4 Description of Alternatives

The alternatives discussed herein reflect a range of potential solutions for addressing local flooding in the Vista Grande drainage basin. Several other alternatives were explored in previous studies and as part of the initial work during this study. The alternatives included in this report were selected by the City and the project team based on their potential for reducing flooding, operational viability, public impacts, environmental benefits, and constructability. The alternatives include three main elements: a drainage tunnel, a storage/detention structure, and stormwater re-use opportunities. Different tunnel inlet locations, tunnel outfall structure locations, stormwater storage locations, and groundwater recharge alternatives were considered. The initial alternatives are summarized below:

- Alternatives 1A and 1B considered possible drainage tunnel alignments running from the beginning of the Vista Grande Canal, beneath the Olympic Club, to either a new outfall structure near Fort Funston (1A) or the existing outfall structure (1B).
- Alternative 2 considered a possible drainage tunnel alignment running from the north side of the Doelger Senior Center at Westlake Park, beneath the Olympic Club, to a new outfall structure near Thornton State Beach.
- Alternative 3 considered a possible drainage tunnel alignment running beneath John Daly Boulevard from the south side of Cliffside Drive, to a new outfall structure at Thornton State Beach.
- Alternative 4 considered a possible drainage tunnel alignment running from Westlake Park, beneath Northgate Avenue, to a new outfall structure near Thornton State Beach.
- Alternatives 5A and 5B considered possible drainage tunnel alignments running from a point approximately 800 feet from the beginning of the Vista Grande Canal, beneath the Olympic Club, to either a new outfall structure near Fort Funston (5A) or the existing outfall structure (5B).
- Alternative 6 considered a possible drainage tunnel alignment running from a point approximately 2,100 feet from the beginning of the Vista Grande Canal, beneath the Olympic Club, to the existing outfall structure.
- Alternatives 7A and 7B considered a possible drainage tunnel alignment running from a point approximately 3,500 feet from the beginning of the Vista Grande Canal, beneath the Olympic Club, to the existing outfall structure. Alternative 7A considered a large-diameter tunnel and Alternative 7B considered a small-diameter microtunnel sized to pass 330 cfs.
- Alternative 8, similar to Alternative 4, considered a possible microtunnel alignment running from Westlake Park, beneath a portion of Northgate Avenue and the Olympic Club, to a new outfall structure near Thornton State Beach.
- Alternative 9 considered the use of a stormwater detention structure located beneath Westlake Park which, following the peak runoff flow, would pump temporary stored water back into the box culvert connected to the Vista Grande Canal. A stormwater detention alternative can complement a tunnel alignment alternative to reduce discharges through an outfall structure.
- Alternative 10 considered the above alternatives in combination with a groundwater recharge feature.

The City compared the alternatives and selected Alternatives 1A, 4, 5B, 6, 7, 9, and 10 for further investigation and development. This decision, based on the above criteria, was formalized in a letter to JA dated August 9, 2007. For consistency, we have kept the original alternative numbers in this report.

The storage/detention alternative (Alternative 9) considers how a detention facility can affect flood control capacity requirements. The stormwater re-use alternative is discussed as an additional approach to using screened water beneficially and reducing overall discharges to the ocean. Table 4.1 summarizes the

key characteristics of the selected tunnel alternatives without stormwater detention. Tables 4.2A and 4.2B present a hydraulic analysis of the flows to the tunnels and detention basins based on the synthetic hydrograph. Table 4.3 summarizes key alternative characteristics with an example stormwater detention option. Appendix C includes conceptual designs and relevant information for the alternatives discussed below.

4.1 Alternative 1A – Beginning of Canal to New Outfall

4.1.1 Description

Alternative 1A, located entirely within San Mateo County, would include a drop structure, a gross solid screening device, a new drainage tunnel that would be approximately 4,500 feet long, and a new outfall structure. A new drop structure, located at the canal inlet, would collect the flows from the three major culvert lines and direct the flows to the gross solid screening device. Assuming the screens are no more than 25% full, the screening device would have a capacity of 1,500 cfs. The transition between the screening device and the new tunnel inlet would incorporate an overflow weir to maintain flows of 170 cfs or less in the Vista Grande Canal. Flows in excess of 170 cfs would flow over the weir into the new tunnel inlet. The new tunnel would run southwest from a point near the canal entry to a new outfall structure located approximately 3,600 feet south of the existing outfall structure. The tunnel would run under the Olympic Club golf course property, Highway 35, and the Golden Gate National Recreation Area (GGNRA) lands.

