacity is just above the 2-year storm.

cfs = cubic feet per second

The PBO Channel, as originally constructed, is a trapezoidal earthen channel with an average depth which ranges from 5-6 feet, has a bottom width that ranges from 3-5 feet, a top width that varies from 20.5-26 feet, and has a longitudinal slope of 0.25%. The current peak average flow rates for the PBO Channel is 80 cfs in the 5-year storm, 96 cfs for the 10-year storm, and 110 cfs for the 25-year storm. The PBO Channel, in its pre-maintenance and designed state, has the capacity to convey the 2-year storm. The primary benefit of maintenance of the PBO Channel is the reduction of the extent of flooding in upstream areas adjacent to the MBHS Channel. The conveyance capacity of the PBO Channel is partially limited by the capacity of the 42-inch RCP, located downstream of the channel, and the hydraulic impacts of the MBSIS box. During the 5-year storm, the PBO Channel is overtopped along most if its length (IHHA 2014).

2.2 Maintenance Practice Modification Evaluation

The current channel maintenance includes sediment and vegetation removal. This section evaluates the efficacy of these practices.

2.2.1 Maintenance Performed

Channel maintenance includes sediment and vegetation removal, but does not include modification to the character, slope, or size of the original designs of the MBHS Channel or PBO Channel. The general maintenance procedure within the channels begins with dewatering standing water from the channel with vactor trucks. After the initial removal of the standing water in the MBHS Channel, the vactor trucks were located at both the upstream and downstream ends of the channel. Vactor trucks were also located at the upstream end of the PBO Channel to capture any incoming or contained surface flows. During maintenance, a temporary sandbag berm was placed across a pipe inlet at downstream end of PBO Channel while the PBO Channel was excavated. Then earth-moving equipment within the facility (skid steer or excavator) pushed the accumulated material to a central site within the channel. Excavated material was then be collected by a gradall, which will be operating from outside the channel, so that the excavated material was directly deposited into a waiting waste disposal truck. The loaded dump truck left the facility and transported the material to the Miramar landfill. Sweepers swept adjacent public rights-of way and immediate truck loading sites nightly. The sandbag berm was removed once the maintenance was completed (IMP 2014a).

Due to the layout of the channels maintenance, excavation began in a specific order, and has not been completed. The upstream channel, the MBHS Channel, was excavated before the PBO Channel. The PBO Channel had two loading areas for the disposal trucks. In each channel maintenance area, vegetation was removed by skid steer/excavator from within the channel (IMP 2014a).

The MBHS Channel was constructed to convey the 2-year storm, which consists of a storm flow rate of approximately 43 cfs. Two maintenance levels (vegetation removal and a combination of vegetation and sediment removal) presented in the IHHA were considered before vegetation and sediment removal was selected for the MBHS Channel and the PBO Channel to improve the conveyance capacity for the channels. The IHHA hydraulic modeling data assumed vegetation removal would include some associated sediment removal, and the ornamental vegetation on the west side slope would be trimmed to the top of the channel. Based on modeling data, vegetation removal would create minor improvements to the conveyance capacity. Vegetation removal would reduce the flooding levels of the 1-year storm from along the entire length down to a point that is approximately located at the southerly edge of the MBHS baseball field (IHHA 2014).

Removing both vegetation and sediment from the MBHS Channel restores enough capacity to convey the 1-year storm. Post-maintenance, the extent of flooding for 5-year storm would be isolated to the southerly fence of the tennis courts when vegetation and sediment is removed from the MBHS Channel. The extent of flooding for all other storms greater than the 5-year storm will overflow along the entire length of the MBHS Channel (IHHA 2014).

Neither removing both sediment and vegetation nor only vegetation would prevent flooding in the PBO Channel during a 5-year storm. However, removing both sediment and vegetation greater flood protection benefits upstream by helping to relieve the flooding conditions in the MBHS Channel (IHHA 2014).

2.2.2 Alternatives

This section describes additional alternative maintenance approaches.

Vegetation Clearing. Vegetation clearing is identified in the MMP as a maintenance alternative to minimize habitat and/or water-quality impacts in sensitive channel areas. In the pre-maintained condition, as much as 2-6 inches of sediment accumulated in some areas of the Channel (IHHA 2014). Based on field observations, vegetation growth and density appeared to be at carrying capacity within the channel areas. Vegetation removal would likely constitute root and associated sediment removal due to the shallow sediment and root system within the channel. Further, past removal of vegetation has provided only minimal added benefit to improve flood control capacity within the MBHS Channel, and would provide no benefit the PBO Channel because the channel configuration only allows the conveyance of approximately the 2-year storm (IBA 2014).

Vegetation removal provides temporary relief of non-native species within the channels, however, it is likely that non-native and invasive species would recolonize the channel due to the consistent presence of dry weather flows, presumed sediment accumulation, and disturbance created from vegetation clearing activities. Further, vegetation clearing of the channel by hand has the same biological impact as removing both sediment and vegetation. Accordingly, vegetation trimming alone would result in an insignificant increase in channel conveyance capacity. More frequent maintenance is needed if only vegetation is removed since the original design capacity of the MBHS Channel would not be restored.

Frequency. Observational evidence indicates that even relatively small storms can result in sediment accumulation and allow vegetation establishment in the San Diego area channel areas. Maintenance frequency is discussed in detail in Section 2.3.

