SECTION 7 ALTERNATIVES ANALYSIS & RECOMMENDATIONS FOR RESERVOIRS ALONG THE SAN GABRIEL RIVER

This section discusses the analysis of sediment management alternatives and recommendations for the three reservoirs under the jurisdiction of the Flood Control District that are located along the San Gabriel River – Cogswell, San Gabriel, and Morris Reservoirs.

Discussion of the sediment management alternatives for each reservoir follows a similar approach as to how alternatives were discussed in Section 6. Each reservoir discussion of the alternatives is organized based on the different phases of the cleanout process, specifically:

1. Staging and Temporary Sediment Storage Areas
2. Sediment Removal Alternatives
3. Transportation Alternatives
4. Placement Alternatives

After the alternatives are discussed, combined alternatives are presented. Combined alternatives were developed by grouping a removal alternative with a transportation alternative and a placement alternative. The total cost of implementing the combined alternative is presented along with a review of the impacts. This Strategic Plan provides recommendations that will guide development of specific cleanout plans for each one of the reservoirs. However, as specific cleanout plans are developed, additional alternatives may be considered.

7.1 INTRODUCTION

The San Gabriel River originates in the San Gabriel Mountains northeast of Los Angeles, draining a rugged, highly erosive, mountainous watershed. Within the mountains there are three dams constructed on the San Gabriel River. Cogswell Reservoir is the uppermost reservoir. It is located along the West Fork of the San Gabriel River (West Fork), as shown in Figure 7-1. San Gabriel Reservoir, the next in the series, is located just downstream of the confluence of the East and West Forks of the river. The final reservoir before the river emerges from the mountains is Morris Reservoir, which is located immediately downstream of San Gabriel Reservoir.

Cogswell, San Gabriel, and Morris Reservoirs are part of the most complex flood risk management and water conservation system managed by the Flood Control District. Releases from upstream reservoirs are captured in the reservoirs below them, in addition to the inflow from each reservoir's own watershed. There are also water rights issues that add to the complexity of the system.

Due to the Army Corps of Engineers' Los Angeles County Drainage Area (LACDA) study, the required water capacity for flood risk management for the reservoirs in San Gabriel Canyon is 50,000 acre-feet (AF) or 80 million cubic yards (MCY). The Flood Control District utilizes Cogswell and San Gabriel Reservoir to meet the capacity requirement as the two reservoirs were built to manage the risk of floods, whereas Morris Reservoir was not.

The three reservoirs also stand out in that together their sediment management need of approximately 27.4 million cubic yards (MCY) constitutes nearly half of this Strategic Plan's total 20-year sediment management planning quantity for the entire Flood Control District.

The sediment management alternatives presented in this section include alternatives that purposely move sediment from one reservoir to the next reservoir, with the idea that moving sediment downstream would facilitate accessing the sediment and removing it. The planning quantities are shown in Table 7-1.

