SECTION 6 SEDIMENT MANAGEMENT ALTERNATIVES – INTRODUCTION & GENERAL OVERVIEW

6.1 INTRODUCTION

This section discusses the various sediment management alternatives considered for the reservoirs and debris basins maintained by the Los Angeles County Flood Control District (Flood Control District). Sediment management alternatives are organized in the following categories based on the different phases of the cleanout process.

- Staging and Temporary Sediment Storage Areas (Section 6.2)
- Sediment Removal Alternatives (Section 6.3)
- Transportation Alternatives (Section 6.4)
- Beneficial Use and Placement Alternatives (Section 6.5)

Each sediment management alternative is discussed independently. For example, discussion of excavation only includes the impacts it has on the facility from which the sediment is removed and the cost of excavating the sediment; it does not include the impacts or cost of transporting or placing the excavated sediment. The impacts and costs of potential staging and storage area alternatives, transportation alternatives, and placement alternatives are discussed separately in their respective sections.

Due to the nature of the Strategic Plan, potential impacts are discussed in general terms. The impacts include long-term impacts and temporary impacts; in some cases, the temporary nature of impacts is mentioned. Discussion of the majority of the alternatives is organized as shown below.

- General Description
- Assumptions
- Environmental Impacts
  - Habitat
  - Water Quality
  - Water Conservation
  - Air Quality
- Social Impacts
  - Traffic
  - Noise
  - Scenic and visual impacts
    Recreation
- Implementability
  - Right of way issues
  - Technical certainty
  - Permitting concerns
- Performance
  - Ability to meet the needs of the reservoirs and debris basins and maintain proper operation
  - Capacity, transport, or removal rate, as applicable
- Cost
  - Order of magnitude 20-year cost estimate
- Conclusion
  - General feasibility for large reservoirs, small reservoirs, and debris basins.

The cost estimates used in this Strategic Plan are based on historic sediment removal projects completed by the Flood Control District, discussion with industry, and additional research. The cost estimates do not include a monetary value for environmental and social impacts. Since there are no market prices for these impacts, artificial ones would need to be created. Economists typically create a cost by studying what people would be willing to pay for a given condition. However, such an approach leads to subjective costs that cannot be compared to the actual dollars that would need to be spent to complete a project.

Performing a cost-benefit analysis using subjective costs could produce skewed cost-benefit ratios that could lead to an appearance that certain alternatives are more favorable than others and dismissal of appropriate alternatives.

Therefore, the Strategic Plan discusses cost separately from environmental impacts, social impacts, implementability, and performance, which allows impacts to be compared in a more objective manner.

Discussion of each alternative includes applicability to the three general categories of facilities – large reservoirs, small reservoirs, and debris basins. As mentioned in Section 2 and shown in Table 6-1, the reservoirs were categorized into large and small reservoirs based on a combination of their capacity and the presence of a standing pool. In general, large reservoirs are operated with a permanent pool of water while small reservoirs are operated dry. Debris basins are significantly different from both large and small reservoirs. Debris basins do not have a pool of water, are typically cleaned in response to an immediate need to remove material between storms, and typically generate significantly less sediment than the reservoirs.

Table 6-1 General Categories of Reservoirs

Large Reservoirs		Small Reservoirs
San Gabriel River Reservoirs	**Other Large Reservoirs**	
Cogswell	Big Tujunga	Big Dalton
San Gabriel	Devil's Gate	Eaton
Morris	Pacoima	Live Oak
	Puddingstone	Puddingstone Diversion
	San Dimas	Thompson
	Santa Anita	

The discussion and conclusions presented in Section 6 provide the basis for which alternatives are considered for each reservoir and the debris basins. Sections 7 through 10 provide more specifics based on location, impacts, and costs. Combinations of alternatives are also considered.

6.2 STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

Depending on the mode of transportation and destination of the sediment, it could be necessary to transfer sediment from one transportation mode to another, which would require a staging area. An example of a staging area could be an area near a reservoir used to transfer sediment from a conveyor belt to trucks.

Temporary sediment storage areas could be beneficial during certain sediment management operations to be able to store temporarily sediment removed from a facility and transport the sediment gradually to its final destination. An example of a temporary sediment storage area would be a downstream basin that is being used for dewatering sluiced sediment.

Staging and temporary sediment storage areas are not typically required for sediment management operations for debris basins. Since the potential impacts of using a staging or temporary sediment storage area are specific to the site, they are discussed within the reservoir-specific sections (Sections 7 through 9).

6.3 SEDIMENT REMOVAL ALTERNATIVES

Section 6.3 discusses sediment removal by means of excavation, dredging, sediment flushing, and sluicing.

6.3.1 EXCAVATION

Excavation - General Description

Sediment removal by excavation requires that the material be generally dry. For reservoirs that do not have a standing pool of water and debris basins, this requirement does not present an issue. This can also be true for reservoirs that are operated with a standing pool of water if only the dry part of the reservoir is to be excavated.

However, in order to excavate the material closest to the dam, a reservoir that has a pool of water would need to be completely drained. Material accumulated closest to the dam presents the greatest potential to inhibit operations.

Excavation of sediment involves the use of conventional excavation equipment such as excavators, backhoes, scrapers, bulldozers, and front-end loaders, as shown in Figure 6-1. As a result, vehicular access to the site is required for excavation.

Excavation – Environmental Impacts

Figure 6-1 Equipment used during excavation

Many debris basins and reservoirs are maintained free of vegetation or habitat; however, some contain significant types or amounts. Within reservoirs, there may also be aquatic habitat. Habitat or vegetation that exists within debris basins and reservoirs could be impacted by excavation activities. Additionally, draining of a reservoir could impact the habitat in the stream below the dam, unless measures are taken to prevent sediment from entering the stream (Flow can typically be bypassed thru the work area or best management practices can be utilized to filter or settle out the debris from the discharged flow). Habitat within the facilities would need to be identified in order to avoid, minimize, or mitigate impacts to plant and wildlife species.

Excavation of sediment from reservoirs and debris basins can be planned to minimize impacts on water conservation. While some losses are expected, most of the water released while draining a reservoir is able to be captured and recharged through downstream facilities, resulting in minimal impact to water conservation quantities.

Emissions from heavy equipment during excavation would minimally affect air quality.

Excavation – Social Impacts

Excavation operations occur within a reservoir or debris basin itself. For the excavation portion alone, there is no increase in traffic in the area surrounding the facility.

For reservoirs in a remote location, excavation operations are not expected to affect the viewshed of any residences. In those cases that a reservoir or debris basin is in close proximity to residences or areas visited by recreational users, excavation activities could have visual and noise impacts.

Recreational uses are not permitted at the majority of the reservoirs and all of the debris basins maintained by the Flood Control District. Therefore, for the most part, excavation does not impact recreational resources. However, in those cases where excavation operations would have an impact on recreation, the impacts are identified within the reservoir-specific sections. In any case, draining of a reservoir in anticipation of excavation activities could potentially impact recreational resources downstream.

Excavation - Implementability

The Flood Control District has conducted numerous sediment removal projects at reservoirs and debris basins using conventional excavation equipment and techniques. Given the Flood Control District's experience, excavating sediment from the reservoirs and debris basins under generally dry conditions is a technically certain method of sediment removal.

As previously mentioned, some reservoirs are operated with a pool of water. For a given reservoir, this could be due to operational concerns, the reservoir's function in the management of flood risk, the reservoir's function in water conservation, or a combination of these reasons. In order not to interfere with a reservoir's operational needs and functions and to minimize hazards to workers, reservoirs are typically drained and excavated outside of the storm season, namely between April 16th and October 14th. However, it could be possible to excavate some material outside of these dates if conditions permit.

Draining of a reservoir is limited by the discharge capacity of the dam's outlets and habitat or stakeholder interests downstream of the reservoir. The time needed to drain the reservoir and get the sediment in the reservoir to an appropriate dryness could limit the time available to excavate sediment from the reservoir.

There are no implementation concerns regarding excavation of sediment from debris basins during the dry season given the relative small size of most debris basins and absence of a standing pool. Debris basins with a burned watershed sometimes need to be cleaned out during the storm season in order to maintain their functionality. Excavation can be implemented during the storm season, even if the material is somewhat wet.

Excavation of sediment from reservoirs and debris basins within Flood Control District property does not present right of way concerns, but requires environmental regulatory permits.

Excavation - Performance

The Flood Control District has effectively used excavation procedures to remove sediment from reservoirs and debris basis in the past. While there may be other issues, the effectiveness of excavation is not a concern for future cleanouts.

Bulldozers, loaders, and excavators used for excavation are among the most commonly used earthmoving machines. It is expected that excavation operations would be able to match the efficiency of any mode of transportation being considered.

Excavation – Cost

The cost to excavate sediment from a reservoir is approximately $3 per cubic yard. Due to the smaller size of debris basins, the cost to excavate sediment is approximately $7.50 per cubic yard. These costs do not include the cost of transporting or placing sediment.

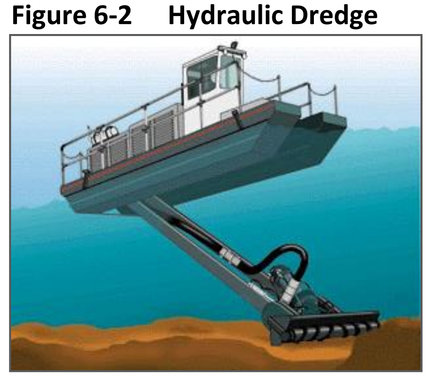
Excavation – Conclusion

☑	Large reservoirs
☑	Small reservoirs
☑	Debris basins

Excavation is a sediment removal method that is feasible at reservoirs, both large and small, and at debris basins.

6.3.2 DREDGING

Figure 6-2 Hydraulic Dredge



Dredging - General Description

Dredging is a type of underwater excavation that is used to remove sediment from a large water body. Generally, dredges either scoop or suction sediment, along with water, from the bottom of a water body. The San Gabriel and Morris Reservoirs Dredging Feasibility Study (2000) completed for the Flood Control District indicates the cutterhead suction dredge would be the most practical type of dredge for the reservoir cleanouts. This plan assumes that is the case still.

Since dredges are designed to be used under water, dredging could not be employed in reservoirs that do not have a pool of water. Dredging is also not a feasible method to remove sediment from debris basins due to both the lack of water and the size of debris basins. Therefore, this section discusses the potential impacts of dredging those reservoirs that usually have a pool of water.

Dredging - Assumptions

The following list presents the assumptions made and taken into account while analyzing dredging as a method to remove sediment from the reservoirs.

- A portable hydraulic cutterhead dredge would be used.
- The dredge would be able to remove sediment at a maximum water depth of approximately 50 feet.
- The dredge would be able to handle only the smaller material in the reservoir. Therefore, sediment from portions of the reservoir with the larger material would need to be removed using a different method.
- The dredge would be able to remove approximately 200 cubic yards of sediment per hour.
- The water-sediment mixture suctioned by the dredge would have a water-sediment ratio of approximately 9 to 1. Therefore, the dredge would have a total discharge of approximately 2,000 cubic yards per hour or 15 cubic feet per second of the sediment/water mixture.
- The dredge would be connected to a 12-inch high-density polyethylene (HDPE) slurry pipeline. (Impacts associated with the use of slurry pipelines are discussed in Section 6.4.4)
- For every 100,000 cubic yards of sediment dredged, a dewatering site of approximately 40 acres would be required to drain the dredged material.
- If a dewatering site is unavailable, a mechanical dewatering machine could be employed to dewater the sediment. The dried sediment would then be placed in a barge or onto a floating conveyor belt to be tranported to the shore for transport to a placement site. However, dewatering machines are very slow and could impact dredging performance.
- Turbidity concerns could be partially mitigated with a silt curtain around the dredge. The curtain would act as a wall to prevent silt from moving beyond the curtain.
- Generally dredging operations would only be able to be conducted six months out of the year because of the need to provide flood protection and water conservation. This limits the water depth and the need for a dewatering area. In wet years, the available timeframe could be less, as it could take longer to drain the reservoir to acceptable levels.
- The dredge would be operated only on weekdays, during two eight-hour shifts, for a total of 16 hours per weekday.
- Dredges could discharge directly to the stream below the dam during the storm season and stormflows could flush the sediment downstream reducing impacts to the habitat in the streamcourse. However, the sediment-laden flows would be inappropriate for groundwater recharge, as suspended sediment in the flows would clog downstream spreading facilities. Also, the quantity of sediment that could be transported in this manner is very uncertain.

Dredging - Environmental Impacts

The potential impacts dredging would have on vegetation and fauna depend on the specifics of the (above ground and underwater) habitat within each reservoir. Existing habitat in the area(s) considered for discharge and drying of dredged material would also need to be determined.

Dredging could impact water quality within a reservoir by increasing turbidity. However, as previously noted, it was assumed that water quality concerns could be partially addressed with a silt curtain around the dredge. A silt curtain would limit the turbidity to the area surrounded by the silt curtain, preventing impacts to the entire reservoir. In the past, water quality regulators have expressed high concern regarding potential residual turbidity in the reservoir as a result of dredging.

Dredging a reservoir (and transporting the dredged slurry via a slurry pipeline) could affect water conservation if the dredging rate is faster than the rate of sediment settling at the downstream facility where the dredged material is being dewatered. Overflows with suspended sediment could result in sediment deposition within channels and spreading facilities downstream of the dewatering area and could significantly impact water conservation quantities.

Dredging - Social Impacts

Since dredging operations would occur within a reservoir itself, there would not be an increase in traffic in the area surrounding the reservoir.

For reservoirs in a remote location, dredging operations are not expected to impact the viewshed of any residences. However, for a reservoir in close proximity to residences or areas visited by recreational users, dredging activities could have visual and noise impacts.

Operating a dredge within a reservoir that serves a recreational purpose would impact recreation by limiting areas around the dredge, pipeline, and discharge locations. However, as previously discussed, the majority of the reservoirs maintained by the Flood Control District are not accessible to the public and do not have permitted recreational uses.