Native Species Recruitment. The colonization of native and non-native species within the channels increases the probability of flooding in surrounding areas, because these species alter hydrology by reducing flood conveyance capacity in the limited channel areas. Removal of non-native species, and recruiting or leaving native vegetation intact, would not prevent the need for maintenance to reduce flood risk to surrounding areas due to the limited channel capacity.

Freshwater marsh native species, including California bulrush, was one of the dominant form of vegetation colonizing both channels (IBA 2014). Both native and introduced freshwater marsh species reduce the flood conveyance capacity in this area that currently experiences flooding issues. There would still be flooding impacts if only non-native species were removed from the channels since both native and non-native species contribute to flood control issues. Consequently, due to the channel configuration and size, removing non-natives is likely infeasible. Maintenance of existing vegetation must be performed periodically to ensure flood protection for the surrounding areas. Native species will be reestablished in disturbed staging areas within 30 days of completion of the maintenance. These areas will be monitored by City staff for 25 months after seeding (IMP 2014). This monitoring will ensure establishment of species to provide adequate erosion control.

Enhance Channel Capacity. The MBHS Channel and PBO Channel area is constrained by surrounding development, including privately owned lands, roadway infrastructure, and other public property including MBHS. There are limited opportunities to enhance the channel capacity unless significant infrastructure changes are considered. Existing infrastructure and the proximity of the channels to Mission Bay provide significant constraints to channel capacity enhancements. The IHHA discusses four potential alternatives to improve channel capacity: raising the channel banks by constructing walls or berms along the top of the channels, diverting storm water in pipes around constrained segments, widening channels to accommodate vegetation, and reducing off-site runoff (IHHA 2014). Of the discussed alternatives, off-site runoff reduction may provide a long-term option for reducing flow volumes and localized flooding in the Mission Bay area. However, watershed-based projects that result in measurable runoff reduction to the Mission Bay area may take decades to implement. There are limited opportunities to enhance the channel capacity unless significant infrastructure changes are considered. The physical constraints of the channels are discussed in more depth in Section 2.7, and opportunities for enhancing channel capacity are elaborated on in Section 3.1.

2.3 Maintenance Frequency Assessment

Channel maintenance within the MBHS Channel and PBO Channel has been conducted on an as needed basis due to hydrological conditions, sensitive biological resource protections, environmental permitting challenges, and weather constraints. This section analyzes the results

of the current frequency of maintenance, and evaluates the potential impacts of changes in maintenance frequency.

In its pre-maintenance condition, the capacity of the MBHS Channel could accommodate less than the 1-year storm. Material likely accumulates within the two channels at different rates, which depend on a variety of environmental factors, including the intensity of storms, the timing of storms during the wet season, the quantity of trash that is mixed in with sediment, and other environmental factors. Moving forward, the MMP process provides a framework to document maintenance effort, sediment accumulation, and vegetation establishment rates. The City may use current maintenance effort documentation processes and other data such as local precipitation and large scale climactic information to estimate optimum frequency of maintenance activities in the MBHS Channel and PBO Channel area.

Given annual rainfall averages approximately nine inches in the San Diego region, it is anticipated that even limited accumulation of sediment and trash from the contributing watershed area will reduce the conveyance capacity of the MBHS Channel and PBO Channel. Additionally, the flat slopes of both the MBHS Channel and PBO Channel result in lower flow velocities that encourage sediment particles from the upstream of the channels to settle out of the storm water runoff along the channel beds. The establishment of vegetation in the deposited material continues the reduction in flow velocities, and in turn encourages more sediment deposition.

Accordingly, the IHHA estimated that channel maintenance activities would be necessary approximately every 1-2 years in order to keep the MBHS Channel free of accumulated sediment and vegetation that reduce conveyance capacities. To improve the capacity of the MBHS Channel the maintenance of the MBHS Channel should occur as needed when the sediment deposition reaches 1-2 inches (IHHA 2014).

To reduce the extent of flooding associated with the limited capacity of the MBHS Channel, the PBO Channel should be maintained when the vegetation growth reaches 6-12 inches in height and/or when sediment deposition reaches 2-4 inches. Accordingly, the IHHA estimated that channel maintenance activities would be necessary approximately every 2-3 years in order to keep the PBO Channel free of accumulated sediment and vegetation that reduce conveyance capacities (IHHA 2014). During wet years more frequent maintenance may be required to maintain design capacity of the both channels than the suggested frequencies proposed above.

2.4 Herbicide Needs Assessment

Non-native species have begun to be removed using mechanized equipment removing the roots and accumulated sediment from the channel. Maintenance of the MBHS Channel and PBO

Channel has not and will not include the use of herbicides during maintenance or post-maintenance (IBA 2014; IMP 2014). Herbicide usage may be considered for future maintenance activities depending on site conditions including channel flow.

2.5 Vegetation Assessment

Pre-maintenance, five distinct vegetation communities or land cover types were identified during the assessment: freshwater marsh, non-native grassland, non-native vegetation/ornamental, disturbed habitat, and developed land (Table 3; Figure 3). The vegetation within in the MBHS Channel and PBO Channel was dominated by freshwater marsh species, and the upland areas were dominated by non-native vegetation. The dominant freshwater marsh species in the MBHS Channel were California bulrush (*Schoenoplectus californicus*) and cattail (*Typha* sp.). The dominant species in the PBO Channel included California bulrush, Brazilian pepper (*Schinus terebinthifolius*), umbrella sedge (*Cyperus involucratus*), and other species (IBA 2014).