Figure 7-1 San Gabriel Canyon Flood Control System

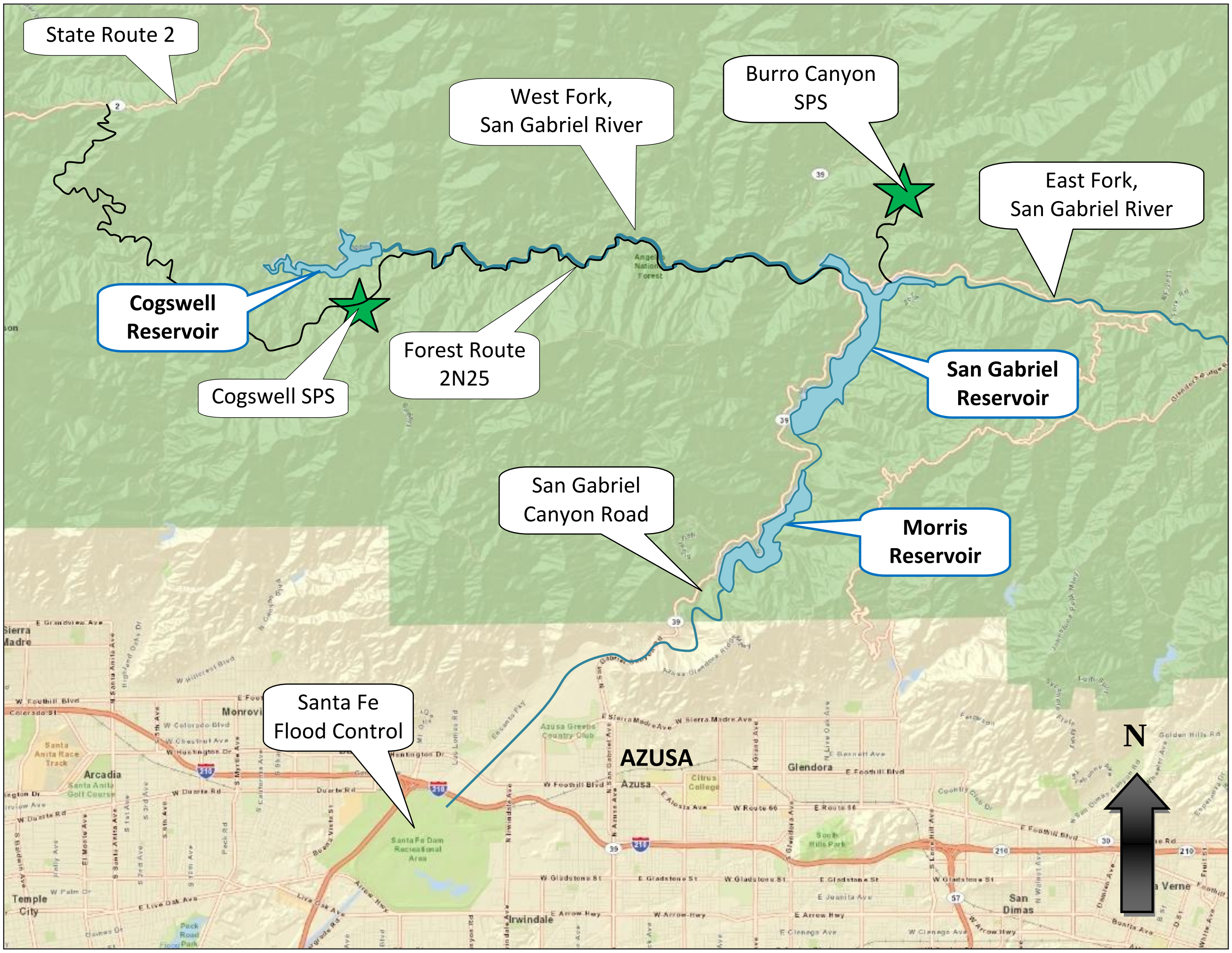


Table 7-1 San Gabriel River Reservoir's Planning Quantities

Reservoir	Projected 20-Year Sediment Accumulation (MCY)	Sediment Already in Storage Also Planned for Removal (MCY)	Sediment from Upstream Reservoir (MCY)	Total 20-Year Planning Quantity (MCY)
Cogswell	2.4	3.3	N/A	5.7
San Gabriel	20.4	-	3.4	23.8
Morris	1.3	-	2	3.3

7.2 COGSWELL RESERVOIR

7.2.1 BACKGROUND

Cogswell Dam, shown in Figure 7-2, is a rockfill dam with concrete cutoff walls and a concrete facing slab on its upstream slope. The dam was constructed in 1934 by the Flood Control District for flood risk management and water conservation. The original storage capacity at spillway was 19.8 million cubic yards (MCY). Cogswell Reservoir has a total drainage area of 39 square miles. Water captured during the storm season behind the dam is gradually released down the West Fork.