Figure 4.1A presents a schematic plan of the tunnel alignment and existing facilities. Figures 4.1B and 4.1C present views of the proposed site. Figures A.3 to A.5 present the conceptual designs for this alternative.

4.1.2 Debris Screening, Collection, and Disposal

A debris screening device could be included with this alternative by integrating a gross solids removal screen inline with existing culverts. Figure A.19 presents a design of a single screening device with a capacity of 1,500 cfs, which could be included with this alternative.

4.1.3 New Facilities

The new facilities included in this alternative are:

- A drop structure at the Vista Grande Canal inlet;
- A debris screening device with an overflow weir at the Vista Grande Canal inlet;
- A 13-foot-diameter, 4,500-foot-long tunnel; and
- A new outfall structure in the GGNRA. The stormwater discharge velocity would be engineered to prevent unsafe swimming conditions, impede pedestrian traffic, prevent unacceptable beach erosion, and reduce the operational impacts of cliff retreat.

4.1.4 Modifications and Connections to Existing Facilities

The flows from the three interceptors, the 60-inch-diameter culvert, the 24-inch-diameter culvert, and the 7-foot by 6-foot box culvert would collect in a concrete drop structure located at the intersection of Lake Merced Boulevard and John Muir Drive. A new drop structure would combine and pass the design stormwater flows to the debris screening device. Upstream stormwater collection system improvements are currently being evaluated by others. System improvements will be integrated across the entire watershed and sequenced to improve system performance. All tie-ins to existing stormwater culverts will be coordinated with the City of Daly City to ensure that service disruptions are minimized. Figure A.2 presents the as-built designs of the existing Vista Grande Canal, Tunnel, and Outfall Structure.

Required modifications to existing facilities are:

- Modify the canal drop structure to combine the flows from the 60-inch-diameter culvert, 24-inch-diameter culvert, and 7-foot by 6-foot box culvert.

4.1.5 Stormwater Re-Use Opportunities

The City of Daly City and the City of San Francisco are jointly developing a concept for a constructed wetlands area adjacent to the Vista Grande Canal and John Muir Drive. The wetlands could include up to 8 acres of land. Up to about 3 cfs of stormwater could be pumped from the Vista Grande Canal into the wetlands development area. This water would flow through the constructed wetlands and into Lake Merced. This alternative does not require major modifications to the Vista Grande Canal or significantly alter the areas being considered for wetlands development.

4.2 Alternative 4 – South of County Line along Northgate Drive

4.2.1 Description

Alternative 4, located entirely within San Mateo County, would include a new 48-inch-diameter, 700-foot-long intercept culvert; a drop structure; two gross solid screening devices; and a new drainage tunnel that would be approximately 4,700 feet long. The new 48-inch intercept would connect the 54-inch-diameter culvert along Cliffside Drive, which currently drains to the 60-inch-diameter culvert, and the new drop structure. A new drop structure, located within Westlake Park, would collect the flows from the new 48-inch culvert, the 5-foot by 8-foot box culvert, and the 24-inch culvert and direct the flows to one of the gross solid screening devices. The screening device would have a capacity of 1,330 cfs. The discharge from the screening device would continue to the new tunnel inlet. The new tunnel would run west from Westlake Park to a new outfall structure near Thornton State Beach. The tunnel would run under Lake Merced Boulevard, Northgate Avenue, Highway 35, and the GGNRA lands. The new outfall structure would be located approximately 5,000 feet south of the existing Vista Grande Outfall Structure.

Stormwater collected north of the drop structure (approximately 170 cfs peak) would continue to flow to the existing Vista Grande Canal. At the end of the existing canal, a new screening device would be installed to screen the stormwater before it flows through the existing Vista Grande Tunnel. Figure 4.2 presents a schematic plan of this alternative showing the tunnel alignment and existing facilities. Figures A.6 to A.9 present the conceptual designs for this alternative.