The banks of the MBHS Channel supported a mix of primarily non-native grassland species such as ripgut grass (*Bromus diandrus*), cheeseweed (*Malva parviflora*), hottentot-fig (*Carpobrotus edulis*), salt heliotrope (*Heliotropium curassavicum*), and crete weed (*Hedypnois cretica*). A few non-native trees included eucalyptus (*Eucalyptus* sp.), ash (Fraxinus sp.), and Mexican fan palm (*Washingtonia robusta*) were adjacent to or near to the channels (IBA 2014).

The access and loading areas of the MBHS Channel consisted of unvegetated areas and sparsely distributed cheeseweed. The PBO Channel's non-native grassland species were dominated by ripgut grass but also included cheeseweed, hottentot-fig, salt heliotrope, and crete weed (IBA 2014).

A total of 1.55 acres of vegetation will be cleared within both channel areas. The maintenance access and staging areas in the channel maintenance area in the MBHS Channel and PBO Channel comprise only a small portion of the Mission Bay WMA. Furthermore, no listed plant species had moderate or high potential to occur within the maintenance area. In general, vegetation removal in the MBHS Channel and PBO Channel will have very little impact on overall habitat and species composition within the Mission Bay WMA.

Table 3
2014 Vegetation Impacts due to Proposed
Maintenance in the MBHS Channel and PBO Channel

Vegetation Community	Vegetation Type	Impact Acreage		Total Acres
		MBHS Channel	*PBO Channel*	
Wetland	Freshwater Marsh	0.13	0.181	0.312
Upland	Non-native Grassland	0.08	0.22	0.30
	Non-native Vegetation/Ornamental	0.12	0.22	0.34
	Disturbed Habitat	0.02	0.20	0.22
	Developed	0.20	0.18	0.38
	Subtotal	*0.42*	*0.82*	*1.24*
Total (Acres)	**All**	**0.55**	**1.0**	**1.55**

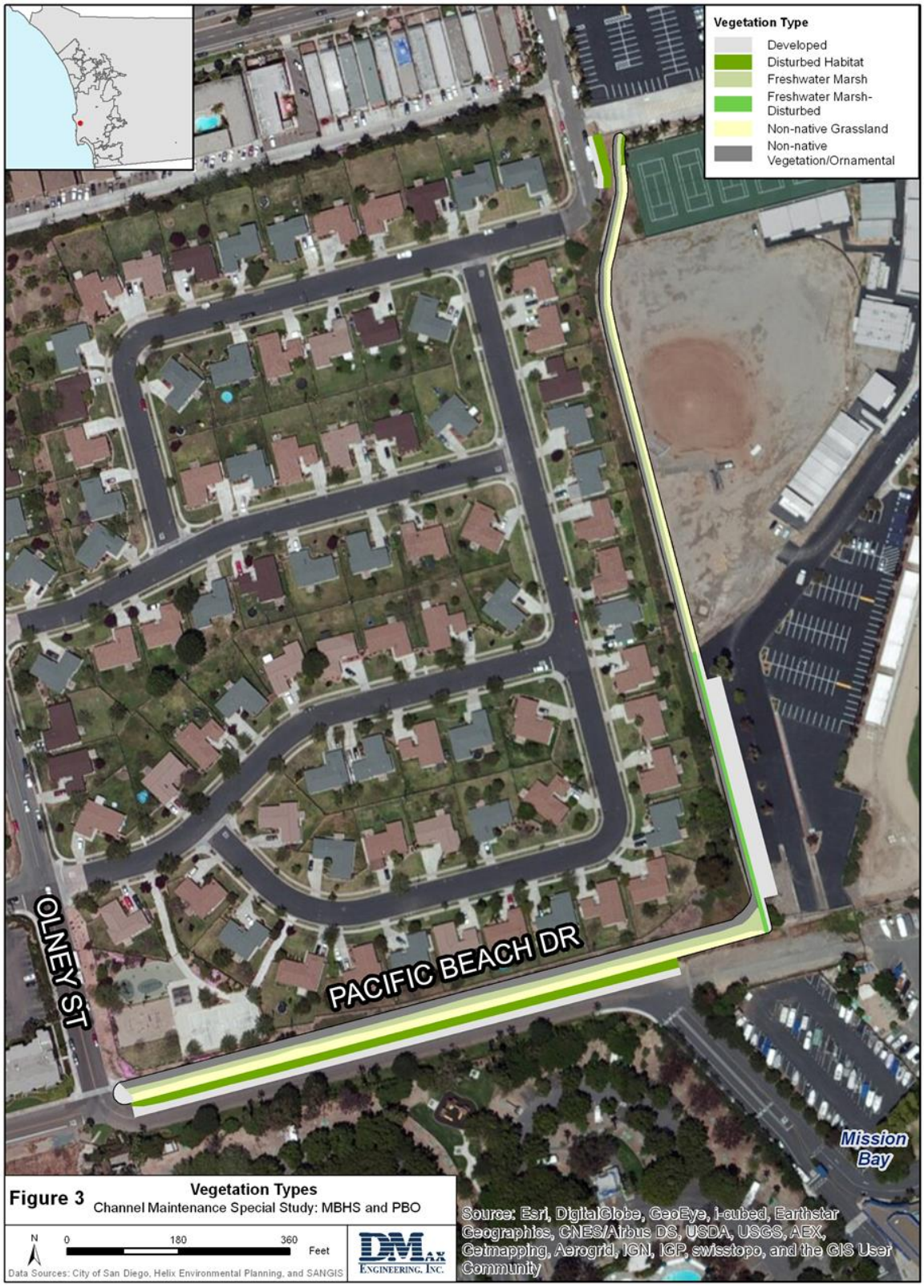
Source: IBA 2014.
[1] These impacts are regulated by the ACOE, RWQCB, and CDFW.
[2] The City and California Coastal Commission require mitigation for freshwater marsh impacts in both earthen and concrete-lined channels.