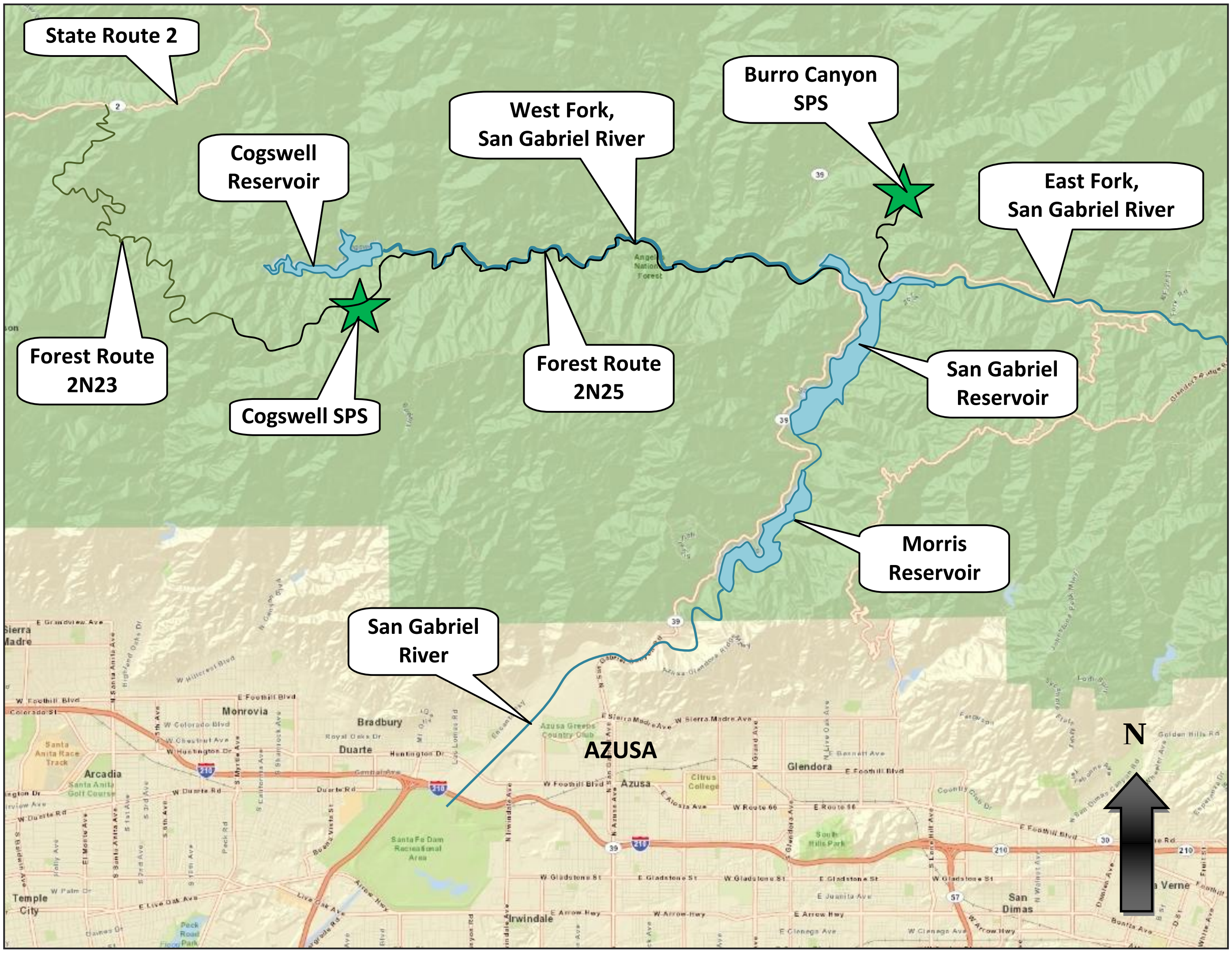
Figure 7-2 Photo of Cogswell Dam

7.2.1.1 LOCATION

Cogswell Dam and Reservoir are located in the San Gabriel Canyon of the Angeles National Forest, approximately six miles north of the City of Azusa, as seen in Figure 7-3. Devil's Canyon Creek, Lobo Creek, Bobcat Creek, and the West Fork flow into Cogswell Reservoir. The West Fork continues downstream of Cogswell Dam. As discussed in Section 7.1, San Gabriel and Morris Dams are both located downstream of Cogswell Dam.

There are two sediment placement sites (SPSs) within the vicinity of Cogswell Reservoir – Cogswell SPS and Burro Canyon SPS. Cogswell SPS has a remaining capacity of approximately 3.2 MCY. Burro Canyon SPS has a remaining capacity of approximately 29 MCY but is reserved solely for sediment removed from San Gabriel Reservoir.