4.2.2 Debris Screening, Collection, and Disposal

A debris screening device could be included with this alternative by integrating a gross solids removal screen or inclined screen into a screening chamber beneath Westlake Park. Figure A.19 presents a design of a 1,330 cfs screening device. A new trashrack and automated trash rake could screen stormwater flows up to 170 cfs.

4.2.3 New Facilities

The new facilities included in this alternative are:

- A 48-inch-diameter, 700-foot-long culvert connecting the 54-inch-diameter culvert beneath Cliffside Drive near Manhole No. 53 to a new drop structure in Westlake Park;
- A debris screening device located in Westlake Park;
- A debris screening device located at the end of the Vista Grande Canal;
- A 13-foot-diameter, 4,700-foot-long tunnel; and

- A new outfall structure in the GGNRA. The stormwater discharge velocity would be engineered to prevent unsafe swimming conditions, impede pedestrian traffic, prevent unacceptable beach erosion, and reduce the operational impacts of cliff retreat.

4.2.4 Modifications and Connections to Existing Facilities

To divert stormwater into the new facilities, three of the existing culverts would be intercepted and routed to the debris screening device. Upstream stormwater collection system improvements are currently being evaluated by others. System improvements will be integrated across the entire watershed and sequenced to improve system performance. All tie-ins to existing stormwater culverts will be coordinated with the City of Daly City to ensure that service disruptions are minimized.

The identified culvert modifications are:

- Intercept the 36-inch-diameter culvert crossing Lake Merced Boulevard (it drains to the 24-inch-diameter culvert at Manhole No. 39).
- Block the 24-inch-diameter culvert to divert stormwater to an existing 36-inch-diameter culvert leading to Manhole No. 37 and the existing 5-foot by 8-foot box culvert.
- Intercept the 54-inch-diameter culvert, which currently drains to the 60-inch-diameter culvert near Manhole No. 53.
- Evaluate the capacity of the existing 5-foot by 8-foot box culvert to carry the stormwater to the drop structure.

4.2.5 Stormwater Re-Use Opportunities

Like Alternative 1A, this alternative would not affect the current planning for wetlands adjacent to the Vista Grande Canal.

4.3 Alternative 5B – 1/3 up Canal to Existing Outfall

4.3.1 Description

Alternative 5B, located within the city limits of San Francisco, would include a drop structure, a gross solid screening device, an 800-foot-long box culvert, and a new drainage tunnel that would be approximately 5,200 feet long.

A new drop structure, located at the canal inlet, would collect the flows from the major culvert lines and direct the flows to the gross solid screening device. Assuming the screens were no more than 25% full, the screening device would have a capacity of 1,500 cfs. The transition between the screening device and the new box culvert would incorporate an overflow weir to split the flows. In the box culvert, flows in excess of 170 cfs would flow over the weir into a separate double box culvert leading to the new tunnel inlet. The flows up to 170 cfs would flow through a separate box culvert to the existing canal north of the new tunnel inlet.

The new tunnel would run northwest from the wide section of the canal corridor, located approximately 800 feet downstream of the canal inlet, to the rehabilitated Vista Grande Outfall Structure. The tunnel would run under the Olympic Club, Highway 35, and the GGNRA lands. Figure 4.3A presents a schematic plan of this alternative showing the tunnel alignment and existing structures. Figures 4.3B and 4.3C present views of the proposed site. Figures A.10 to A12 present the conceptual design for this alternative.

4.3.2 Debris Screening, Collection, and Disposal

A debris screening device could be included with this alternative by integrating a gross solids removal screen into a new box culvert section in the canal upstream of the new tunnel drop structure. Figure A.19 presents a design of a screening device with a capacity of 1,500 cfs.

4.3.3 New Facilities

The new facilities included in this alternative are:

- A drop structure at the Vista Grande Canal inlet;
- A debris screening device at the Vista Grande Canal inlet with a controllable weir;
- An 800-foot-long split (triple) box culvert connecting the debris screening device with the new tunnel inlet and the existing Vista Grande Canal; and
- A 15-foot diameter, 5,200-foot-long tunnel.