Dredging - Implementability

As previously discussed, dredging can only be conducted at reservoirs with an adequate standing pool. While dredging is a technique that has been used in other areas of the country for decades, pilot testing would need to be completed to identify more accurately feasibility for specific reservoirs.

Dredging would not present right of way concerns. The use of a dredge would require environmental regulatory permits.

Dredging - Performance

Based on the previously mentioned assumptions, a 6-month dredging operation could remove approximately 400,000 CY of sediment from a reservoir. In turn, a total of approximately 4 MCY or 2,500 acre-feet of water-sediment slurry would need to be dewatered. The dredged material could be transported to the shore from the dredge via slurry pipeline, floating conveyor, or another barge.

Alternatively, dredged material could be mechanically dewatered on shore. However, the rate at which a mechanical dewatering machine operates is relatively slow and could likely not meet the need of the large quantities to be removed from the reservoirs.

Dredging – Cost

Dredging, including operating costs, would cost approximately $10.50 per cubic yard of sediment dredged. Employing a mechanical dewatering machine would cost an additional $34.50 per cubic yard. These costs do not include the cost of transporting and placing sediment.

Dredging – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Dredging is a removal alternative that could be feasible at large reservoirs, which have a pool of water. However, it is not feasible at small reservoirs, which do not have a pool of water or at debris basins.

Mechanically dewatering material is not feasible for any dredging operations due to the low efficiency and high cost. It is not considered further as part of this Strategic Plan.

6.3.3 SEDIMENT FLUSHING

Sediment flushing is a method that allows water flows to transport silts and other light sediment accumulated in a facility through the facility. In the past, the Flood Control District has referred to this method as flow assisted sediment transport (abbreviated as FAST). To be consistent with nomenclature used by other agencies throughout the country and the world, the Flood Control District now refers to flow assisted sediment transport as sediment flushing.

Due to the different characteristics of debris basins and reservoirs and the channels downstream of the two types of facilities, the opportunity for implementing flushing at the debris basins and reservoirs is different. For this reason, discussion of sediment flushing and debris basins is separated from the discussion of sediment flushing and reservoirs.

6.3.3.1 SEDIMENT FLUSHING AND DEBRIS BASINS

By the nature of their purpose and design, debris basins serve to settle out the sediment in incoming flows and do not let significant amounts of sediment pass through the facilities. In order for flows to be able to carry sediment past a debris basin, the debris basin would need to be modified. Modification of a debris basin would affect the ability of the debris basin to manage flood risk. Allowing sediment to pass through a debris basin could result in clogged connections between the debris basin and the receiving channel. The sediment-laden flows could exceed the flood-carrying capacity of the channel, clog the channel, or lead to sediment depositing in the channel, which in turn would result in a loss in channel capacity. Sediment deposited in the channels could also make their way into spreading facilities, which in turn could result in loss of capacity and reduced water infiltration rates at spreading facilities. Further, due to the abrasive quality of the sediment, such flows could impact the concrete channels downstream of the debris basins by scouring of the channels' banks and invert over time. All these impacts would lead to additional maintenance at the debris basins and in the channels downstream of the debris basin. Modification of the channels downstream could possibly also be required. For all these reasons, sediment flushing is considered an unsuitable alternative for debris basins.

6.3.3.2 SEDIMENT FLUSHING AND RESERVOIRS

Unlike debris basins, the channels downstream of reservoirs are mostly natural channels instead of lined channels. Reservoirs also differ from debris basins in that flows from reservoirs are able to be regulated. This allows flows to be held and later released to wash out sediment deposited in the channels after sediment flushing is employed at a reservoir. For these reasons, sediment flushing may be a suitable alternative for reservoirs. The process and potential impacts of employing sediment flushing at reservoirs are discussed in the following paragraphs.

Typically, reservoirs are operated with a "Minimum Pool" in the reservoir. This pool serves to slow down stormflows into the reservoir. When sediment-laden stormflows reach this reservoir pool and slow down, the sediment settles to the bottom of the reservoir, away from the dam's gates and valves. In order to employ sediment flushing at a reservoir that is operated with a minimum pool, one of the following two actions would need to be taken prior to a storm event during the storm season. One would be to lower the water level in the reservoir significantly. The other would be to drain the reservoir completely. For those reservoirs that are not operated with a minimum pool, no action would be required prior to a storm event during the storm season.

Following the actions just described, during a storm event (or possibly throughout the entire storm season), stormwater runoff into the reservoir would be allowed to flow through the dam through the low-level gate and valves. This would flush accumulated sediment in the reservoir. However, upon the forecast of large storms, the low-level gate could be closed and the dam valves could be operated under normal flood management guidelines, in order to manage the risk of floods downstream.

Sediment flushing is employed at Devil's Gate Reservoir. Section 3.3.3 includes discussion of the operations at Devil's Gate Reservoir.

It should be noted that in some cases during storm events when very high flow rates are both entering and being released from the reservoir, the flow velocities may be high enough that the sediment does not settle out in the reservoir, and instead is carried through the dam's gates or valves. This is considered a "sediment pass-through" method and most closely mimics natural conditions. It prevents/minimizes sediment accumulation.

The following discussion addresses issues and concerns within the reservoirs and sites downstream of the reservoirs.

Sediment Flushing - Environmental Impacts

Depending on the conditions downstream of the reservoir, sediment flushing could potentially have negative or positive impacts on habitat or infrastructure. Given that existing operational practices (as of 2012) reduce heavily sediment-laden outflows from most facilities, downstream reaches may be sediment starved. In that case, the sediment-laden flows could replenish sediment-poor washes and rivers and positively impact habitat. Alternatively, sediment flushing that results in high volumes of sediment transported downstream could result in excessive accumulation of sediment in reaches, potentially filling in seasonal pools or the streambed, which could negatively affect habitat wildlife.

Sediment flushing could impact water quality in the waterways downstream of the reservoir. That is because the flows from the reservoir during sediment flushing would have a higher turbidity than that of the typical flows during existing dam operations. However, sediment flushing would more closely mimic natural conditions during storm events, and the turbidity in natural runoff is typically high.

Sediment flushing could significantly impact stormwater capture and groundwater recharge. Under the existing operational practices (as of 2012), whenever feasible, stormflows are directed into spreading facilities for groundwater recharge. However, directing sediment-laden water into the spreading facilities could result in sediment depositing on the bottom of the facilities, reducing water infiltration rates and recharge quantities. Similarly, sediment that deposits upstream of the spreading facilities could be resuspended and carried into the spreading facilities by future flows. Furthermore, since stormflows would be used to flush sediments downstream and not be captured and stored in the reservoirs, that volume of stormwater available to be methodically released to maximize groundwater recharge would be reduced.

In addition, employing sediment flushing at the San Gabriel Canyon Reservoirs – Cogswell, San Gabriel, and Morris Reservoirs – could lead to a reduction in the amount of water infiltrated through the streambed of the San Gabriel River. Sediment deposition in the river resulting from sediment flushing at the San Gabriel Canyon Reservoirs could affect percolation rates in the San Gabriel River. However, three measures may help to mitigate these potential issues – (1) performing sediment flushing during the storm season, which gives the ability to wash out the river with less turbid flows; (2) conducting monitoring of river reaches; and (3) using an adaptive management approach.

Air quality would likely not be impacted by employing sediment flushing.

Sediment Flushing – Social Impacts

Traffic and noise would not be impacted by the use of sediment flushing. However, visual characteristics of the waterways could be negatively impacted by the sediment-laden flows. At reservoirs with downstream waterways that have permitted recreational uses such as fishing and swimming, the sediment in the water could potentially impact those recreational uses. However, in some cases, beneficial sediment accumulation could improve vegetation and habitat, which could improve recreational opportunities and aesthetics.

Sediment Flushing – Implementability

Based on previous discussions with regulatory agencies, it appears that sediment flushing will only be allowed when sediment transport would naturally be occurring in the washes/rivers, such as during storm events. Additionally, monitoring and implementation of an adaptive management approach would likely be required. Pilot studies may be required before regulatory agencies would accept sediment flushing as part of the typical operating guidelines for the facility. Additionally, depending on downstream resources, the regulatory agencies may require that a portion of accumulated sediment be removed from the reservoir before a sediment flushing regime can begin. This would be in cases where it is expected that initiating sediment flushing would bring too much sediment to the downstream watercourse, significantly more than the amount expected under natural conditions.

Sediment Flushing – Performance

As mentioned earlier in this section and explained in Section 3.3.3, sediment flushing is employed at Devil's Gate Reservoir. The method is able to address silts and lighter sediment, but it is not able to address the heavier stuff or effectively address large amounts of sediment due to high flows and fires. Due to the Flood Control District's limited use of sediment flushing in the past, it would be beneficial to conduct a pilot study at a reservoir where the method has not been used. A pilot study would help determine the performance as well as the impacts of sediment flushing under conditions that are different from those at Devil's Gate Reservoir.

Sediment Flushing – Cost

The cost to employ flushing could be minimal at the reservoirs. However, employing this method could result in the need for modifications to or additional maintenance of channels and/or spreading facilities. Prior to pursuing sediment flushing at a reservoir, potential costs should be analyzed.

Sediment Flushing – Conclusion

⃠	Large reservoirs
⃠	Small reservoirs
☒	Debris basins

It is recommended that this alternative be evaluated further in the future for both large and small reservoirs. Sediment flushing is not feasible for debris basins.

6.3.4 SLUICING (AS A REMOVAL ALTERNATIVE)

This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within a reservoir only. For the impacts of sluicing downstream, see Section 6.4.1.

Sluicing (Removal) - General Description

Sluicing is a sediment removal method that employs water flow to remove smaller-sized sediment (i.e., sands and silts). Sluicing involves draining a reservoir to expose the accumulated sediment to incoming water flows so that the water can resuspend the sediment and carry it through the dam's sluice gate or valves. Typically, the sediment-laden water is captured in a reservoir or other facility downstream that is more accessible for sediment removal operations than the reservoir from which sediment was sluiced. Figure 6-3 shows the channel cut by the water in the sediment at the upstream of Morris Reservoir.

Sluicing (Removal) – Assumptions

The following list presents the assumptions made and taken into account while analyzing sluicing as a method to remove sediment from the reservoirs.

- Equipment (e.g., bulldozers) would be used in the reservoir to push sediment into the water flowing through the reservoir in order to optimize sediment transport and removal from the reservoir.
- The sediment-laden water leaving the reservoir would have a water-sediment ratio of approximately 9-to-1.

Figure 6-3 Sluicing event at Morris Reservoir

Sluicing (Removal) - Environmental Impacts

Impacts from sluicing operations on biological resources within the reservoir would vary, depending on whether the reservoir has a pool year-round. Sluicing operations typically occur after reservoir inundation periods, so there usually is not vegetation within the areas in which equipment would be pushing sediment into the sluiceway. However, this would not be the case for a reservoir that is kept dry, except for storm periods; such a reservoir could have vegetation that would be impacted.

Water quality within the reservoir would not be impacted by sluicing operations since no significant amounts of water would remain in the reservoir after draining it. The only water within a reservoir that is being sluiced would be water flow entering and passing through the reservoir.

Dewatering a reservoir in order to sluice could affect water conservation if the water is released faster than downstream spreading facilities can handle. Furthermore, some of the silt resuspended in the water during dewatering and sluicing can deposit in the channel and affect water conservation efficiency. This is discussed further in Section 6.4.1, which discusses the impacts along the channel downstream of the reservoir.

Sluicing operations within a reservoir would result in equipment emissions. However, based on experience from the Flood Control District's previous sluicing projects, only a few pieces of equipment would be necessary within the reservoir. Therefore, air quality impacts would not be significant.

Sluicing (Removal) - Social Impacts

The social impacts of removing sediment from a reservoir by sluicing are the same as the social impacts associated with excavating and dredging a reservoir (Again, this section focuses on the impacts within or in the proximity of a reservoir). Sluicing activities within a reservoir would not impact traffic or recreational resources. Visual and noise impacts would be experienced by those in proximity of the reservoir.

Sluicing (Removal) - Implementability

The ability to remove sediment from a reservoir by sluicing will be dependent on inflow into the reservoir, which is entirely dependent on the weather or, in the case of San Gabriel and Morris Reservoirs, on an upstream reservoir. Large reservoirs with watersheds that can deliver sufficient inflow during the summer and fall seasons would be sluiced during the summer and fall. Reservoirs with watersheds that deliver inflow only during and immediately after storms would be sluiced during the storm season if it is safe to do so. Typically, sluicing operations occur during or after very wet storm seasons. In addition to inflow, another factor that limits sluicing is the availability of temporary sediment storage areas and the rate at which they can receive the sluiced water-sediment mixture.

Similar to the other methods of sediment removal already discussed, environmental regulatory permits would be needed.

Given that numerous sluicing projects have been conducted in the past by the Flood Control District, sluicing sediment from reservoirs is a technically certain method of sediment removal.

Sluicing (Removal) - Performance

The time required to sluice a given amount of sediment out of a reservoir depends on the inflow into the reservoir and the entrainment of sediment into the water stream as it travels through the reservoir. Typically, sluicing operations occur during or after very wet storm seasons. Based on historical records, the Flood Control District has been able to remove between 150,000 to 2,600,000 CY of sediment in a given sluicing season, depending on the reservoir and the wetness of the storm season during or preceding the sluicing operation.

Sluicing (Removal) – Cost

The cost of sluicing sediment from a reservoir is approximately $2.50 per cubic yard. This does not include costs associated with transporting to and removal from the temporary sediment storage areas or for final placement.

Sluicing (Removal) – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Sluicing as a removal alternative could be feasible at large reservoirs that typically have enough inflow during the dry season. However, it is not feasible at small reservoirs or debris basins, which do not have sufficient flows needed to sluice.

6.4 TRANSPORTATION ALTERNATIVES

Section 6.4 discusses transportation of sediment removed from the reservoirs and debris basins by means of sluicing, trucking, conveyor belt, slurry pipeline, rail, two-way saltwater pipeline, and cable bucket system.