2.6 Habitat Assessment

The area surrounding the MBHS Channel and PBO Channel is in a highly developed area of the City of San Diego (Mission Bay Responsible Parties 2014). The MBHS Channel drains the urbanized Pacific Beach community. Additionally, the maintenance area is in close proximity to public and private infrastructure. The Mission Bay WMA is located within the Pacific Flyway, which provides foraging and breeding habitat for many migrating bird species. The proposed project site is not located in any critical wildlife corridor. Additionally, the Kendall-Frost Mission Bay Marsh Reserve is located southwest of the PBO Channel. Although the project site is not within Multi-Habitat Planning (MHPA) lands, the project will conform to Area MHPA Adjacency Guidelines since it is located within the buffer zone of the MHPA (IBA 2014).

Pre-maintenance, no federal or state-listed plant or animal species were detected in the channel maintenance area. However, a single individual of the special-status animal species Cooper's hawk (*Accipiter cooperi*) was observed. Two other federal and state endangered and MSCP covered animal species, the Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) and light-footed clapper rail (*Rallus longirostris levipes*), have been documented in the vicinity of the project area in the CNDDB and USFWS databases. However, suitable habitat does not exist within the proposed maintenance area for the Belding's savannah sparrow and light-footed clapper rail (IBA 2014).

Figure 3 Vegetation Types



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With the implementation of mitigation measures, channel maintenance will not result in significant direct and indirect impacts to biological resources, including special-status species and habitats. Project activities follow all mitigation measures and BMPs outlined in the permits issued for this project, and the overall PEIR (City of San Diego 2011).

2.7 Infrastructure Assessment

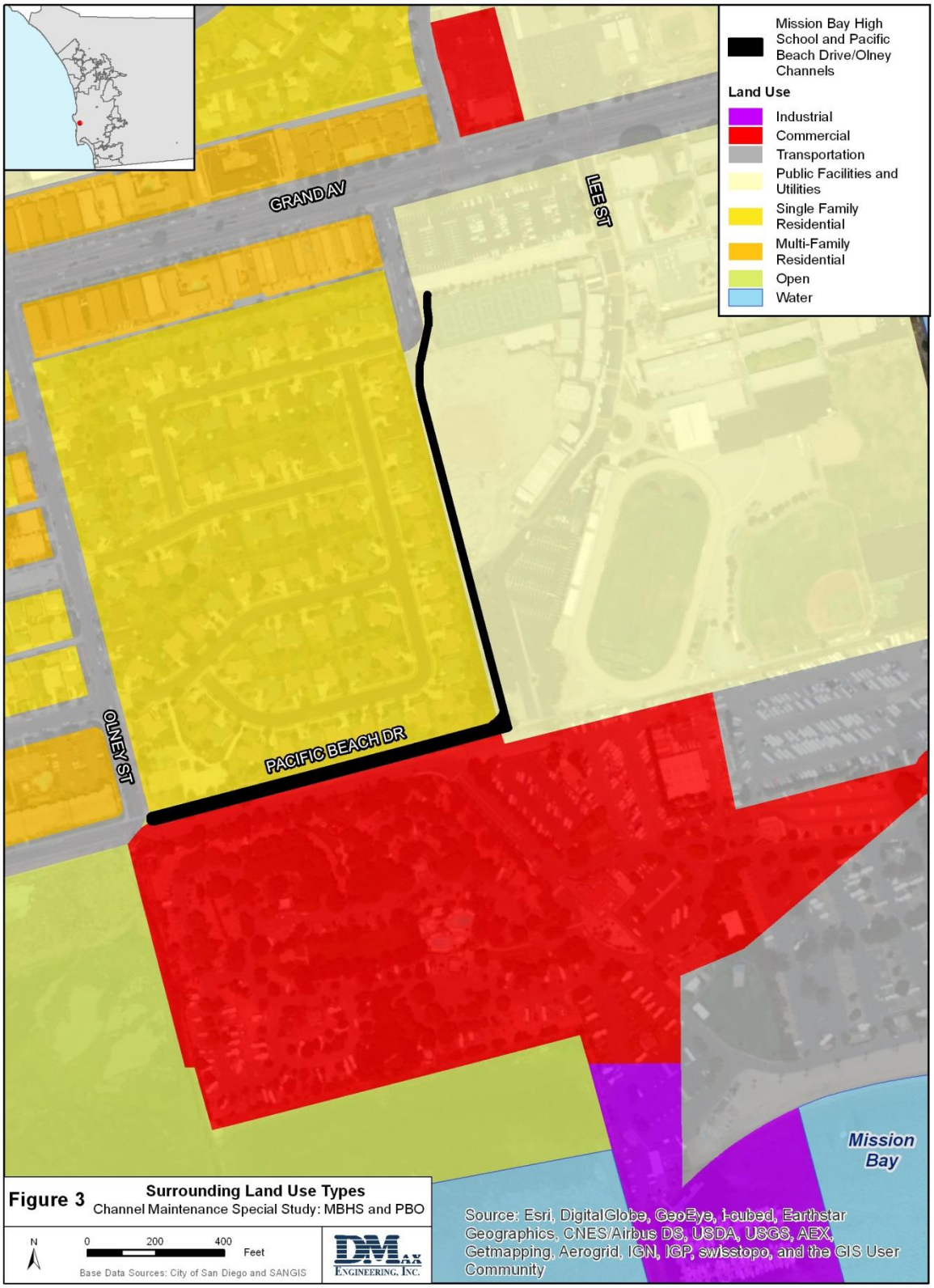
A number of watershed configuration, land ownership, and infrastructure components provide limits to channel maintenance alternatives in the MBHS Channel and PBO Channel. The channels are completely surrounded by adjacent streets, MBHS, and the Campland area. The main flow to the area upstream and surrounding the maintenance area in the MBHS Channel consists of public facilities (MBHS), residential, and commercial land uses (Figure 4). The PBO Channel is bordered by residential areas to the north and a commercial area to the south. Berms, bridges, and roadways constructed to direct floodwaters away from existing infrastructure and provide access have reduced the dynamic capacity of the channel system to shift location over time. Accordingly, a multitude of land use, existing infrastructure and climatic factors impacting watershed dynamics serve to affect the feasibility of alternatives to channel maintenance needed to protect life and property in Pacific Beach. The adjacent infrastructure indubitably limits the potential for maintenance alternatives, such as widening the channel or installing retention facilities. Additional discussion of channel widening and other approaches to channel reconfiguration is provided in Section 3.1.