4.3.4 Modifications and Connections to Existing Facilities

The flows from the three interceptors, the 60-inch-diameter culvert, the 24-inch-diameter culvert, and the 7-foot by 6-foot box culvert would collect in a new concrete drop structure located at the intersection of Lake Merced Boulevard and John Muir Drive. Upstream stormwater collection system improvements are currently being evaluated by others. System improvements will be integrated across the entire watershed and sequenced to improve system performance. All tie-ins to existing stormwater culverts would be coordinated with the City of Daly City to ensure that service disruptions were minimized.

Modifications to the canal would involve increasing its capacity so it could convey the maximum flow rate of 1,500 cfs from the canal inlet to the new tunnel inlet. This would be accomplished by replacing the first 800 feet of the canal with a split box culvert.

The existing Vista Grande outfall structure would require extensive modification to increase the discharge from 170 cfs to 1,500 cfs. The stormwater discharge velocity would be engineered to prevent unsafe swimming conditions, impede pedestrian traffic, prevent unacceptable beach erosion, and reduce the operational impacts of cliff retreat.

Required modifications to existing facilities are:

- Modify the canal drop structure to tie in the 60-inch-diameter culvert, 24-inch-diameter culvert, and 7-foot by 6-foot box culvert.
- Modify the existing outfall structure for the design discharge flow and new tunnel connection.

4.3.5 Stormwater Re-Use Opportunities

This alternative would require use of the Vista Grande Canal as a source of water for the wetlands areas. By constructing the wetlands on top of and adjacent to the new concrete box culverts, the size of the wetlands could be increased above the areas currently being studied. Coordination would be required once the tunnel alternative was developed.

4.4 Alternative 6 – 2/3 up Canal to Existing Outfall

4.4.1 Description

Alternative 6, located within the city limits of San Francisco, would include a drop structure, a gross solid screening device, a 2,100-foot-long box culvert, and a new drainage tunnel that would be approximately 4,200 feet long.

A new drop structure, located at the canal inlet, would collect the flows from the major culvert lines and direct the flows to the gross solid screening device. Assuming the screens were no more than 25% full, the screening device would have a capacity of 1,500 cfs. The transition between the screening device and the new box culvert would incorporate an overflow weir to split the flows. In the box culvert, flows in excess of 170 cfs would flow over the weir into a separate double culvert leading to the new tunnel inlet. The flows up to 170 cfs would flow through a separte box culvert to the existing canal north of the new tunnel inlet.

The new tunnel would run northwest from a wide section of the canal, located approximately 2,100 feet downstream of the canal inlet, to the rehabilitated Vista Grande Outfall Structure. The tunnel would run under the Olympic Club, Highway 35, and the GGNRA lands. Figure 4.4A presents a schematic plan of this alternative showing the tunnel alignment and existing facilities. Figures 4.4B and 4.4C present views of the proposed site. Figures A.13 to A.15 present the conceptual designs for this alternative.

4.4.2 Debris Screening, Collection, and Disposal

A debris screening device could be included with this alternative by integrating a gross solids removal screen into a new box culvert section in the canal. Figure A.19 presents a design of a screening device with a capacity of 1,500 cfs.

4.4.3 New Facilities

The new facilities included in this alternative are:

- A drop structure at the Vista Grande Canal inlet;
- A debris screening device at the Vista Grande Canal inlet with a controllable weir;
- A 2,100-foot-long split (triple) box culvert connecting the debris screening device with the new tunnel inlet and the existing Vista Grande Canal; and
- A 15-foot-diameter, 4,200-foot-long tunnel.

4.4.4 Modifications and Connections to Existing Facilities

The flows from the three interceptors, the 60-inch-diameter culvert, the 24-inch-diameter culvert, and the 7-foot by 6-foot box culvert would collect in a new concrete drop structure located at the intersection of Lake Merced Boulevard and John Muir Drive. All tie-ins to existing stormwater culverts will be coordinated with the City of Daly City to ensure that service disruptions are minimized.

Modifications to the canal would involve increasing its capacity so it could convey the maximum flow rate of 1,500 cfs from the canal inlet to the new tunnel. This would be accomplished by replacing the first 2,100 feet of the canal with a split box culvert.