6.4.1 SLUICING (AS A TRANSPORTATION ALTERNATIVE)

Sluicing involves using flow water to carry sediment suspended in it. This section focuses on the impacts sluicing has on the waterways downstream of the reservoirs. For the impacts of sluicing within a reservoir, refer to Section 6.3.4.

Sluicing (Transportation) - Environmental Impacts

Impacts from sluicing operations on biological resources below the dam would vary, depending on whether the watercourse below the dam contains significant aquatic resources. Some reservoirs contain significant fish and amphibian life and habitat downstream of them while others do not. Riparian vegetation could be positively impacted due to the nutrients provided by the sluiced sediment.

As sluiced flows travel downstream, some of the silt in the flows deposits along the waterway. This affects water conservation in two ways. In the case of the San Gabriel River, which has detention basins within the river for groundwater recharge, deposits would lower percolation rates. In other waterways, deposits can remain in the channel, resuspend with future flows, and possibly make it to downstream recharge facilities, causing percolation rates in the recharge facilities to decrease. Washing out the channel after sluicing helps to remove deposits and decrease the impact on groundwater recharge; however, the ability to do so is highly dependent on the availability of base flows or water from upstream reservoirs.

Figure 6-4 Channel flowing with sediment laden flow

Sluicing (Transportation) - Social Impacts

If waterways have permitted recreation uses such as fishing and swimming, that recreation would be impacted. There would be visual impacts along the channel as the flows would not be clear. Additionally, there could be odor impacts and a temporary rise in insects near the channel.

Sluicing (Transportation) - Implementability

Environmental regulatory permits would be needed to sluice sediment along the waterways downstream of the reservoirs. Some of the sediment will settle in the waterway as sediment-laden water travels downstream. Sediment that deposits downstream could reduce the hydraulic capacity of the channel. Such sediment could need to be removed. Environmental regulatory permits would be needed to remove sediment from the waterways.

The ability to transport sediment by sluicing is affected by a channel's slope and other characteristics. In channels that are relatively flat, there would be more sediment deposition than in steeper channels. Therefore, a channel's grade and other characteristics need to be considered.

Sluicing (Transportation) - Performance

Sediment will settle as sediment-laden water travels downstream. Heavy equipment could be used to manage sediment deposition and, if necessary, remove the deposited sediment within the waterway. The sluiced sediment traveling through portions of lined channels can be highly erosive, increasing the need for maintenance and repairs.

Sluicing (Transportation) - Cost

As mentioned previously, the cost for sluicing is approximately $2.50 per cubic yard. This does not include costs associated with transporting to and removal from the temporary sediment storage areas or for placement.

Sluicing (Transportation) – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Sluicing as a transportation alternative is exclusively associated with sluicing as a removal alternative. Therefore, its feasibility for the different types of facilities is the same as for sluicing as a removal alternative.

6.4.2 TRUCKING

Trucking is a transportation method that is suitable for generally dry material and has been used extensively by the Flood Control District to transport sediment from reservoirs and debris basins. In the past, standard trucks have been used along regular roadways. However, the following sections include discussion of low emission trucks as well as trucking in channels.

6.4.2.1 TRADITIONAL & LOW EMISSION TRUCKING

Trucking – General Description

Using trucks to transport sediment from reservoirs and debris basins involves the use of single-dump and double-dump trucks.

The impacts associated with employing traditional or low emission trucks would be the same, except for the impact on air quality. While it is possible that low emission trucks are not currently available in the quantities needed, it is expected that the size of the low emission truck fleet accessible to the Flood Control District will increase in the years to come.

Figure 6-5 Excavation equipment loading single-dump trucks

Trucking – Assumptions

The following list describes the general assumptions made and taken into consideration while analyzing trucking as a method to transport sediment from the reservoirs and debris basins.

- A single-dump truck would handle approximately 8 CY of sediment per trip while a double-dump truck would handle approximately 16 CY of sediment.
- Trucks would average a speed of 15 to 30 miles per hour, and possibly faster depending on the route.
- For trucking operations from reservoirs, approximately 400 truck loads would be transported per day. For operations from debris basins, the number of truck loads would differ depending on the time to load the trucks.
- Trucking operations that are part of sediment removal projects at reservoirs and non-emergency debris basin cleanouts (that is, for debris basins in non-burned watersheds or have not been impacted by a major storm) would generally be conducted during weekdays for eight hours per day. Each trucking operation at a reservoir would last approximately six months.

- Trucking operations that are part of emergency debris basin cleanouts (that is, for a debris basin in a burned watershed with little time in between storms, or has been impacted by a major storm and the storm season has not yet ended) could possibly include operations during the weekend and around-the-clock work hours. The duration of such trucking operations would depend on the quantity of sediment to be removed.
- Trucking impacts can be reduced in some instances by stockpiling the sediment oustide of the reservoir or debris basin and then trucking it at a reduced rate for a longer period of time. This involves double handling of the material and less efficient operations which increases cost.

Trucking – Environmental Impacts

If existing roads are used, no particular impacts would be expected on habitat and water quality. However, if new or temporary roads are used, there would be habitat impacts and potentially water quality impacts associated with the construction and use of those routes.

The use of low emission trucks would result in lower air quality impacts than if standard trucks were used. The Flood Control District will consider opportunities to employ low emission trucks.

Trucking – Social Impacts

Employing trucks could significantly impact traffic. This is especially true along two-lane roads in and out of the remote locations where some of the reservoirs are located. The same would be true along residential streets in the neighborhoods where debris basins are located. Additionally, employing trucks could result in above-normal pavement wear.

Depending on the route and the vicinity along the route, trucking could impact recreational resources with the increase in traffic. Route selection would consider avoidance of neighborhoods and schools, traffic impacts, and trucking efficiency, among other issues. New or temporary roads in some locations would help alleviate some of the social impacts. Heavy truck traffic can also impact pavement which could lead to more re-paving projects, which would also have social impacts.

Trucking – Implementability

Some cities require trucking permits, but if truck routes were able to remain entirely on existing public roads, no right of way concerns would be expected. On the other hand, if new or temporary roads are used, right of way and possibly environmental issues woud need to be addressed.

Trucking – Performance

Based on the assumptions previously stated, approximately 400,000 CY of sediment would be able to be transported from a reservoir during a six-month operation employing single-dump trucks. On the other hand, a six-month operation employing double-dump trucks would be able to transport approximately 800,000 CY of sediment

Trucking – Cost

The cost of employing single-dump trucks is approximately $0.65 per cubic yard per mile traveled. The cost of employing double-dump trucks is approximately $0.30 per cubic yard per mile traveled. This does not include the cost for removing or placing sediment.

Trucking – Conclusion

☑	Reservoirs
☑	Small reservoirs
☑	Debris basins

Trucking is transportation alternative that could be feasible for sediment removed from reservoirs and debris basins. Wherever it is feasible to use trucks, employment of low emission trucks will be considered to reduce air quality impacts.

6.4.2.2 TRUCKING IN CHANNELS

Trucking in Channels - General Description

This method would be similar to trucking alternatives described in the previous section. However, portions of the haul route could include driving within the existing network of concrete-lined flood control channels instead of traveling on roadways.

Figure 6-6 Typical Rectangular Channel

Trucking in Channels - Environmental Impacts

The environmental impact associated with trucking in channels would be similar to other trucking methods, except for potential impacts to water quality for the stream course within the channel. Depending on the specific location, best management practices could be employed to reduce impacts by avoiding contact with the water and reducing the introduction of pollutants through fluid leaks from the trucks. Noise and emissions may be impacted to residents or businesses adjacent to the channels.

Trucking in Channels - Social Impacts

Depending on the location, rerouting truck traffic through channels could reduce traffic impacts on to communities through which the trucks need to travel. Noise could increase or decrease for residents in the vicinity, depending on the location of their house compared to the channel and the street.

Trucking in Channels - Implementability

While this method seems reasonable at first glance, two major concerns severely limit its implementability. First, in areas where social impacts could be avoided by use of this method, the relatively narrow channel widths and low bridge clearances restrict truck traffic within the channels. Channels increase in size further downstream, but arterial roadways and freeways typically become available for truck traffic, reducing the social benefits achieved by trucking within the channels. Second, the heavy, repetitive loads produced by the trucks have been shown in the past to degrade severely the concrete inverts (bottom) of the channels. This was experienced in the Los Angeles River during the Los Angeles County Drainage Area (LACDA) improvements in the 1990s. Because of these obstacles and the tremendous cost to implement significant infrastructure modifications necessary to accommodate trucks in the channels, this methodology in not currently feasible.

Trucking in Channels - Performance

For the very few, if any locations, where this method could be employed without major infrastructure modifications, its use would also be limited to the dry season. Other than this issue, performance is not expected to be a concern if the issues with implementability and social impacts can be overcome.

Trucking in Channels - Cost

New access ramps and modification to the channel bottom to allow for truck loading would significantly increase the cost compared to trucking along roadways. Costs would vary with the specific location and project.

Trucking in Channels – Conclusion

☒	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Given the limited implementability and performance of trucking in channels, this transportation method will no longer be considered for future Flood Control District sediment removal projects.

6.4.3 CONVEYOR BELT

Conveyor Belt – General Description

This could involve the permanent or temporary installation of conveyor belt systems or the use of existing conveyors as a potential transportation alternative for sediment that has been excavated or that needs to be transported from a temporary sediment storage area to another site.

Generally, conveyor belts are not being considered for use at debris basins given the small quantity of sediment.

Figure 6-7 Conveyor Belt System

Excavators load the sediment on a hopper (top left), then the sediment is transported via conveyor belt (top right & bottom left) and eventually placed at a placement location (bottom right).

Conveyor Belt – Assumptions

- Conveyors with a minimum 42-in conveyor width would be used.
- A conveyor efficiency of approximately 800 CY of sediment per hour and 8 hours of operation per day, which result in the movement of approximately 6,400 CY of sediment per day.
- Conveyor operations would last approximately six months during a given year since that is the approximate number of months that sediment can be excavated out of the reservoir.

Conveyor Belt – Environmental Impacts

In order to identify and minimize the potential impacts of a conveyor operation, the habitat along the potential conveyor alignment would have to be studied. If the conveyor could be placed along existing roads, impact on habitat would be expected to be minimal. Water quality and groundwater recharge would not be expected to be impacted.

If the conveyors were to be electrically powered, air quality would only be impacted by fugitive dust as sediment is transported on the conveyor belts or as it passes through a hopper between conveyor belts. However, moisture levels of the sediment could help reduce fugitive dust emissions. Furthermore, enclosing the conveyor system or spraying the sediment with water would also reduce emissions. For systems located in areas where there is inadequate electrical power available, there would be additional air quality impacts from generators.

Conveyor Belt – Social Impacts

There would be some visual disturbances during the life of a conveyor operation. In addition, depending on the alignment of the conveyor belt system, recreational resources could be impacted visually and physically. During the installation and removal of the conveyor belt system there could be additional noise impacts to nearby areas. However, noise would not be expected to be a concern during the operation of the conveyor belt. Tests at local facilities show that the sound levels are within location noise ordinances. The following results were taken from noise testing completed at Santa Anita Sediment Placement Site (SPS) in May 2012. The first two results capture the noise from mainly just the conveyor belt whereas the last three results include the noise from other large construction equipment like scrapers and excavators.

Description	Noise Limit (dBA L_{EQ})	Approximate Distance from Activity (feet)	Measured Noise Level (dBA L_{EQ})
Parking Lot of Arcadia Wilderness Park	60	150	51.2
Near Property Line to the West of Middle SPS	60	400	48.9
Northwest Corner of Lower SPS	75	50	74.9
South Edge of Lower SPS	75	350	61.0
West Edge of Lower SPS	75	400	65.8

For comparison purposes, the following table provides the decibel level of common noises.

Noise Source	Approximate Distance (feet)	Decibel Level (dB)
Passenger car at 65 mph	25	77
Air conditioning unit	100	60
Large electrical transformers	100	50

Modified from: http://www.chem.purdue.edu/chemsafety/training/ppetrain/dblevels.htm

Conveyor Belt – Implementability

Depending on the alignment of the conveyor belt, right of way issues could have to be addressed. Placement of a conveyor belt across or along roads would need to ensure roadway safety issues (e.g., visibility, vehicle clearance, traffic controls) are taken into account. Use of an existing conveyor system would need to be arranged with the owner of the conveyor system.

Conveyor Belt – Performance

Based on the assumptions previously stated, approximately 800,000 CY of sediment could be moved by a conveyor belt system in a 6-month removal operation.

Conveyor Belt – Cost

The cost of a generally linear conveyor belt would be approximately $800 per linear foot. Complex conveyors, that is, conveyors with turns and larger elevation changes, would cost approximately $1,200 per linear foot. This does not include the cost for removing or placing sediment.

Conveyor Belt – Conclusion

☑	Large reservoirs
☑	Small reservoirs
☒	Debris basins

Conveyors are a transportation alternative that could be feasible for sediment removed from reservoirs by excavation. However, transport of sediment from debris basins on conveyors is not feasible.

6.4.4 SLURRY PIPELINE

Slurry Pipelines - General Description

Slurry pipelines would be used in conjunction with the dredging sediment removal alternative. The dredged water-sediment slurry would be pressurized and transported to its destination via the slurry pipeline.

Since dredging is not feasible at debris basins or small reservoirs, slurry pipelines are not either. Since dredging is feasible at the large reservoirs, the use of slurry pipelines to transport sediment dredged from large reservoirs may be feasible. Thus, this section focuses on the use of slurry pipelines for large reservoirs.

Figure 6-8 Slurry Pipeline

Slurry Pipelines - Assumptions

A detailed analysis of the sediment in the reservoirs and consequently of the slurry would be needed in order to design the slurry pipelines and define optimal operating conditions. However, for planning purposes, the following assumptions were made.