A general discussion of infrastructure configuration must begin with an assessment of the natural flood plain for the 64 square mile Mission Bay WMA (Project Clean Water 2015). The MBHS Channel and PBO Channel are located outside of the Special Flood Hazard Area have a minimal flood risk since they are above the 0.2% flood elevation (FEMA 2015). However, both the MBHS Channel and PBO Channel are subject to flooding, especially in their pre-maintained states, due to the channel configuration. As previously mentioned, flooding often occurs in the MBHS Channel due to the flat topography surrounding the channels.

In general, there are limited opportunities for the City to influence and/or implement watershed-based storm water controls to reduce flows into downstream channel areas. Due to this close proximity and difference in parcel ownership, channel reconstruction would require settlements, permitting, and other collaborative efforts. The cost of these efforts would far exceed the benefits of reduced channel maintenance frequency. Conservation and property acquisition could be utilized to balance property ownership and flood risk through a variety of mechanisms in the surrounding maintenance area. Accordingly, the City may seek to identify appropriate partnership and grant programs that may provide capital and/or long-term operation and maintenance funding for purchase of property with existing infrastructure that may be restored to

native habitat. Multiple benefits may include expansion native habitat, improved recreational trails, and reduction of infrastructure requiring flood protection.

Figure 4 Surrounding Land Use Types



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3 RETROFIT OPPORTUNITIES

This section identifies different retrofit opportunities for channel maintenance operations, and includes analyzing the present channel configuration and opportunities to alter the capacity, habitat preservation options in the Mission Bay WMA, and channel discharge maintenance opportunities.

3.1 Channel Configuration

As discussed in Section 2.7, there are limited opportunities to alter the MBHS Channel and PBO Channel configuration in an effort to abate flooding in the proximity due to limited space, adjacent parcel ownership, and projected cost. However, other means of channel modification were considered to reduce flooding in the surrounding maintenance area in addition to vegetation and sediment removal.

One potential retrofit opportunity outlined in the Settlement Agreement is to "daylight" the channels, which aims to restore the channels to a more natural state. The MBHS Channel is already an open channel and consequently no pipes or underground structures may be removed. To convert the MBHS Channel to a more natural state, the concrete lining of the channel could be removed.

The current channel configuration is the result of previous work to manage water quality. It is likely there would not be sufficient space to expand the MBHS Channel and convert it into a more natural stream due the proximity to MBHS and residential development. As mentioned before, the PBO Channel drains into a 42-inch RCP which flows to the southwest side of Pacific Beach Drive and then discharges to the MBSIS box. From the MBSIS box, storm water discharges into a concrete bowl-shaped basin, where it then flows into a natural channel, which eventually drains the storm water into Mission Bay (IHHA 2014). Reconfiguring the PBO Channel could mean these concrete vaults and culverts would need to be reconfigured as well, and is not in the scope of this maintenance proposal. Additionally, these engineered structures are necessary in order to treat dry weather flows before they enter Mission Bay to address one the highest priority water quality condition, which is bacteria for the Mission Bay WMA, as outline in the watershed's Water Quality Improvement Plan (Mission Bay Responsible Parties 2014). The existing earthen PBO Channel functions with the existing concrete structures that cannot be easily reconfigured while simultaneously meeting current and future water quality objectives. Furthermore, removal of the channel infrastructure would have water quality impacts and likely have little flooding reduction benefit. Removal of concrete lining in the MBHS Channel appears to be relatively infeasible, due to space, cost, and functionality.