The existing Vista Grande Outfall Structure would require extensive modifications to increase the discharge from 170 cfs to 1,500 cfs. The stormwater discharge velocity would be engineered to prevent unsafe swimming conditions, impede pedestrian traffic, prevent unacceptable beach erosion, and reduce the operational impacts of cliff retreat.

Required modifications to existing facilities are:

- Modify the canal drop structure to tie in the 60-inch-diameter culvert, 24-inch-diameter culvert, and 7-foot by 6-foot box culvert.
- Modify the existing outfall structure for the design discharge flow and new tunnel connection.

4.4.5 Stormwater Re-Use Opportunities

This alternative would require use of the Vista Grande Canal as a source of water for the wetlands areas. By constructing the wetlands on top of and adjacent to the new concrete box culverts, the size of the wetlands could be increased above the areas currently being studied. Coordination would be required once the tunnel alternative was developed.

4.5 Alternative 7 – Parallel Tunnel South of the Existing Tunnel

4.5.1 Description

Alternative 7, located within the city limits of San Francisco, would include a drop structure, a gross solid screening device, a 3,500-foot-long box culvert, and a new drainage tunnel that would be approximately 3,200 feet long.

A new drop structure, located at the canal inlet, would collect the flows from the major culvert lines and direct the flows to a gross solid screening device. Assuming the screens were no more than 25% full, the screening device would have a capacity of 1,500 cfs. The transition between the screening device and the new box culvert would incorporate an overflow weir to split the flows. In the box culvert, flows in excess of 170 cfs would flow over the weir into a separate double box culvert leading to the new tunnel inlet. The flows up to 170 cfs would flow through a separate box culvert to the existing canal north of the new tunnel inlet.

The new tunnel would run west from a point in the canal approximately 200 feet south of the existing tunnel, to the rehabilitated Vista Grande Outfall Structure. The tunnel would run beneath the Olympic Club, Highway 35, and the GGNRA lands. Figure 4.5A presents a schematic plan of this alternative showing the tunnel alignment and existing facilities. Figures 4.5B and 4.5C present views of the proposed site. Figures A.16 to A.18 present the conceptual design for this alternative.

4.5.2 Debris Screening, Collection, and Disposal

A debris screening device could be included with this alternative by integrating a gross solids removal screen into a new box culvert section in the canal. Figure A.19 presents a design of a single screening device with a capacity of 1,500 cfs, which could be included with this alternative.

4.5.3 New Facilities

The new facilities included in this alternative are:

- A drop structure at the Vista Grande Canal inlet;
- A debris screening device at the Vista Grande Canal inlet with a controllable weir;
- A 3,500-foot-long split box culvert connecting the debris screening device with the new tunnel inlet and the existing Vista Grande Canal; and
- A 15-foot-internal-diameter, 3,200-foot-long tunnel.

4.5.4 Modifications and Connections to Existing Facilities

Required modifications would be similar to those described in Alternative 5B.
The flows from the three interceptors, the 60-inch-diameter culvert, the 24-inch-diameter culvert, and the 7-foot by 6-foot box culvert would collect in a new concrete drop structure located at the intersection of Lake Merced Boulevard and John Muir Drive. Upstream stormwater collection system improvements are currently being evaluated by others. System improvements will be integrated across the entire watershed and sequenced to improve system performance. All tie-ins to existing stormwater culverts would be coordinated with the City of Daly City to ensure that service disruptions were minimized.

Modifications to the canal would involve increasing its capacity so it could convey the maximum flow rate of 1,500 cfs from the canal inlet to the new tunnel inlet. This would be accomplished by replacing most of the canal with a split (triple) box culvert.

The existing Vista Grande outfall structure would require extensive modification to increase the discharge from 170 cfs to 1,500 cfs. The stormwater discharge velocity would be engineered to prevent unsafe swimming conditions, impede pedestrian traffic, prevent unacceptable beach erosion, and reduce the operational impacts of cliff retreat.

Required modifications to existing facilities are:

- Modify the canal drop structure to tie in the 60-inch-diameter culvert, 24-inch-diameter culvert, and 7-foot by 6-foot box culvert.
- Modify the existing outfall structure for the design discharge flow and new tunnel connection.