- A 12-inch high-density polyethylene (HDPE) slurry pipeline would be permanently installed and used at the frequency at which material would be dredged.
- The HDPE slurry pipeline would be flexible and able to handle sharp turning radii.
- The flow rate in the slurry pipeline would be approximately 15 cubic feet per second, based on the assumed dredge discharge mentioned previously.
- A lift station would be required for approximately every 5,000 feet of pipeline. The cost of installing and operating a lift station is approximately $1 per cubic yard of sediment moved.
- Slurry pipelines would be placed above ground.

Slurry Pipelines - Environmental Impacts

In order to identify and minimize the potential environmental impacts of placing and operating a slurry pipeline, the habitat along the potential alignments would have to be studied. No impacts are expected on water quality and air quality.

Transportation via slurry pipelines could affect water conservation if the discharge rate is faster than the sediment settling rate at the downstream facility where the dredged material is being dewatered. Overflows with suspended sediment can result in sediment deposition within the channel downstream of the dewatering area and downstream spreading facilities and could significantly impact water conservation.

Slurry Pipelines - Social Impacts

If placed above ground, construction of a slurry pipeline would cause some visual disturbances and temporary construction impacts. If the slurry pipeline is placed underground, it could cause visual, traffic, and recreational impacts during construction.

Slurry Pipelines - Implementability

Placement of a slurry pipeline could present both right of way and permitting issues. If a slurry pipeline is to be placed along a roadway, roadway impacts would need to be considered while determining the best alignment.

Employing slurry pipelines to transport sediment would require a discharge location where sediment can be dewatered and temporarily stored. The specifics of the required dewatering area would need to be evaluated if a slurry pipeline is to be pursued for a specific reservoir cleanout project.

Operating the lift stations along a slurry pipeline alignment would require energy. The capacity of the power grid from which the energy would be drawn would need to be evaluated if a slurry pipeline is to be employed.

Slurry Pipelines - Performance

The slurry pipeline would transport approximately 200 CY of sediment per hour, which corresponds to approximately 15 cubic feet of the slurry per second, based on the assumed limitations of a dredging operation. This type of pipeline is also expected to perform for the 20-year planning timeline, which would result in minimal maintenance effort.

Slurry Pipelines - Cost

The cost to install and operate a slurry pipeline is approximately $37.50 per linear foot. Additionally, the cost to install a lift station would be approximately $1 per station per cubic yard moved. These costs do not include the cost for removing or placing sediment.

Slurry Pipelines – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Slurry pipelines are a transportation alternative that could be feasible for sediment removed by dredging from reservoirs. Since wet removal alternatives (dredging or sluicing) are not feasible at debris basins, slurry pipelines are not either.

6.4.5 <u>RAIL LINES</u>

Rail is an extremely efficient mode of transportation, but is limited by the location of its tracks. The following subsections describe the possibility of using existing rail networks or constructing new ones to transport material from sediment removal projects.

6.4.5.1 EXISTING RAIL LINES

Figure 6-9 Train on rail lines

Existing Rail Lines - General Description

There is a relatively extensive rail network in Southern California. Loading and unloading of rail cars can occur at sidings, where a train can "pull over" and not impact through traffic on the main line.

Existing Rail Lines - Environmental Impacts

Use of the existing rail network for transport of sediment would result in minimal air quality, habitat, and other environmental impacts.

Existing Rail Lines - Social Impacts

Additional social impacts associated with the use of the existing rail network are also expected to be very low, except for traffic and noise impacts near sidings, where loading and unloading of the rail cars could occur.

Existing Rail Lines - Implementability

Most existing sidings are associated with a specific business and require negotiation for their use. Furthermore, significant modification of sidings could be required in order to load sediment. Due to the limited locations where sidings are located, use of this alternative would be highly limited.

Existing Rail Lines - Performance

Performance of transport by rail is limited by the proximity of sidings to the origin and destination locations of the sediment. In almost all cases, trucks or some other mode would be required to transport the sediment from its source location to a siding where it could be loaded onto a rail car. Trucks would also likely be needed to transport from another siding to the final placement location.

Existing Rail Lines - Cost

Once the sediment is on the rail cars, transport by rail is relatively inexpensive at approximately $0.03 per cy-mile. However, the cost of loading and unloading the sediment increases the cost of this alternative by $10 per cubic yard. These costs do not include the cost of removing or placing sediment.

Existing Rail Lines – Conclusion

☒	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Given the limited implementability and performance of existing rails, this transportation method will no longer be considered for future Flood Control District sediment removal projects.

6.4.5.2 NEW RAIL LINES

Establishing new rail lines would result in higher social and environmental impacts than any other alternative mainly due to the wide right of way that is required. Given the high social and environmental impact, the implementability of new rail lines would be very low, if at all feasible. It is also highly expensive, costing approximately $150 million per mile to acquire right of way and install.

New Rail Lines – Conclusion

Due to the combination of high social and environmental impacts, limited implementability, and expensive cost, the construction of new rails lines as a transportation method for Flood Control District sediment management projects is not considered as part of the this plan.

6.4.6 TWO-WAY SALTWATER PIPELINE

Two-Way Saltwater Pipeline - General Description

Seawater could possibly be used as a fluid for slurry transport of sediment for facilities that do not have sufficient water naturally tributary to them. It would need to be pumped to the facility from a coastal source, then mixed with sediment and returned to a coastal outfall.

Two-Way Saltwater Pipeline - Environmental Impacts

Depending on the route considered, environmental impacts would be limited to the habitat disturbed due to the installation of the two-way pipeline and pump stations. Much of the pipeline could be located within existing rights of way.

The two-way saltwater pipeline would require high-energy usage, impact wildlife at the pumping intakes, create a higher concentration of sediment at the outfall, and modify the natural process of sediment going to the coast. The coastal intake and outfall location would have very high environmental impacts and are not considered viable options.

Two-Way Saltwater Pipeline - Social Impacts

Construction of approximately 50 miles of two-way piping, many pump stations, and an intake and outfall location would create significant traffic, noise, air quality, and visual impacts.

Two-Way Saltwater Pipeline – Implementability

This alternative is not feasible due to implementability concerns. The concerns are best illustrated by an example; take Morris Reservoir in the San Gabriel Canyon as the example. The horizontal distance from the ocean to Morris Reservoir is approximately 50 miles. The elevation difference is about 1,000 feet. The rate at which water would need to flow in the pipeline is approximately 10 cubic feet per second. Based on these and other assumptions, a total dynamic head of approximately 15,000 feet would need to be overcome to transport seawater from the ocean to Morris Reservoir. Consequently, at least 15 pump stations would be needed along the pipeline transporting saltwater upstream, along with custom made piping and flanges due to the high pressure. The pipeline carrying sediment-laden slurry would need booster pumps approximately every mile. Because of these requirements, significant amounts of electrical or diesel gas power would be required for the implementation of this alternative. Power availability for the pump stations would be a concern that would need to be addressed if this alternative was to be pursued.

Due to the geographically distributed nature of reservoirs, permanent pipeline and pump station infrastructure would be required for each reservoir.

Major environmental permitting issues are also anticipated, particularly for the intake and outfall locations.

Two-Way Saltwater Pipeline – Performance

If the implementability concerns can be addressed, the conveyance capacity of the pipeline would not present performance concerns.

Two-Way Saltwater Pipeline – Cost

The cost of a two-way saltwater pipeline including upstream and downstream piping and pump stations is expected to be approximately $400 million for each reservoir, and cost for operation and maintenance costs of the pipeline could be as high as $10 million. These costs do not include removing or placing sediment.

Two-Way Saltwater Pipeline – Conclusion

☒	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Given the limitations on implementability and the extremely high cost, the use of two-way saltwater pipeline as a transportation method is not considered as part of the this plan.

6.4.7 CABLE BUCKET SYSTEM

Figure 6-10 Cable bucket system

Cable Bucket System - General Description

Cable bucket systems have seen some use in large mining operations worldwide. They function similar to a ski gondola, with a bucket for sediment suspended from an overhead cable, supported by a series of towers.

Cable Bucket System - Environmental Impacts

Depending on the route considered, environmental impacts would be limited to the habitat disturbed due to construction of the support towers and loading and unloading areas.

Cable Bucket System - Social Impacts

The visual impacts associated with a cable bucket system are very high. Due to the complex initial setup, the system would be permanently installed, resulting in a permanent visual impact.

Cable Bucket System - Implementability

The ability to implement this system is limited mainly by the potential environmental permitting issues for constructing the support towers, which is highly dependent on the length and alignment of the route.

Cable bucket systems will require right-of-way acquisition. In addition, overhead limitations such as bridges and power lines may inhibit the use of cable bucket systems.

Because of the construction methods, cable bucket systems are considered permanent systems unlike conveyors that can be dissembled and moved.

Cable Bucket System - Performance

This alternative is expected to perform well, provided the considerable site logistics are addressed. It shares many of the same performance characteristics as conveyor belts. As previously discussed, a conveyor belt system is estimated to move approximately 800,000 CY over a 6-month removal operation.

Cable Bucket System - Cost

The cost of a cable bucket system is expected to be $2,000 per linear foot. This cost does not include the cost of removing or placing of sediment.

Cable Bucket System – Conclusion

☒	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Given the limited implementability and the expensive cost, the use of a cable bucket system as a transportation method will no longer be considered for future Flood Control District sediment removal projects.

6.5 BENEFICIAL USE AND PLACEMENT ALTERNATIVES

Section 6.5 describes beneficial use and placement alternatives for the sediment that reaches the reservoirs and debris basins. Specifically, this section discusses use of the sediment for beach nourishment, use in the aggregate industry and other industries, use as daily cover at solid waste landfills, use as fill at pits, and other potential beneficial uses. This section also discusses placement offshore and at sediment placement sites.

6.5.1 BEACH NOURISHMENT

This section begins by discussing coastal conditions and human interventions that have and continue to influence the coast. Then, this section discusses the transport of sediment within waterways as it relates to beach nourishment. Finally, the extraction of sand from reservoirs and debris basins deposits and the placement of that sand on the beach as part of beach nourishment projects are discussed.

6.5.1.1 COASTAL CONDITIONS AND HUMAN INTERVENTIONS

Without human intervention, most Southern California beaches would naturally be narrow and rocky. The wide beaches in Southern California were created and have been maintained by various agencies through artificial beach nourishment projects (also referred to as beach fill projects) and the construction of protective coastal structures since the 1930s. However, since the 1960s, the rate at which the initial beach nourishment quantities have been replenished has significantly decreased. In the meantime, waves continuously remove the sand that has been artificially placed at the beaches. These facts and other information within this section are discussed in the following references:

- The August 2012 draft of the Los Angeles County Coastal Regional Sediment Management Plan by the U.S. Army Corps of Engineers Los Angeles District and the California Coastal Sediment Management Workgroup
- The 2002 Beach Restoration Study by the California Department of Boating and Waterways and the California Coastal Conservancy
- The 1993 paper titled “The Myth and Reality of Southern California Beaches” by Reinhard E. Flick of the California Department of Boating and Waterways

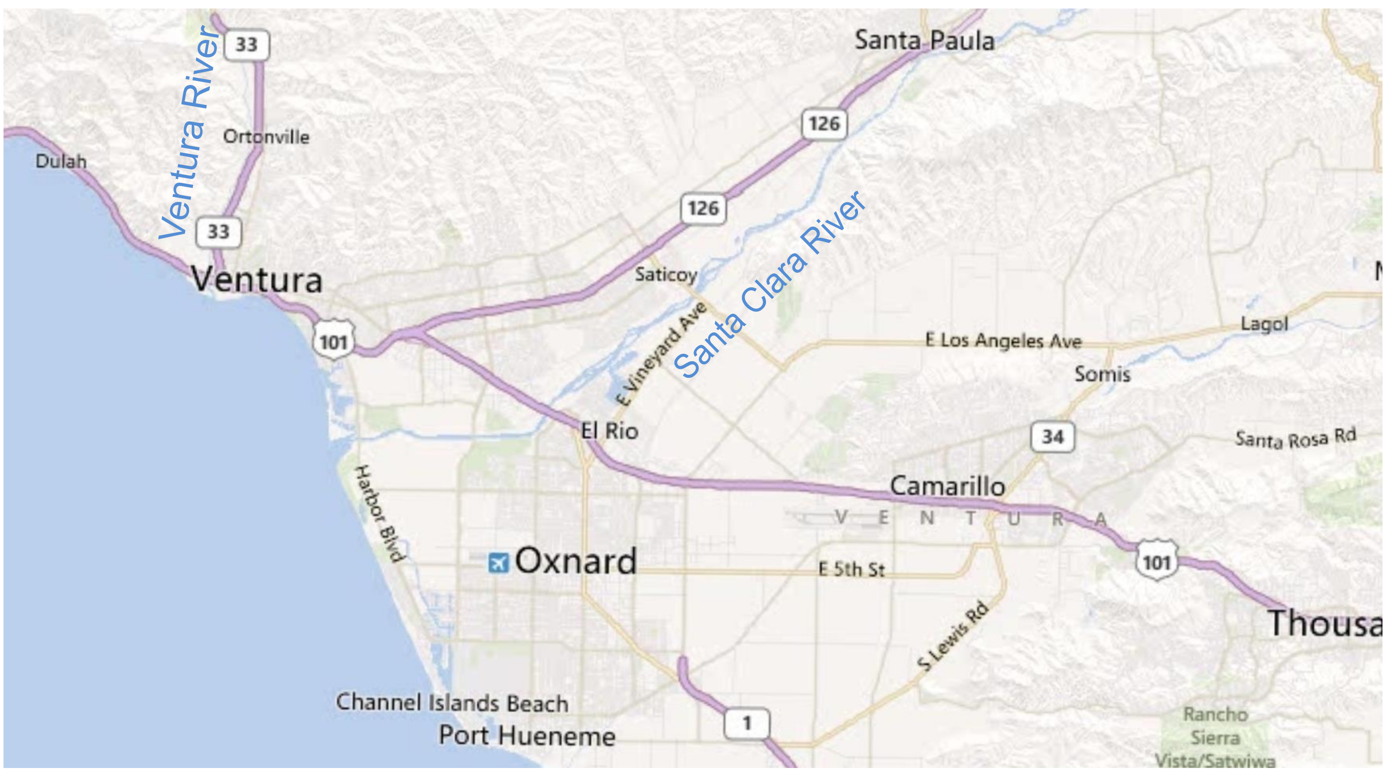
- The 2009 Coastal Regional Sediment Management Plan covering the County of Santa Barbara's and County of Ventura's coasts (from Point Conception to Point Mugu) by U.S. Army Corps of Engineers Los Angeles District, the California Coastal Sediment Management Workgroup, and the multi-County and multi-City Beach Erosion Authority for Clean Oceans and Nourishment
- The April 2012 draft of the Orange County Coastal Regional Sediment Management Plan by the U.S. Army Corps of Engineers Los Angeles District, the California Coastal Sediment Management Workgroup, and the County of Orange
- The Peninsula Beach Preservation Group's website (www.lbpeninsula.org, September 2012)

The following paragraphs discuss in detail the coastal areas within and close to the Flood Control District. The reaches, regions, or littoral cells subsequently described match those described in the aforementioned coastal regional sediment management plans. The reaches, regions, or littoral cells are defined by limits on the movement of sand along the coast or coastal sediment management planning areas rather than watershed boundaries.