Additional channel configuration alternatives originally considered as part of the PEIR and described in the IHHA are discussed below and in Section 3.3.

Raising the Channel Banks. Channel capacity could theoretically be increased by raising the banks along the MBHS Channel and PBO Channel. Raising the channel banks allows for vegetation and sediment accumulation. If the banks were raised in MBHS Channel, but the sediment and vegetation remained, then upstream areas around the channel will be affected by flooding due to the increase in the water surface elevation. Storm drain pipes which discharge flows into the channels will be blocked by accumulated sediment and vegetation leading to further flooding impacts of upstream properties. Specifically the extent of upstream flooding around the school loading/unloading zone of MBHS would be increased. If the banks were raised, storm water flows originating from MBHS will be prevented from entering the MBHS Channel since the surrounding topography is relatively flat. With this alternative, if flood water does manage to exceed the banks it could result in greater damage to the surrounding infrastructure. For the above reasons raising the channel banks is not a feasible alternative to channel maintenance (IHHA 2014).

Diverting Storm Water Flows. Using pipes around constrained segments to divert storm water does not eliminate the need for channel maintenance. In order to sustain the wetland habitat a diversion structure would need to be designed which maintains a low flow through the existing channel. Without maintenance, sediment and/or vegetation would build up in the existing channel and ultimately block the desired low flows from entering the channel, which would cause the wetland to dry out. Diverting storm water to underground pipes around constrained segments is not a feasible considering the already problematic relatively flat topography of the area and due to the proximity of the channel to Mission Bay. Additionally, due to the hydraulic conditions of the channel, the underground culvert would be larger than the current cross-sectional area of the channel (IHHA 2014).

Widening Channels to Accommodate Vegetation. The MBHS Channel configuration is located on an easement that is fifteen feet wide, and the top width of the channel is ten feet wide. The physical size of both channels are constrained by the size of the easements. It would be necessary to acquire additional land in order to expand the easement (IHHA 2014). It is possible that the MBHS Channel could potentially be expanded into the baseball fields, tennis courts, and parking lot of MBHS. This expansion, however, would reduce the parking spaces available for faculty and students. Additionally, residents of the surrounding community are pursuing the creation of a nature center in Campland through the Mission Bay Gateway Project (Chipman 2012). The proposed MB Gateway Project intends to use the existing southerly parking lot at MBHS to accommodate nature center visitors in addition to the students and faculty at MBHS. Mission Bay High School itself has over 1,500 students; accordingly the

parking lot at MBHS may need to accommodate a maximum of 800 to 900 students and faculty vehicles during normal school hours.

Students displaced by the reduction in parking would require additional parking areas or alternative modes of transportation. Alternative transportation could include walking, biking, carpooling, and the use of public transportation which would be necessary for students unable to park in the parking lot or along streets in residential areas. Further studies would be needed to see if bus routes are sufficient to provide access to all students impacted by a reduction in parking spaces.

An increase in channel width may potentially impact school facilities including the tennis courts and baseball fields at MBHS. Further discussion with school officials would be necessary to determine if existing school infrastructure may be reconfigured to accommodate an increase in channel width. Since the channel configuration is already prone to flooding issues upstream, the MBHS Channel may be needed a significant increase in space to alleviate flooding issues. Removing the recreational areas of the school may disrupt the normal daily activities of students and faculty. Demolition of the costly infrastructure at MBHS, which is consistently used by students at MBHS, likely outweigh the flood control benefits from widening channel.

As mentioned previously, aside from vegetation and sediment obstruction within the MBHS Channel and PBO Channel, flooding occurs due to the relatively flat topography surrounding the channels. The MBHS Channel is limited in its ability to convey flow to the PBO Channel, which results in increased flooding to the southern parking lot at MBHS. It would be infeasible to alter the elevation of the channels within the scope of this maintenance project since it may require reconstruction of the entire channel configuration. Due to the environmental permitting requirements of the initial and subsequent project and adjacent urbanized areas, it is unlikely that the agencies would approve either a wider channel or a different channel alignment. Additionally, the space available for channel widening is limited by adjacent infrastructure as described in Section 2.7 and habitat. Utilizing the existing channel will minimize impacts to the sensitive resources found adjacent to the channel.

Further analysis is necessary to determine how much benefit channel widening would provide and how much adjacent property would be needed (IHHA 2014). Channel maintenance appears to be the most efficient means of restoring the channels capacity while having no permanent impacts on surrounding areas including MBHS.

3.2 Habitat Preservation

The MBHS Channel and PBO Channel are surrounded by development and habitat preservation will predominantly be in the form of mitigation. Mitigation consists of the creation and enhancement of wetland enhancement.