4.5.5 Stormwater Re-Use Opportunities

This alternative would require use of the Vista Grande Canal as a source of water for the wetlands areas. By constructing the wetlands on top of and adjacent to the new concrete box culverts, the size of the wetlands could be increased above the areas currently being studied. Coordination would be required once the tunnel alternative was developed.

4.6 Alternative 9 – Detention Basins

4.6.1 Description

Utilizing a large capacity stormwater detention basin involves diverting a portion of stormwater flows into a temporary storage structure until there is available capacity in the stormwater system to discharge the stored stormwater. A detention structure is typically designed to supplement existing or planned stormwater facilities. It may be sized to store the entire design storm (full detention) or only a portion of the storm (peak shaving).

Working from the synthetic hydrograph, stormwater volumes were developed to complement the potential tunnel flow capacities. Table 4.2A and 4.2B summarizes the volumes associated with several detention options.

Several parameters were used in siting the project's stormwater detention structure:

- Land must be available for the storage site.
- The site must be large enough to accommodate the required structure footprint.
- The foundation soils must be strong enough to support a large reinforced concrete structure that will create very substantial hydrostatic loads.
- The structure should be located close to existing stormwater culverts (trunks).
- The structure should be located near the existing water treatment facility to preserve groundwater recharge opportunities.

Westlake Park, within the City of Daly City limits, meets these criteria. A detention structure could be sized to store 3.9 million gallons (MG), 16.2 MG, 30.8 MG, or 43 MG. The detention structure could be used independently or in combination with one of the tunnel alternatives described above. The structure's design could be modularized so that discrete storage capacity could be placed in service while the balance

of the storage capacity is constructed. By comparing columns (a) and (h) in Tables 4.2A and 4.2B, it is possible to size each alternative's tunnel diameter based on the amount of flow detained. Without storage capacity, the new tunnels must be sized to pass 1,330 cfs, which (in combination with the existing Vista Grande Tunnel) would pass the design flow. When the storage capacity is 1,330 cfs, no modifications are required to the Vista Grande Canal or Tunnel. This alternative develops stormwater detention capacity beneath Westlake Park. For simplicity, an area beneath the north softball field was separated into two adjacent areas. Area 1 is adjacent to the existing wastewater treatment facility, and is 31,000 square feet (310 feet by 100 feet). Area 2 is between Area 1 and the tennis courts, and is about 58,900 square feet (310 feet by 190-feet). The depths of the structures vary by the amount of desired storage capacity.

Figure 4.6 presents a schematic plan of this alternative showing the preliminary stormwater detention structure and existing facilities. Figures A.20 to A.24 present the conceptual design for this alternative.

Under routine operating conditions, water in the stormwater culverts would bypass the detention structure. When necessary to prevent or reduce flooding, stormwater would be diverted to the detention structure, stored until adequate downstream flow capacity existed, then pumped from the detention structure back to the culvert where it would flow to the Vista Grande Canal.

Automatic Hydraulic Control System

This alternative would include an automatic hydraulic control system which would monitor the water level in the Vista Grande Canal. When the canal began to reach capacity, the system would divert stormwater to the detention structure through a new culvert. A hydraulic control, like an inflatable weir, would be installed in the 7-foot by 6-foot box culvert (and other culverts as applicable). Normally, the inflatable weir would be flat on the invert and normal culvert flows would follow the culvert to the Vista Grande Canal. However, when flow in the canal reached a preset flood stage (equal to the new and existing tunnel capacity), the system would inflate the weir, and stormwater would be diverted to the detention structure. When the flows in the canal return to normal, the weir would deflate, and culvert flows would run directly to the canal. The automatic hydraulic control system could be monitored and controlled remotely by the wastewater treatment plant personnel using a Supervisory Control and Data Acquisition (SCADA) system. A dedicated air compressor would be located near the detention structure and have air piping connecting it with the inflatable weir(s). The compressor would run during high flow conditions and only to keep the weir inflated. Weekly, the compressor would be run for a short time for preventative maintenance purposes.