Oxnard Plain Reach (County of Ventura)

The Oxnard Plain Reach extends from the Ventura River to Port Hueneme Harbor, as shown in Figure 6-11. The mouths of two rivers – Ventura River and Santa Clara River – are located within the Oxnard Plan Reach. The headwaters and a large portion of the Santa Clara River are located within the boundaries of the Flood Control District. The Flood Control District does not maintain any dams along the Santa Clara River. Within this reach, the ports have affected the wide beaches and have made regular sand bypassing operations necessary.

Figure 6-11 Oxnard Plain Reach



Malibu Region (County of Los Angeles)

The Malibu Region consists of the region between the County of Ventura/County of Los Angeles boundary line and Topanga Canyon, as shown in Figure 6-12. The quantity of sand on the beaches in this region is largely due to the numerous streams that outlet to the coast and the sand retaining bedrock exposures and boulder forms at the mouths of the streams.

Figure 6-12 Malibu Region

Santa Monica Bay Region (County of Los Angeles)

The Santa Monica Bay Region extends from Topanga Canyon (just east of the City of Malibu) to Malaga Cove (near the boundary of the Cities of Torrance and Palos Verdes Estates), as shown in Figure 6-13. Since the Los Angeles River changed course in 1825, the largest waterway reaching this region of the coast is Ballona Creek, which has an estimated annual sediment yield of less than 50,000 cubic yards and delivers generally fine-grained sediment that is not appropriate for beach nourishment.

Figure 6-13 Santa Monica Bay Region

The relatively wide beaches in the Santa Monica Bay Region stem from the construction of various projects and artificial nourishment projects that were completed mostly between the 1930s and 1960s, namely the Santa Monica Breakwater, Hyperion Treatment Plant, Marina del Rey, and a beach nourishment project at Redondo Beach. The Santa Monica Breakwater that was built in the early 1930s helped to prevent coastal erosion. Construction of Hyperion Treatment Plant, from the late 1930s to the late 1940s, and later expansion of the treatment plant contributed over 15 million cubic yards of sand to the beaches between Santa Monica Pier to the City of El Segundo. Construction of Marina del Rey in the 1960s contributed 3.2 million cubic yards of sand that were used to widen Dockweiler Beach. In the late 1960s, approximately 1.4 million cubic yards of sand were dredged from a nearby offshore location and placed at Redondo Beach.

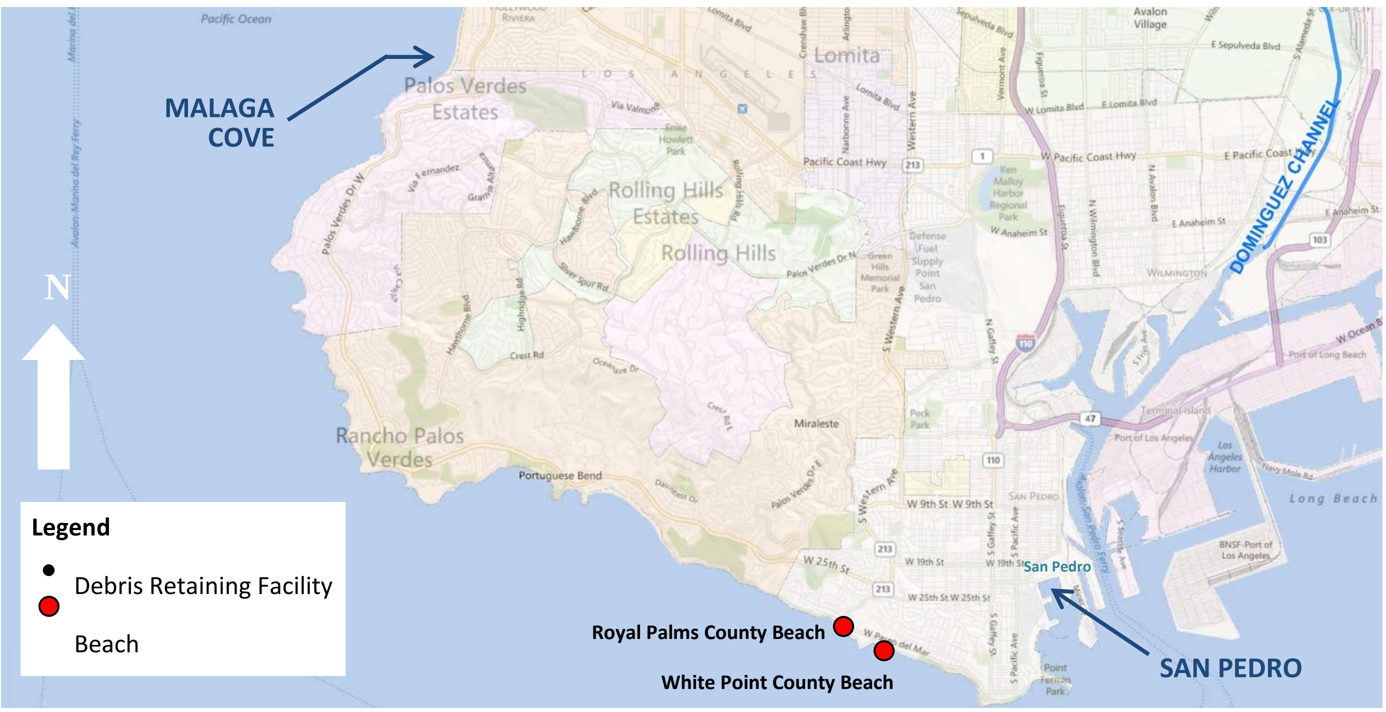
Additionally, between 1969 and 2007, material resulting from maintenance dredging at Marina del Rey was used to nourish Dockweiler Beach and Redondo Beach. These nourishment operations and those of the 1930s to 1960s were opportunistic beach nourishment projects, that is, while the intent of the projects was not beach nourishment, the resulting sand presented an opportunity in terms of beach nourishment.

Overall, as part of artificial beach nourishment projects, more than 35 million cubic yards of sand have been placed in the beaches of the Santa Monica Bay Region. In comparison, per the Flood Control District's records, between the 1940s and 2010, a total of approximately 330,000 cubic yards of sediment were removed from the three debris basins (Cloudcroft, Sullivan, and Nichols) closest to the beaches in the Santa Monica Bay Region.

Palos Verdes Peninsula Region (County of Los Angeles)

The Palos Verdes Peninsula Region extends from Malaga Cove (near the City of Torrance/City of Palos Verdes Estates boundary line) to the City of San Pedro, as shown in Figure 6-14. Only a few streams reach the coast in this region. Much of this region remains unchanged. Beaches in this region are narrow, rocky, and gravelly.

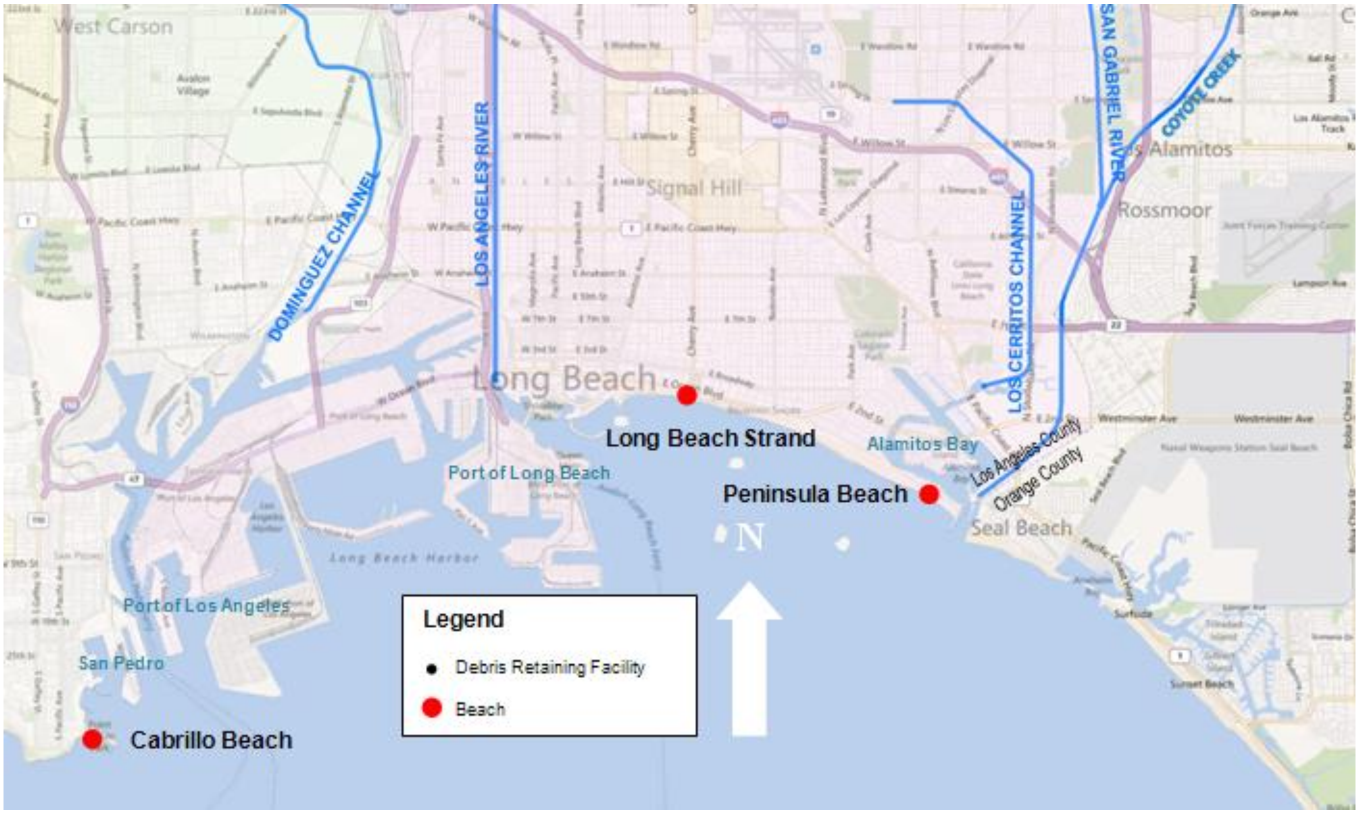
Figure 6-14 Palos Verdes Peninsula Region



Long Beach Region (County of Los Angeles)

The Long Beach Region extends from the City of San Pedro to the County of Los Angeles/County of Orange boundary line, just north of where the San Gabriel River outlets, as shown in Figure 6-15. This region includes 1) the Port of Los Angeles, where the Dominguez Channel outlets; 2) the Port of Long Beach, including Queensway Bay, where the Los Angeles River outlets; and 3) the Long Beach Marina/Alamitos Bay, where the Los Cerritos Channel outlets.