There are no potential wildlife corridors or extensive riparian woodland habitat which will be disturbed due to channel maintenance. According to the IBA, there is a moderate to high potential for the light-footed clapper rail (*Rallus longirostris levipes*), other nesting birds, and raptors to occur in or adjacent to the channel maintenance area. Light-footed clapper rails nest in cordgrass (*Spartina foliosa*) which does not occur in the maintenance area. It is unlikely that individual clapper rails would relocate on site, due to lack of habitat, and adjacency to road. The channels proposed for maintenance are not connected to the light-footed clapper rail habitat area. The closest occurrence of the light-footed clapper rail is located in the northern portion of the Kendall-Frost Mission Bay Reserve, approximately 300 feet south of the western tip of the PBO maintenance area. No part of the maintenance area occurs within the Kendall-Frost Mission Bay Reserve, but the project will conform with the MHPA Adjacency Guidelines (IBA 2014).

Measures have been incorporated to avoid any impacts to light-footed clapper rail and nesting raptors, which have been documented in the general vicinity of the mitigation site. If any listed species are detected during maintenance, minimization and mitigation measures will be taken. For example, if a nesting site of a Cooper's hawk (*Accipiter cooperii*) is detected, maintenance will not occur within 300 feet of the nest. Similarly, maintenance will not occur within 1,500 feet of any known locations of the southern pond turtle (*Clemmys marmorata*). Additionally, if it is determined that there is a high potential for a particular special species to be present during their breeding season, maintenance activity will be restricted.

The channel maintenance project will impact a total of 0.31 acres of wetland habitat which is entirely comprised of freshwater marsh. Mitigation for the 0.31 acres of wetland impacts is required by the City and the California Coastal Commission. Additionally, the proposed maintenance will impact 0.3 acres of non-native grassland (IBA 2014).

Mitigation for wetland impacts will occur within the Los Penasquitos Canyon and through payment into the City's Habitat Acquisition Fund. Accordingly, this project is not expected to substantially adversely affect any species found within the project area or the surrounding MHPAs since the project activities are within the established guidelines for minimizing impacts as established by the PEIR (IBA 2014).

3.3 Channel Discharge

Discharges from the Mission Bay WMA have minimal impacts to water quality in Mission Bay. Fecal indicator bacteria and sediment are the highest priority water quality condition for the Mission Bay/La Jolla Watershed Management Area as outlined in the watershed's WQIP (Mission Bay/La Jolla Responsible Parties 2015). The MBHS Channel and PBO Channel do not discharge directly to a water body on the 303(d) List of Water Quality Limited Segments (303(d) list), and is not within 200 ft buffer zone for any 303(d) listed shorelines at Mission Bay (SWRCB 2011). Mission Bay, which is located in hydrologic subarea 906.80, is an environmentally sensitive area and has multiple beneficial use designations. One beneficial use of Mission Bay is the RARE beneficial use which includes habitat which supports state and federally listed species (RWQCB 2011).

As outlined in the IWQA, there is no potential for water quality impacts that would result from the loss of pollutant assimilative capacity through vegetation removal. Water quality will not be impacted since no dry weather flows were detected for both channels (IWQA 2014). For this reason, sediment pollutant loading estimates were unnecessary and would only prove that channel maintenance has a greater positive impact on water quality than leaving the vegetation and sediment in place. The maintenance activities will result in a pollutant reduction benefit due to sediment removal, and therefore no activity-specific, long-term water quality measures must be taken as part of the maintenance. Removal of sediment from within the channels results in removal of pollutants that could potentially contribute to a degradation in downstream water quality, human health complications, and native vegetation impacts. Additionally, all dry weather runoff is diverted by the MBSIS box and directed to the sanitary sewer system (IWQA 2014).

A suite of water quality BMPs are required as part of the Coastal Development Permit authorizing channel maintenance activities in the MHBS Channel and PBO Channel (Table 4) (City of San Diego 2012). Implementation of these BMPs may potentially reduce the need for maintenance through the integrated suite of required pollution prevention, source control, and treatment activities (CCC 2012).

Table 4
City of San Diego BMPs to Reduce Sediment and Pollution Load

Water Quality Activity Type	Description	Implementation Frequency	Duration
Pollution Prevention	Commercial and residential property sediment reduction outreach distribution.	152 parcels	Approximately one month prior to maintenance initiation

Table 4
City of San Diego BMPs to Reduce Sediment and Pollution Load

Water Quality Activity Type	Description	Implementation Frequency	Duration
Source Control	Street sweeping improvements- targeted vacuum-assisted/regenerative air machine usage	1.0 curb miles	One year subsequent to sediment removal maintenance events
Source Control	Street sweeping improvements- targeted median sweeping route addition.	0.9 curb miles	
Treatment1	Enhanced catch basin inspection and as-needed cleaning implementation.	10 inlet locations	

[1] The MBSIS dry weather diversion is located at the downstream end of the MBHS

Channel and PBO Channel. The diversion treats 100% of the dry weather runoff by diverting it to the sanitary sewer system.