Option to Store 3.9 MG

To provide approximately 3.9 MG of storage, a portion of the Westlake Park's existing north softball field designated as Area 1 and shown in Figure A.20, would be temporarily closed while a detention basin is constructed. The detention structure would be approximately 310 feet long by 100 feet wide with an operating depth of 17-feet. The 5-foot by 8-foot box culvert would be connected to the detention basin with a new double box culvert. A screening device would be placed near the inlet or within the structure. The water would then flow through the multiple diaphragms and wet wells. After the storm was over the water would be pumped back through the new double culvert line to the 5-foot by 8-foot box culvert. Once the flows reached the 5-foot by 8-foot box culvert line, the water would flow by gravity to the existing Vista Grande canal and tunnel. Access hatches and ventilation would be provided along the perimeter of the tennis court fence. During construction, Westlake Park visitors would be disturbed by construction equipment coming in and out of the park and by limited parking. After construction, the softball field would be restored to its pre-project condition.

Option to Store 16.2 MG

To provide approximately 16.2 MG of storage, the Westlake Park's existing north softball field designated as Areas 1 and 2, and shown in Figure A.20 would be temporarily closed while a detention basis is constructed. The detention structure would be approximately 310 feet long by 290 feet wide with an operating depth of 25-feet. The connection to the 5-foot by 8-foot box culvert would be similar to that described for the 3.9 MG option. A screening device would be placed near to the inlet or within the structure. The water would flow through the multiple diaphragms and wet wells. After the storm was over the water would be pumped back through the new double culvert line to the 5-foot by 8-foot box culvert. Once the flows reached the 5-foot by 8-foot box culvert line the water would flow by gravity to the existing Vista Grande canal and tunnel. Access hatches and ventilation would be provided along the perimeter of the structure. During construction, Westlake Park visitors would be disturbed by construction equipment coming in and out of the park and by limited parking. After construction, the softball field would be restored to its pre-project condition.

Option to Store 30.8 MG

To provide approximately 30.8 MG of storage, the Westlake Park's existing north softball field shown in Figure A.20 would be temporarily closed while a detention basis is constructed. The detention structure would be approximately 310 feet long by 290 feet wide, with an operating depth of 46-feet. In addition to connecting the detention structure to the existing 5-foot by 8-foot box culvert, a new 48-inch diameter culvert will connect with an existing 54-inch culvert beneath Cliffside Drive. The connection to the 54-inch culvert on Cliffside Drive would be similar to that described in Alternative 4. A new double culvert line would connect the detention basin to the box culvert. Screening devices would be placed near the inlet or within the structure. The water would flow through the multiple diaphragms and wet wells. After the storm was over, the water would be pumped back through the new double culvert line to the 5-foot by 8-foot box culvert. Once the flows reached the 5-foot by 8-foot box culvert line, the water would flow by gravity to the existing Vista Grande canal and tunnel. Access hatches and ventilation would be provided along the perimeter of the structure. During construction Westlake Park visitors would be disturbed by construction equipment coming in and out of the park and by limited parking. After construction, the softball field would be restored to its pre-project condition.

Detention Storage Pump-Out

The detention structure could temporarily store between 3.9 and 30.8 million gallons depending on its depth and footprint. Stormwater collected from the Sub Basin No. 1 (Cliffside Drive) could be stored in a shallow chamber within the detention structure and drained by gravity. The majority of the stormwater, however, would need to be pumped back into the existing 5-foot by 8-foot box culvert line .

Pumping capacities ranging from 26 MGD (40 cfs) to 39 MGD (60 cfs) could be designed to dewater the facility within 24 hours following the peak storm flow. The expected interval between storms, assumed to be 24 hours, would influence the desired dewatering rate. Keeping the flood control conduits flowing at full capacity would dewater the detention structures in the minimum time period.

Flow control logic and SCADA could be used to manage flows and coordinate pump cycle times. SCADA could be used to remotely sequence the pumps and keep the flood control conduits flowing at full capacity until the detention structures were drained.

4.6.2 Debris Screening, Collection, and Disposal

Including a stormwater detention structure in the flood control plan provides an opportunity to screen stormwater before it is discharged by the outfall structure. An inclined screen or a linear radial gross

solids removal device could be incorporated into the detention structure beneath Westlake Park. A new trash rack and trashrake could be incorporated at the inlet to the existing tunnel.