Figure 6-15 Long Beach Region



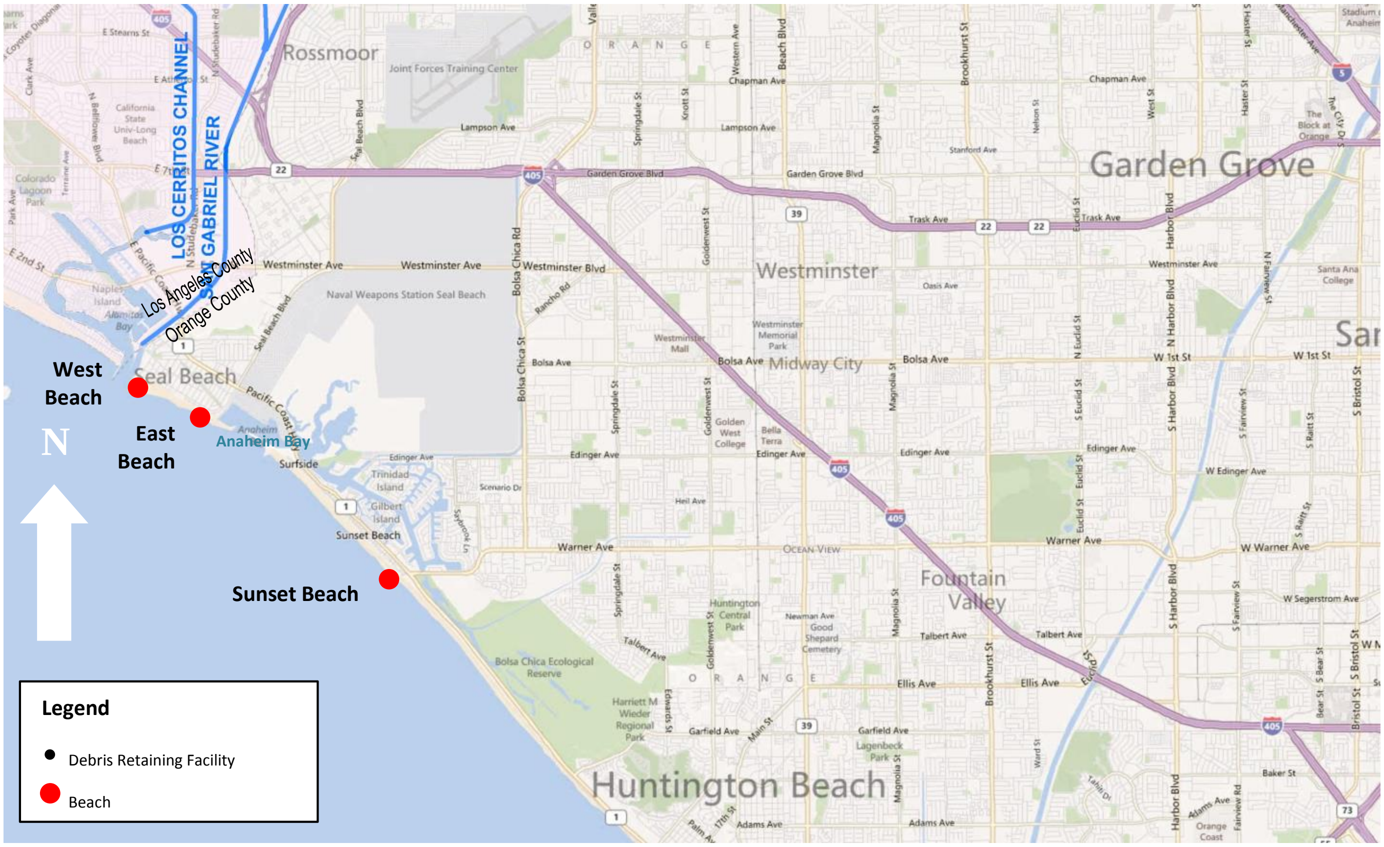
The Long Beach Region includes three beaches – Cabrillo Beach, the City of Long Beach strand, and Peninsula Beach. Cabrillo Beach, located in the Port of Los Angeles, is a man-made beach. The City of Long Beach strand is mostly stable thanks to the protection it receives from the Long Beach Breakwater, which was built in the early 1900s. However, the erosion prone area of the strand near the entrance to Alamitos Bay is dependent on regular sand backpass operations. Similar to Cabrillo Beach, Peninsula Beach is also a man-made beach; it was created with sediment dredged from Alamitos Bay during the construction of Long Beach Marina in the 1950s and 1960s. Because the west jetty of Alamitos Bay and the San Gabriel River prevent natural supply of sand to Peninsula Beach, Peninsula Beach has been replenished by regular sand bypass operations.

Currently, most of the sediment delivered by the Los Angeles River consists of fine-grained silt and clay. If sediment were allowed to flow down the Los Angeles River, there would need to be additional dredging at the port.

Seal Beach Littoral Cell (County of Orange)

The Seal Beach Littoral Cell extends from where the San Gabriel River outlets, just south of the County of Los Angeles/County of Orange boundary line, to the west jetty of Anaheim Bay, as shown in Figure 6-16.

Figure 6-16 Seal Beach Littoral Cell



The mouth of the San Gabriel River is located within this littoral cell. On its journey from its headwaters to the coast, the San Gabriel River passes through three reservoirs maintained by the Flood Control District - Cogswell Reservoir (West Fork of the San Gabriel River), San Gabriel Reservoir, and Morris Reservoir – and two dams maintained by the U.S. Army Corps of Engineers – Santa Fe Dam and Whittier Narrows Dam. Current sand delivery by the San Gabriel River is relatively low; a significant amount of sediment is trapped upstream as the river makes its journey.

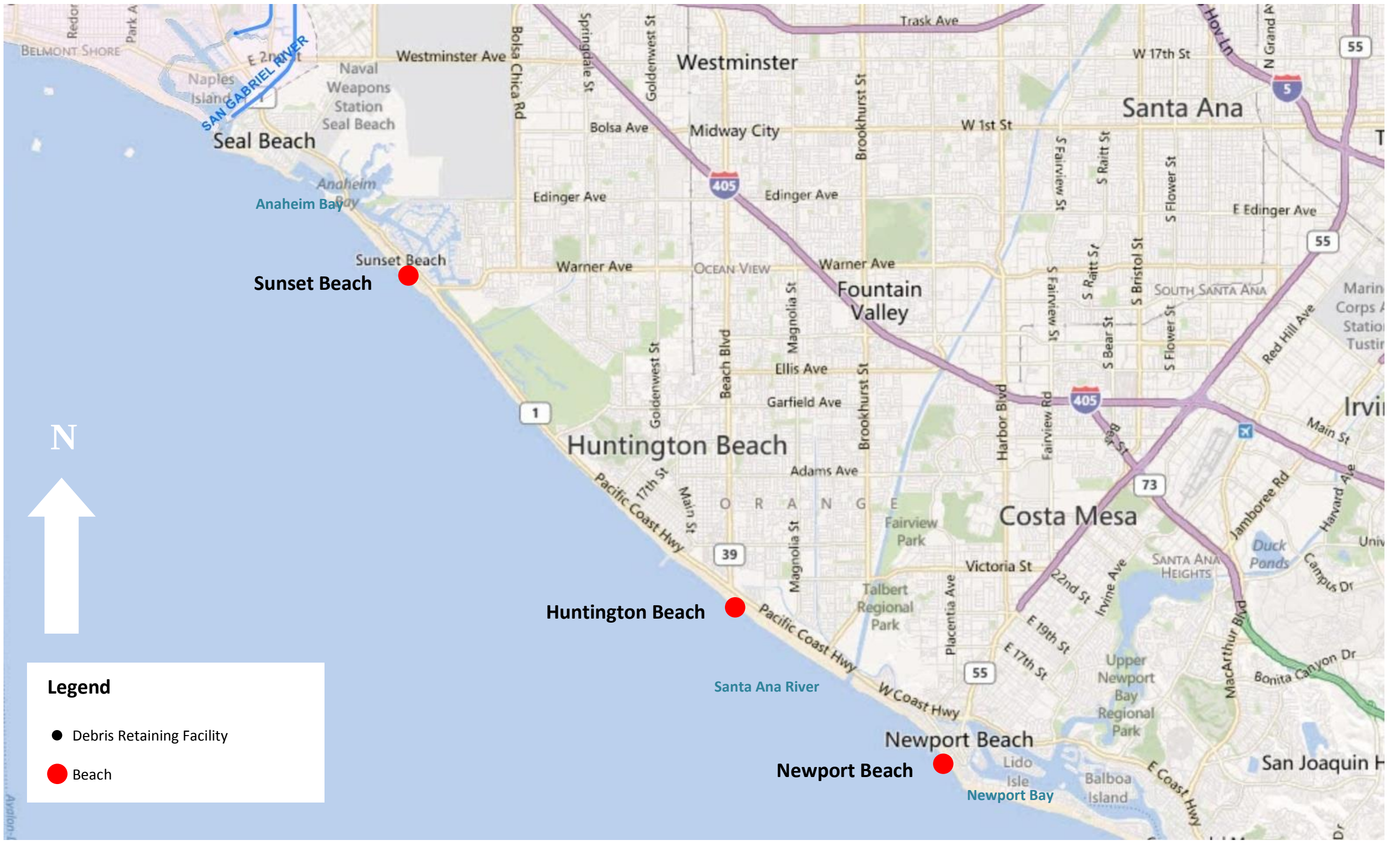
Within the Seal Beach Littoral Cell exist two distinct beaches, East Beach, which consists of the portion east of the City of Seal Beach Municipal Pier, and West Beach, which consists of the portion west of the pier. Due to the Long Beach Breakwater and to the waves that reflect off the west jetty of Anaheim Bay, sand from the East Beach is transported to the West Beach. This has led to widening of West Beach at the expense of East Beach. The issue has been managed with a groin and artificial beach nourishment projects that have employed sand from Anaheim Bay, West Beach, the San Gabriel River, and the City of Palmdale.

Huntington Beach Littoral Cell (County of Orange)

While no waterway managed by the Flood Control District outlets within the Huntington Beach Littoral Cell, it is discussed here due to the interests shared by stakeholders during the development of this Strategic Plan.

The Huntington Beach Littoral Cell extends from the east jetty of Anaheim Bay to the west jetty of Newport Bay, as shown in Figure 6-17. The major, natural contributor of sediment to this littoral cell is the Santa Ana River. Sand within this littoral cell is lost to the Anaheim and Newport Bays and Newport Submarine Canyon.

Figure 6-17 Huntington Beach Littoral Cell



Newport Beach, one of the beaches in this littoral cell, is the result of artificial nourishment. Similar to the beaches at Santa Monica and Venice, prior to artificial nourishment Newport Beach was narrow. More than 9 million cubic yards of sand were placed on Newport Beach between 1935 and 2009 to create and maintain the beach conditions known by many. The material used for the nourishment projects was obtained from the Santa Ana River, Balboa Peninsula, Newport Harbor, and Newport Beach.

Surfside-Sunset Beach, another one of the beaches within this littoral cell, has also been artificially nourished and widened. A total of more than 20 million cubic yards of sediment from Anaheim Bay and offshore were used to nourish Surfside-Sunset Beach from 1945 to 2009. Beach nourishment at Surfside-Sunset Beach is responsible for significant beach width increases not only at Surfside-Sunset Beach, but also at the other beaches within the Huntington Beach Littoral Cell.

6.5.1.2 Transport of Sediment Via Stream Flows and Beach Nourishment

The 2002 Beach Restoration Study by the California Department of Boating and Waterways and the California Coastal Conservancy explains that in natural river systems the sediment transported by water flows can deposit "in the stream channel, in the flood plain adjacent to the stream, or in an estuary at the stream mouth [or be] delivered directly to the ocean." Based on information in the aforementioned study, an estimated 8 to 36 percent of the sediment that the water flows are able to transport is the size of sand. However, the location where the sediment would be delivered by the water flows must be considered. Since many local beaches were initially created by artificial beach nourishment projects or are the result of decades-long protection by breakwaters and groins, sending sediment down the Los Angeles and San Gabriel Rivers and other waterways would not be able to address the issues of the artificially made beaches. Furthermore, there are also other regional issues to consider, such as the following:

- The water needed to transport sediment all the way to the coast would end up being lost to the ocean. This would reduce the amount of water that is conserved by capturing it in reservoirs and later infiltrating it into the local groundwater aquifers through spreading facilities. In turn, this would result in a greater dependence of imported water, which future availability is uncertain and requires significant energy to be transported into the region.
- The additional sediment that would deposit in the stream channels could also affect water conservation operations as some of the sediment would be resuspended by water flows directed to the spreading facilities and that sediment would then deposit in the facilities and reduce infiltration rates. Remediating this problem would require sediment removal operations at the spreading facilities.
- The additional sediment that would deposit in the stream channels could reduce channel capacity, which could affect the ability to manage flood risk. Restoring flood capacity would require additional maintenance operations in the channels.
- The Port of Long Beach is located at the mouth of the Los Angeles River. As a result, additional sediment carried by the Los Angeles River would mean additional sediment at the Port of Long Beach, which would require additional maintenance dredging operations at the port.

6.5.1.3 IMPACTS OF PROCESSING AND PLACING SEDIMENT AT BEACHES

As discussed in Section 6.5.1.1, various sources of sand in close proximity to the beaches have been used by various agencies since the region's artificial beaches were created in the early 1930s. The sources have included sand dunes excavated for the construction of Hyperion Treatment Plant, sediment dredged during the construction of marinas, sediment from harbors, and offshore deposits. Due to the opportunities afforded by those closer sources of sediment, sediment deposits in the reservoirs and debris basins maintained by the Flood Control District have not been used previously as a source of sediment for beach nourishment purposes.

Beaches - General Description

The sediment that collects in the reservoirs and debris basins contains various soil types and sizes. If sediment that deposit in the reservoirs and debris basins were to be used as a source of sand for beach nourishment, it would need to be processed in order to separate the sand from the silt, clay, and rocks.

The reservoirs and most of the debris basins that are maintained by the Flood Control District are located 30 to 60 miles away from the coast. Placing sand extracted from reservoir and debris basin sediment deposits would entail transporting that sand 30 to 60 miles from the processing site to the beaches by one of the transportation alternatives in Section 6.4, in addition to transporting it from the reservoirs and debris basins to the processing site.

Continued use of sources of sand similar to those previously used could avoid a number of the issues identified below.

Beaches - Environmental Impacts

Beach nourishment would require consideration of environmental impacts to the area disturbed by placement activities. Environmental concerns at the beaches include impacts on Snowy Plovers, Grunion runs, and water quality, which the County of Los Angeles Department of Beaches and Harbors has indicated are easily mitigated and monitored during sand placement. Air quality could be impacted depending on the transportation alternative employed to take the sand from the processing site to the beach. Water conservation quantities are not expected to be impacted by the placement of sand on the beaches; this is assuming that the reservoirs would be drained to excavate the sediment in order to maintain the proper functionality of the reservoirs and not for the main purpose of getting material from which sand can be extracted.

Beaches - Social Impacts

Beach nourishment would likely require sediment to be transported through several communities including those in the foothills and by the beaches. It would also temporarily affect noise, aesthetics, and recreational use of the beach during the placement activities. However, employing this alternatively would positively impact recreation in the long-term by providing wider beaches and possibly improved surfing conditions until the waves naturally moved the sand somewhere else.

Beaches - Implementability

Permitting issues are expected to be a major hurdle for this placement option. Consideration must be given to color, angularity, size, and organic content of the sediment. Based on these requirements and the Sediment Characterization and Potential Use Assessment Report completed for the Flood Control District (2011), approximately less than 25 percent of the reservoir and debris basin sediment deposits would be appropriate for use in beach nourishment projects. This is based on the finding that approximately 25 percent of the deposits match the characteristics of washed sand, which has less stringent characteristics than beach sand. Due to the requirements, reservoirs and debris basin deposits would need to be processed in order to extract sand appropriate for the particular beach; unacceptable material would then need to be transported and used or placed somewhere else. As indicated above, implementing this alternative would require partnerships.