Given the Mission Bay WMA configuration, property ownership, and infrastructure framework, limited opportunities exist to integrate alternative approaches to channel maintenance efforts aimed at reducing flood risk. Upstream diversion could serve as a potential method to minimize flooding in the area. Low Impact Development (LID) features, such as bioretention areas, and best management practices could be installed. Typically retention basins are created to improve water quality, but these features can also reduce runoff volumes and flow rates. However, LID features are usually designed based on the 85th percentile storm, which is much smaller than the 10-, 50-, or 100-year storms generally used for flood control design. For that reason, LID installation would not have a measurable impact on peak flows for large storms, downstream flooding. In addition, LID BMP implementation opportunities are generally associated with new development and redevelopment projects as part of an overall site-specific water quality management strategy. Therefore, the rate of LID BMP implementation in the Mission Bay WMA is dependent on new and re-development project initiation, site-specific topography and configuration constraints, and LID design standards. It is anticipated that these factors will limit overall LID BMP impacts to channel flows until widespread implementation is accomplished throughout the watershed. Accordingly, in the flood control analysis conducted as part of the IHHA, the benefit of LID BMPs (e.g., reducing the impermeable area and redirecting runoff to pervious areas) was considered negligible due to the limited implementation opportunities.

Over longer timescales, infrastructure improvements designed to enhance public safety or improve transportation efficiency can often provide opportunities for examination of drainage and flood control needs. In urbanized areas with undersized channels or sediment and vegetation filled drainage features, adjacent roadway and bridge infrastructure improvements regularly allow for evaluation of various alternatives to frequent channel capacity-restoring maintenance.

Examples of potential integrated infrastructure and flood control improvement projects include improved access to maintenance areas to reduce habitat impacts, channel widening, and integration of LID features to reduce flow velocity and improve water quality. The relative impact of reducing impermeable areas, redirecting runoff into previous areas, and other LID approaches are likely to provide limited flow reduction and downstream flood relief throughout the watershed (IHHA 2014).

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4 DISCUSSION

The City's MMP is designed to allow flood control channel operation and maintenance activities for the protection of life and property to be conducted in an efficient, economic, environmentally, and aesthetically acceptable manner. This Channel Maintenance Special Study is required under a legal agreement related to the MMP. This special study evaluated the purpose, need, and alternatives to channel maintenance activities in the MBHS Channel and PBO Channel.

There has been no history of recent maintenance within the two channels. Maintenance practices for the MBHS Channel and PBO Channel include periodic clearing of vegetation, trash, and debris. Channel conveyance capacity for the MBHS Channel and PBO Channel will be improved after maintenance, but may have limited effectiveness in reducing flooding of the surrounding properties.

The City recently began maintenance of the MBHS Channel and PBO Channel to reduce flood risk to life and property. The MBHS Channel and PBO Channel conveyance capacity has been improved after maintenance, which will provide flood risk management benefits. The City and resource agencies have reviewed the project impacts and determined a set of compensatory mitigation measures, which include implementing habitat and water quality mitigation measures that are commensurate with the impacts of the project.

Alternatives to the maintenance activities were considered, but the alternative approaches were not found to be effective substitutes in achieving the goal of restoring flood protection to the area surrounding the MBHS Channel and PBO Channel. An analysis of the alternatives is provided earlier in this report and is summarized below.

Raising the channel banks in the MBHS Channel and PBO Channel could be an option, but the storm drain pipes that discharge into the channel would become blocked, causing flooding around the school loading\unloading zone of MBHS (IHHA 2014). Installing LID features like bioretention areas throughout the tributary drainage area may be benefit water quality but it is not likely to have a major effect on flooding for larger storms. Since both the MBHS Channel and PBO Channel are already open channels no "daylighting" opportunities exist to convert the channels to a more natural state. Removal of concrete lined areas in the MBHS Channel is not considered feasible due to space constraints that prevent widening the channel.

The City is participating with other municipal agency dischargers to develop a WQIP aimed at reducing pollutants in the municipal separate storm sewer system (MS4). Under the current NPDES regulatory framework, dischargers have identified indicator bacteria and sediment as the

current highest priority water quality condition for the Mission Bay/La Jolla WMA. The WQIP identifies a suite of water quality improvement strategies to effectively and efficiently eliminate non-storm water discharges to the MS4, reduce pollutants in storm water discharges from the MS4 to the maximum extent practicable, and achieve identified interim and final regulatory numeric goals. The Mission Bay WQIP identifies a strategy of implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, channels as allowed by resource agencies, detention basins, pump stations, etc.) for water quality improvement and for flood control risk management

Through this and other partnership efforts, the City aims to pursue appropriate operational and multi-agency projects to reduce sediment and non-storm water discharges conveyed by the MS4 prior to discharge to the MBHS Channel and PBO Channel areas. While these activities are anticipated to have ancillary benefits that may reduce the long-term need for channel maintenance activities, the current channel configuration and adjacent infrastructure limits opportunities to reduce channel maintenance in the MBHS Channel and PBO Channel maintenance area.

The MBHS Channel and PBO Channel in its current condition will continue to result in flooding risk to life and property unless periodic maintenance is implemented. Channel configuration, adjacent biological resources, and private property generally limit maintenance practice modifications and alternatives to current activities. The MBHS Channel and PBO Channel maintenance area is located in only a small portion of the overall watershed. The existing conditions in the contributing watershed upstream from the maintenance area and altered hydrology in the flat topography of the channel areas generally result in sediment accumulation and maintenance need. The maintenance activities in the MBHS Channel and PBO Channel are therefore provide limited reductions in flood risk to adjacent areas.

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