4.6.3 New Facilities

The new facilities included in this alternative are:

- A detention basin, which could range in size and volume, including a debris screening system, pump station, air compressor, instrumentation and control, and associated piping; and
- A 48-inch-diameter, 700-foot-long culvert connecting the 54-inch-diameter culvert near Manhole No. 53 to the detention basin in Westlake Park.

4.6.4 Modifications and Connections to Existing Facilities

Required modifications and connections would be similar to those described in Alternative 4 and would include modifying the wastewater treatment plant's control room to include the detention structure's instrumentation and control system.

4.6.5 Stormwater Re-Use Opportunities

Like Alternative 1A, this alternative would not affect the current planning for wetlands adjacent to the Vista Grande Canal.

4.7 Alternative 10 – Stormwater Re-Use Opportunities

4.7.1 Description

Several of the alternatives provide opportunities to reuse stormwater. This evaluation includes the identification and conceptual discussion of two stormwater re-use opportunities: wetlands development and groundwater replenishment.

4.7.2 Wetlands Development

In a separate and current effort to study water quality improvement opportunities in Lake Merced, wetlands developments are being considered along John Muir Drive between the Vista Grande canal and the Lake Merced Impound Lake. Wetlands provide habitat for many plants and animals, and naturally enhance water quality. The conceptual wetlands design diverts a portion of the stormwater into a series of cascading wetlands basins. The water flows through the wetlands and undergoes a natural water treatment process which filters and removes pollutants. The effluent from the wetland basins could be diverted into Lake Merced. This natural water treatment approach has many benefits to the ecology and community.

Each of the alternatives provides an opportunity for developing and sustaining wetlands along John Muir Drive. Opportunities to increase the wetlands development are available with Alternatives 5B, 6, and 7. One option is to increase the canal capacity by flowing screened stormwater through new box culverts. Additional wetland basins could be constructed on top of the proposed box culvert, creating up to 2.4 acres of additional wetlands habitat.

4.7.3 Groundwater Replenishment

Another stormwater management alternative is to screen the stormwater and use it to replenish groundwater resources. Groundwater replenishment could occur either through infiltration facilities (ponds or other surface facilities) or groundwater injection wells. Infiltration opportunities are limited but could include a pervious subfloor and drainage system beneath the storage basin. Based on Treadwell and Rollo's initial review of the geotechnical conditions near Westlake Park and the footprint of the detention basins, the likely infiltration capacity would be on the order of magnitude of 15,000 to 150,000 gallons per day (gpd). Injection wells would be more attractive, probably on the order of 350,000 to 500,000 gpd,

about half the production rate of newly constructed wells within the basin. A groundwater injection system might operate successfully year-round, treating the base flow in the Vista Grande Canal. A 500,000-gpd system would be equal to about 5% of the City's average annual water demand. Further investigation would be required to determine the actual replenishment rates, number of injection points, and anticipated operation and maintenance costs.

It is expected that the stormwater would have to be treated prior to injection. The San Francisco Bay Regional Water Quality Control Board would establish water quality standards for injected stormwater when issuing its NPDES permit for the project. At this time, the State has not established firm requirements for injected stormwater, but requirements similar to the draft regulations proposed for groundwater recharge with recycled wastewater (CDHS, 2007) provide some general guidance about the standards which might apply. Constituents of potential concern include pathogenic organisms, nitrogen compounds, and trace compounds – metals and synthetic organic chemicals. Limited water quality data for stormwater in the Vista Grande Canal showed relatively low levels of these constituents (RMC, 2006). Diversion into a detention basin would help to settle out soil particles and capture flotable material. After screening, the stormwater may require filtration, coagulation, and disinfection prior to injection into the groundwater to satisfy water quality requirements.

To further evaluate the groundwater replenishment alternatives, additional characterization of the site conditions and environmental regulations would be appropriate. The characterization could include comprehensive analysis of the local stormwater, identification of injection or percolation sites, evaluation of minimum distances between injection or percolation sites and withdrawal site, subsurface investigations to locate and monitor the groundwater level, and estimate the injection capacity. Discussions with regulators would be needed to better define opportunities and requirements.