Beaches - Performance

Beach nourishment would require a location where the reservoir and debris basin deposits could be processed and potentially stored until the extracted sand would be able to be placed on the beach.

Since only a fraction of the total sediment could be used for beach nourishment, this alternative represents only a partial solution to the massive quantity of sediment that needs to be managed.

Beaches - Cost

The cost to process and place sediment for beach nourishment would vary with each facility due to differences in sediment characteristics and the distance from the facility to the placement beach. It is expected that the cost would be high. Additional operations and costs associated with extracting sand from the reservoir and debris basin deposits and placing that sand at the beach would require partnerships with other agencies that would benefit from the beach nourishment projects. Based on their responsibilities, potential partnering agencies could include the County of Los Angeles Department of Beaches and Harbors and cities located along the coast.

Beaches - Conclusion

⃠	Reservoirs
⃠	Small reservoirs
⃠	Debris basins

The Flood Control District is open to meeting with agencies willing to share in the additional costs of processing, permitting, transporting, and placing the material. However, the Flood Control District understands that as long as better sources of sand are available to those agencies, there may be no interest for those agencies to incur additional expenses to extract sand from the reservoir and debris basin deposits. The Flood Control District will continue to analyze this alternative further.

6.5.2 <u>AGGREGATE AND OTHER MATERIALS</u>

The sediment that accumulates in the reservoirs and debris basins maintained by the Flood Control District is composed of a wide range of materials, including silts and large boulders. In order to utilize the sediment as a source of material for the aggregate industry and other industries, the sediment would need to be processed into materials of specific grain size and gradations. Figure 6-18 shows a sediment processing plant in the Irwindale area.

Figure 6-18 Sediment Processing Plant in the Irwindale Area

6.5.2.1 ESTIMATED AGGREGATE NEED

In 2006, the California Department of Conservation completed a report titled "Aggregate Availability in California." The report includes estimated 50-year demands for aggregate and the permitted aggregate resources in distinct areas of the State referred to as Production-Consumption Regions. Each Production-Consumption Region includes "a group of aggregate production mines" and "the market they serve." The two most relevant Production-Consumption Regions for this Strategic Plan are the San Gabriel Valley and the San Fernando Valley-Saugus-Newhall Production-Consumption Regions. According to the 2006 report, the estimated 50-year demand for the San Gabriel Valley Production-Consumption Area was over 1 billion tons of aggregate. However, at the time of the report, the Irwindale aggregate companies, which serve the San Gabriel Valley Production-Consumption area, were only permitted to excavate 370 million tons of aggregate. The estimated 50-year need for the San Fernando Valley-Saugus-Newhall Production-Consumption Region was approximately 450 million tons. However, at the time of the report, the San Fernando Valley-Saugus-Newhall Production-Consumption Region only had approximately 88 million tons of permitted resources. Therefore, any outside sediment taken to the aggregate companies would help cover supply deficiencies and provide a benefit to the aggregate industry.

6.5.2.2 DAMS AND DEBRIS BASINS AS POTENTIAL SOURCES

In 2011, a Sediment Characterization and Potential Use Assessment Report was completed for the Flood Control District; the report can be found in Appendix E. The soils investigation conducted for the report was completed on sediment samples representative of the sediment that accumulates in the reservoirs and debris basins. The report indicates that a portion of the sediment that accumulates in the facilities could potentially have commercial value and could be processed into the following products:

- Fill sand (for use as unclassified fill)
- Coarse aggregate
- Aggregate base

- Washed sand (for use in concrete, asphalt, mortar, and such)
- Top soil

Based on the report, the net value of the typical products derived from reservoir and debris basin deposits, considering processing costs, but not the costs of handling at the source or transportation, is estimated at about $1.30 per cubic yard. Depending on the distance from the sediment source to the processing location, the net value of these materials could easily be exceeded by the cost of transporting the materials to an aggregate plant for processing. However, transportation costs are generally unavoidable when removing sediment from a debris basin or reservoir, whether the excavated materials are transported to a sediment processing plant, a landfill, a pit, a sediment placement site, or offshore. Any gains achievable from producing aggregate or other materials would help offset costs associated with managing the sediment that accumulates at the reservoirs and debris basins. The indirect value of diverting sediment from existing sediment placement sites and thereby extending the service life of those facilities is also a benefit. It is envisioned that members of the aggregate industry or other appropriate soil brokers would handle the processing or sorting of the sediment at their facilities.

Based on the results of field explorations, laboratory testing, and economic analyses, the following conclusions are presented:

Major Findings:

- Materials accumulating in the reservoirs and debris basins have commercial value when processed into aggregate materials, which could offset some of the cost of managing sediment at the facilities maintained by the Flood Control District.
- In addition, the service life of existing sediment placement sites could be extended by diverting material from these disposal sites to useful applications.

Other Findings:

- Because of the low value of top soil with respect to the production cost and the amount of waste associated with materials containing more than 70 percent fines, processing low quality materials should be avoided.
- Inclusion of washed sand in the final mix of products generally results in an overall higher valuation. However, washed sand does not provide a significant higher valuation compared to fill sand due to the relatively small gain in value with respect to the increased cost of waste disposal.
- Although fill sand could have similar net valuation compared to washed sand due to waste disposal costs, there may not be sufficient demand to keep up with production, and substantial stockpiling could be necessary.

6.5.2.3 PROPOSED SEDIMENT PROCESSING CONTRACT

As of late 2012, the Flood Control District was in the process of establishing a contract that would allow sediment to be taken to third-party sites where the sediment could potentially be processed into construction or other materials or used otherwise by the third party. In the County of Los Angeles, there are sand and gravel processing plants in the Irwindale, Sun Valley, Claremont, and Palmdale areas. The sediment could be transported to any of these areas from the Flood Control District’s reservoirs or debris basins for processing into aggregate material.

6.5.3 DAILY COVER AT SOLID WASTE LANDFILLS

Some solid waste landfills use dirt to cover daily deposits of solid waste in order to avoid odors and other issues. This alternative considers delivering sediment from the Flood Control District’s sediment management operations to solid waste landfills for daily cover purposes. Sediment would need to be delivered by truck; the deliveries would meet any regulatory requirements governing the transport of sediment, including regulatory requirements dealing with moisture content, as appropriate. The following discussion is based on landfill operations as of 2012. However, it is important to note that landfill operations, including the quantity of sediment needed for daily cover and tipping fees, change over time. Furthermore, landfill operations are regulated by the landfill's conditional use permit and other permits.

In addition to discussing the general impacts of using sediment from the Flood Control District's sediment management operations as daily cover, this section provides details about a couple of the landfills in the County of Los Angeles, namely Sunshine Canyon Landfill and Scholl Canyon Landfill. Other landfills are not discussed due to their size, restrictions, impending closure (e.g., Puente Hills Landfill), or unknown future (e.g., Chiquita Canyon Landfill).

6.5.3.1 GENERAL

Solid Waste Landfills - Environmental & Social Impacts

It is assumed sediment deliveries from the Flood Control District would only be changing the source of the sediment used as daily cover and not the landfills' operations. Therefore, use of solid waste landfills for placement of sediment from reservoirs and debris basins would have minimal environmental and social impacts. However, if the use of sediment from the Flood Control District's facilities resulted in additional truck traffic, there could be some traffic impacts within the communities surrounding the landfills. It is expected that the agencies that regulate the landfills and their impacts on air quality would address any potential impact on air quality due to stockpiling of sediment, if stockpiling was required.

Solid Waste Landfills - Implementability

Implementation of this alternative would be contingent on a landfill's conditional use permit and any other permits or regulatory requirements.

Landfill acceptance of sediment is constrained to their daily cover needs. The quantity and rate of removal from a cleanout activity would need to match that of the daily cover needs, unless a temporary sediment storage area could be utilized. Temporary storage areas could be located at the removal location, landfill, or another alternate location. Removal operations could also be altered to meet the daily cover needs.

Additionally, landfills have limitations on the maximum stone size and moisture content in sediment used for daily cover. This could limit the implementability of this alternative.

Sediment that is to be placed at a landfill may require testing to determine that it meets the requirements of that landfill.

Solid Waste Landfills - Performance

If sediment from various Flood Control District facilities needed a placement site at the same time and the quantity of sediment available is greater than the quantity that can be accepted by the landfills, a determination would have to be made as to what sediment would be taken to the landfills.

6.5.3.2 SUNSHINE CANYON LANDFILL

Sunshine Canyon Landfill, shown in Figure 6-19, is located at the northwestern end of the San Fernando Valley near the interchange of the 5 and 210 Freeways. As of 2012, the following conditions applied to the landfill.

- Currently the landfill uses approximately 2,000 CY of soil each day as cover.
- The landfill has adequate space to stockpile sediment. Therefore, delivery of sediment would not be constrained to the rate of daily cover needs.

- A tipping fee of approximately $7.50 per cubic yard or less would be assessed for sediment deliveries from the Flood Control District to offset the cost of rehandling stockpiled materials.
- The landfill would be interested in accepting sediment from the Flood Control District for daily cover purposes.
- The landfill is anticipated to remain open until 2037, given current disposal rates.

Figure 6-19 Sunshine Canyon Landfill Aerial

Sunshine Canyon Landfill – Performance

For planning purposes, it was assumed that approximately half of the landfill's daily cover needs could be reserved for sediment from the Flood Control District's sediment management operations. Based on this assumption, a total of approximately 20,000 CY of sediment could be delivered to Sunshine Canyon Landfill in a given month. This rate of acceptance will need to be compared with the rate at which sediment needs to be removed from a facility or a temporary sediment storage area.

Sunshine Canyon Landfill - Cost

As previously discussed, tipping fees at Sunshine Canyon Landfill are approximately $7.00 per cubic yard of sediment. This cost does not include the cost of removing or transporting sediment.

6.5.3.3 SCHOLL CANYON LANDFILL

Scholl Canyon Landfill, shown in Figure 6-20, is located in the City of Glendale just north of State Route 134. As of 2012, the following conditions applied to Scholl Landfill.

- Approximately 300 cubic yards of sediment are used at Scholl Canyon Landfill for cover each day.
- The landfill area has multiple areas for stockpiling material.
- The landfill does not accept dirt delivered on bottom dump trucks; therefore, sediment cannot be delivered to the landfill on double-dump trucks.
- A tipping fee of approximately $5.00 per cubic yard would be charged for clean dirt delivered.

- The landfill is currently interested in receiving clean dirt deliveries.
- As of August 2012, closure of the landfill is scheduled for 2032.

Figure 6-20 Scholl Canyon Landfill

Scholl Canyon Landfill – Performance

Assuming half of the landfill's daily cover needs could be reserved for sediment from the Flood Control District's sediment management operations, approximately 3,000 CY of sediment could be delivered to Scholl Canyon Landfill in a given month. To determine the performance of this alternative, this rate of acceptance is compared with the rate at which sediment would need to be removed from a facility or a temporary sediment storage area in the reservoir-specific sections.

Scholl Canyon Landfill - Cost

As previously discussed, tipping fees for clean dirt at Sunshine Canyon Landfill are approximately $6.00 per cubic yard. This cost does not include the cost of removing or transporting sediment.

6.5.3.4 Solid Waste Landfill Summary & Conclusion

☑	Large reservoirs
☑	Small reservoirs
☑	Debris basins

The alternative to beneficially use sediment for daily cover purposes at Sunshine Canyon and Scholl Canyon Landfills appears to be an available opportunity for the entire period covered by the Strategic Plan. The rate of acceptance of Sunshine Canyon Landfill and Scholl Canyon Landfill will need to be compared with the rate at which sediment would need to be removed from a facility or a temporary sediment storage area in the reservoir-specific sections. For the most part, this alternative alone cannot meet the sediment placement needs of the reservoirs and debris basins. If the entire removal quantity is too great for a landfill's need, this placement alternative could be a partial placement solution.

6.5.4 FILL AT PITS

Pits – General Description

In this Strategic Plan, the term "pits" includes inert landfills, engineered fill operations, quarries (pits) that are currently being mined, and retired pits. Inert landfills are facilities that are permitted to accept inert waste. Engineered fill operations must meet specifications prepared and certified for a specific project designed to act as a structural element. As of February 2012, there was one permitted and active inert landfill in the County of Los Angeles and eight active engineered fill operations.

There are a number of pits that are currently being mined and several that have been retired, which could potentially accept sediment in the future. Most of the facilities are privately owned by members of the aggregate industry and are located near Sun Valley, Irwindale, and Claremont. Figure 6-21 shows the relative location of these three areas. The majority of pits are available in the City of Irwindale area. Figure 6-22 shows an aerial image of some of the Irwindale Pits. There are a few pits located in the Sun Valley area. Figure 6-23 shows an aerial image of some of the pits in Sun Valley. Due to the distance of the Claremont pits from the facilities maintained by the Flood Control District and the fact that there is large number of pits in the Irwindale and Sun Valley area, the Claremont pits are not considered as part of this Strategic Plan. Therefore, this section discusses the pits in the Irwindale and Sun Valley areas only.

Figure 6-21 Location of Pits

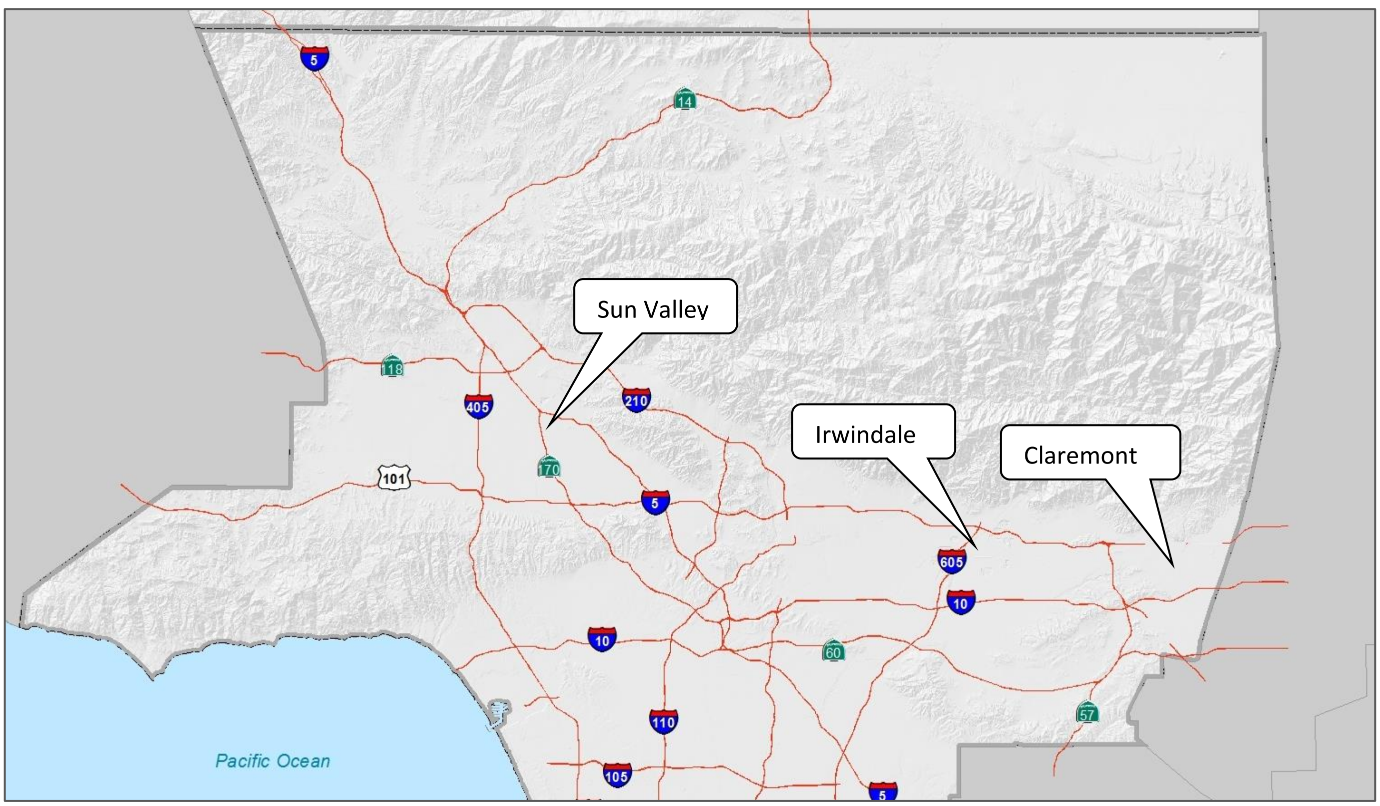
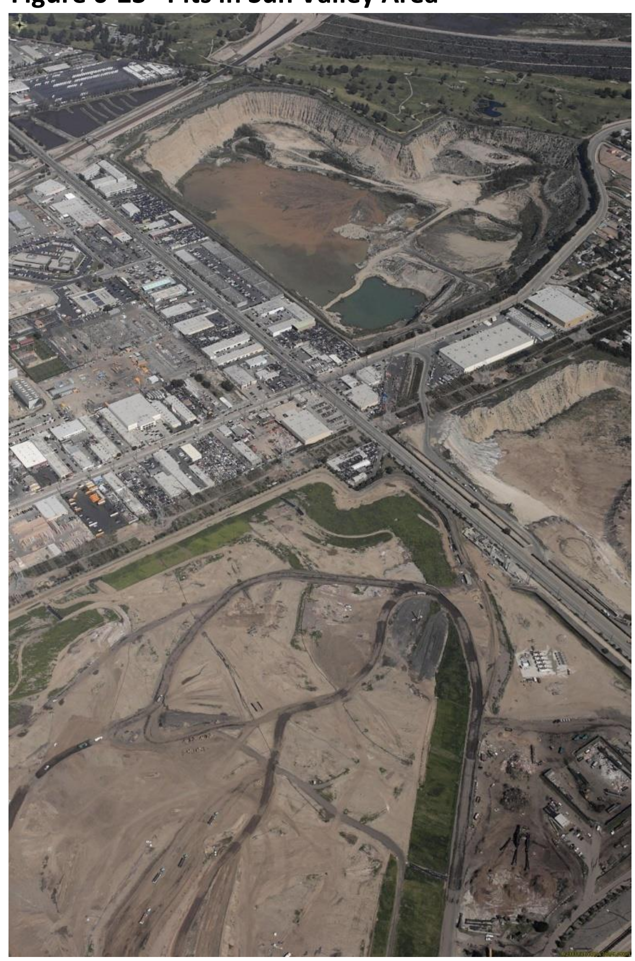


Figure 6-22 Pits in Irwindale Area

Pits – Assumptions

- Agreements can be developed with the gravel operator(s) for their acceptance of sediment from the Flood Control District.
- The gravel operator(s) have an ability to accept both marketable material for processing and sale as sand and aggregate, and non-marketable material for filling pits. Negotations would have to take place for how to value their acceptance of both types of material. For planning purposes, it is assumed they would accept marketable sediment along with an equal amount of non-marketable sediment free of charge.
- Material dredged or sluiced from the reservoirs would likely not be marketable due to the high concentration of fines in the material.
- The tipping fees of future inert landfill and engineered fill operations would be similar to the current tipping fees at the existing inert landfills and engineered fill operations.
- If the Flood Control District was able to acquire a pit for sediment placement, cost would be approximately $1 per cubic yard of available space. This cost is for the acquisition of property only.
- If the Flood Control District was able to acquire a pit for sediment placement, only the material that

Figure 6-23 Pits in Sun Valley Area



would not be accepted at the third-party pit free of charge would be taken to the Flood Control District pit for placement. The cost to place sediment at a Flood Control District pit would be approximately $2 per cubic yard. This cost is only for moving, placing, and grading sediment at the placement location

Pits - Environmental Impacts

Use of inert landfills, engineered fill operations, and pits for placement of sediment from reservoirs and debris basins would have minimal environmental impact because the sites are already disturbed.

Pits - Social Impacts

For the most part, depositing material in the pits would have minimal social impacts given the magnitude of the facilities and their existing uses. If transported by trucks, placing sediment at an inactive facility that is adjacent to residential neighborhoods would result in traffic and noise impacts. Freeway traffic in the region would also be impacted.

Pits - Implementability

No agreement would be needed in order to deliver sediment to the inert landfills or engineered fill operations, unless the operator was willing to engage in a long-term agreement with the Flood Control District for the receipt of sediment at a reduced rate. Agreements would be needed in order to deliver sediment at the pits currently being mined or are still active. As of 2012, development of these agreements was being explored with the companies in the aggregate industry. The possibility of the Flood Control District acquiring retired pits for the purpose of sediment placement will be considered in more detail. The Sun Valley Pits are shown in Figure 6-23.

Pits - Performance

It was assumed that existing and future inert landfill and engineered fill operations would have the capacity to accept material at the rate at which it would need to be delivered for optimum sediment management operations at the reservoir and debris basins. Existing conveyors between some of the facilities could facilitate deliveries to the pits, if use of the conveyor belts can be arranged.

If sediment from several Flood Control District sediment management operations needed to be taken to the subject facilities at the same time and the sum of the quantities exceeded the maximum acceptable quantity, it would have to be determined which sediment to place at the pits.

Pits - Cost

As previously discussed, it is assumed that facilities operated by the gravel industry would accept marketable, high-quality sediment plus an equal amount of non-marketable material free of charge. It is assumed that for the remainder of the material, tipping fees would be as follows:

- Facilities in the Irwindale Area:
  - Single-dump trucks: $9.70 per cubic yard
  - Double-dump trucks: $7.00 per cubic yard
- Facilities in Sun Valley:
  - Single-dump trucks: $15.00 per cubic yard
  - Double-dump trucks: $10.00 per cubic yard

The estimated cost for the Flood Control District to acquire a pit is approximately $1 per cubic yard. Additionally, the cost to place sediment at the acquired pit would be approximately $2 per cubic yard. These costs do not include the cost of removing or transporting sediment.

Pits - Conclusion

☑	Reservoirs
☑	Small reservoirs
☑	Debris basins

Pits are a viable placement alternative for all facilities and the purchase and/or use will be pursued for future cleanout operations. In this Strategic Plan, availability is assumed.

6.5.5 OTHER POTENTIAL BENEFICIAL USES

Other potential uses for the sediment include wetland restoration, replenishment of sediment-poor waterways, and replenishment of reefs. Similar to the use of the sediment for beach nourishment projects, use of the sediment for the aforementioned beneficial uses would require partnerships between the Flood Control District and agencies charged with those tasks. The Flood Control District is open to meeting with agencies willing to share in the additional costs of processing, permitting, transporting, and using the material that accumulates in the Flood Control District's facilities for these beneficial uses.

6.5.6 OFFSHORE

The U.S. Environmental Protection Agency and the Army Corps of Engineers operate a number of offshore sediment placement sites. One of the offshore placement sites is located off San Pedro. Placing sediment that accumulates in the reservoirs and debris basins in offshore placement locations is not feasible because current regulations prohibit use of offshore placement sites, if onshore sites are available. In the case of sediment from Flood Control District facilities, many feasible options would need to be exhausted prior to investigating offshore placement.

Further, the transport distance to the port is more than double that of other placement locations. Additional costs would also result from double-handling the material to transfer it to a barge and then transport the material offshore to the disposal site.

Offshore Placement - Conclusion

☒	Reservoirs
☒	Small reservoirs
☒	Debris basins

Due to the previously stated issues, offshore placement is not considered as a placement location for future Flood Control District sediment removal projects.

6.5.7 SEDIMENT PLACEMENT SITES

As discussed in Section 2.4, sediment placement sites (SPSs) are sites developed by the Flood Control District throughout the County to be strategically filled with sediment resulting from the cleanout of facilities such as reservoirs and debris basins. This section discusses placement at previously used SPSs and at potential new SPSs.

Figure 6-24 Dunsmuir SPS

6.5.7.1 PREVIOUSLY USED SEDIMENT PLACEMENT SITES

As described in Section 2.4, the Flood Control District owns 36 SPSs. Of these, 17 sites that are considered active have a combined estimated remaining capacity of approximately 48 MCY. One site in particular, Burro Canyon SPS, has a remaining capacity of approximately 29 MCY, accounting for the bulk of the remaining capacity at all sites. These facilities will continue to be used as part of the Flood Control District's sediment management operations until other placement alternatives have been fully analyzed and developed for use. As a result, this alternative is not compared with the other placement alternatives considered by the Sediment Management Strategic Plan unless the site is needed for future placement.

6.5.7.2 NEW SEDIMENT PLACEMENT SITES

While it is understood that there are environmental concerns associated with the development of new SPSs, this alternative is still being considered as part of this Sediment Management Strategic Plan. A new SPS and transportation of sediment to it could have fewer impacts than placing and transporting sediment to another placement alternative that is farther away. The uses of specific SPSs are explored further with placement options for various facilities in Sections 7 through 10.

6.5.7.3 SEDIMENT PLACEMENT SITES SUMMARY & CONCLUSION

☑	Reservoirs
☑	Small reservoirs
☑	Debris basins

SPSs are a viable placement alternative for all facilities. Previously used SPSs will continue to be used until other placement alternatives have been fully analyzed and developed for use. Potential new SPSs will continue to be considered in cases where impacts could be less than other alternatives.

6.6 SUMMARY

A number of alternatives were considered for sediment management at large reservoirs, small reservoirs, and debris basins. However, only some are feasible for the sediment management needs of the Flood Control District.

The alternatives identified to be feasible in this section are considered specifically for each reservoir and the debris basins in Sections 7 through 10. In those sections, location specific impacts and quantity specific costs are presented. Additionally, the alternatives are joined to form combined alternatives that address the entire sediment management process and planning quantities for the specific facilities. Figure 6-25 provides a summary of the alternatives for each general category of facility. Those that have been removed from consideration for that category of facility have been shaded out.

Figure 6-25 Alternative Feasibility Summary

Analysis

ALL ALTERNATIVES CONSIDERED	LARGE RESERVOIRS	SMALL RESERVOIRS	DEBRIS BASINS
Removal Alternatives	**Removal**	**Removal**	**Removal**
Excavation	Excavation	Excavation	Excavation
Dredging	Dredging	Dredging	Dredging
Sediment Flushing	Sediment Flushing	Sediment Flushing	Sediment Flushing
Sluicing	Sluicing	Sluicing	Sluicing
Transportation Alternatives	**Transportation**	**Transportation**	**Transportation**
Sluicing	Sluicing	Sluicing	Sluicing
Trucks (including Low Emission (LE) Trucks)	Trucks (inc. LE)	Trucks (inc. LE)	Trucks (inc. LE)
Trucking in Channels	Trucking in Channels	Trucking in Channels	Trucking in Channels
Conveyor Belts	Conveyor Belts	Conveyor Belts	Conveyor Belts
Slurry Pipeline	Slurry Pipeline	Slurry Pipeline	Slurry Pipeline
Rail Lines	Rail	Rail	Rail
Two-Way Saltwater Pipeline	Saltwater Pipeline	Saltwater Pipeline	Saltwater Pipeline
Cable-Bucket Systems	Cable-Bucket	Cable-Bucket	Cable-Bucket
Beneficial Use and Placement Alternatives	**Beneficial Use and Placement**	**Beneficial Use and Placement**	**Beneficial Use and Placement**
Beach Nourishment	Beaches	Beaches	Beaches
Aggregate and Other Materials	Aggregate, etc.	Aggregate, etc.	Aggregate, etc.
Daily Cover at Solid Waste Landfills	Daily Cover	Daily Cover	Daily Cover
Fill at Pits	Fill at Pits	Fill at Pits	Fill at Pits
Offshore	Offshore	Offshore	Offshore
Sediment Placement Sites (SPSs)	SPSs	SPSs	SPSs

Gray boxes indicate alternatives no longer considered for the listed facility type.