Figure 7-3 Cogswell Reservoir Vicinity Map



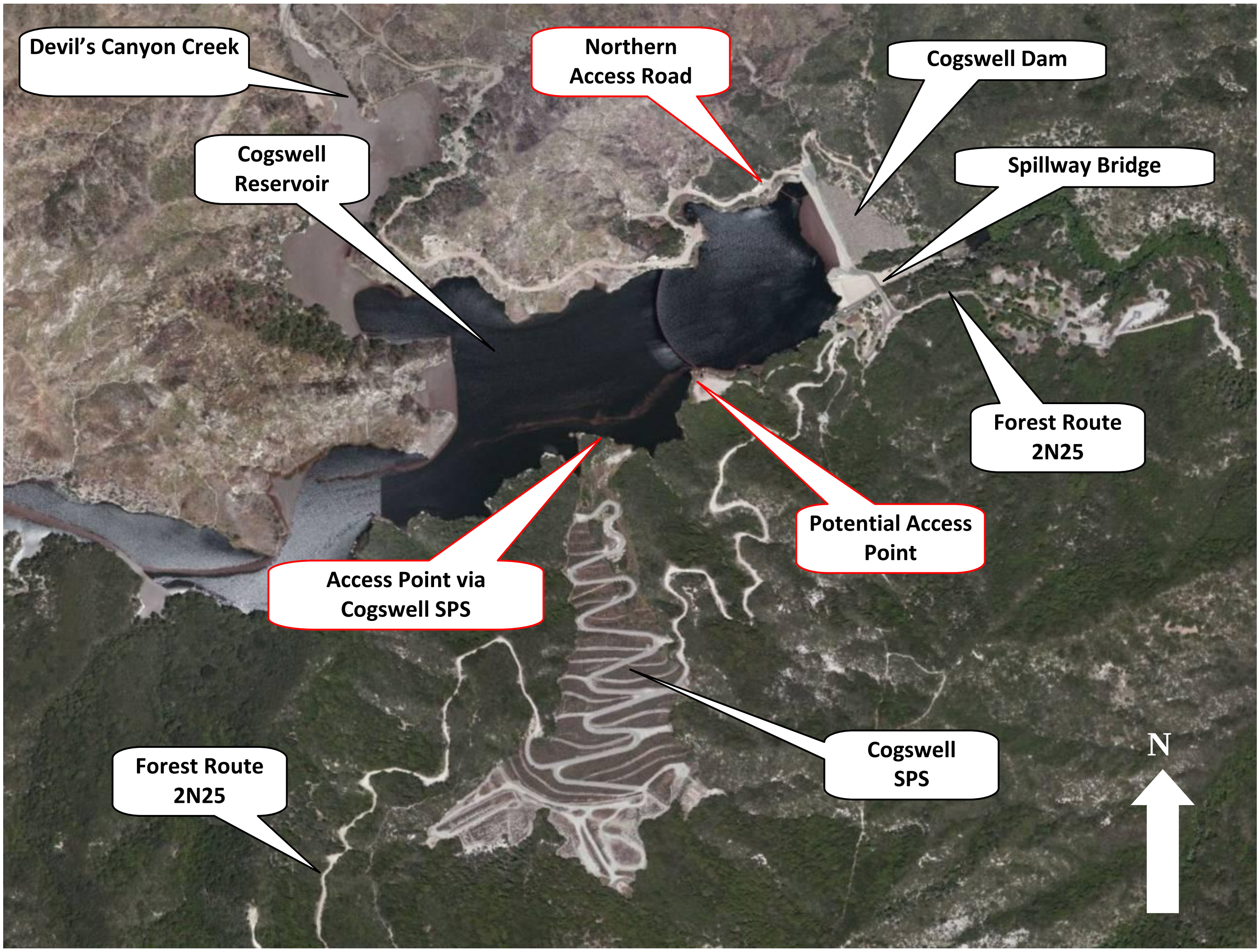
7.2.1.2 Access

Access to the downstream side of the dam is available from San Gabriel Canyon Road (State Route 39) via Forest Route 2N25 as seen in Figure 7-3. Forest Route 2N25 is a sinuous, narrow, paved road located adjacent to the West Fork between Cogswell Dam and San Gabriel Reservoir that is often only wide enough for one-way traffic. There is no vehicular access to the immediate downstream face of Cogswell Dam. Forest Route 2N25 extends westward past Cogswell Dam, through Cogswell SPS, and rounds north until it meets with Forest Route 2N23, which continues north to the Angeles Crest Highway (State Route 2). However, all tractor-semi trailer combinations with 3 axles or greater are prohibited from the portion of State Route 2 that would allow access to Forest Route 2N23.

Access to the body of Cogswell reservoir along the southern side could be established at two locations. One location is approximately 0.2 miles upstream of the dam, as shown in Figure 7-4. Access could also be established from the bottom of Cogswell SPS' access road, approximately 0.5 miles upstream of the dam. A dirt access road into the reservoir would need to be reestablished from either location.

Along the north side of the reservoir there is an unpaved access road that can be reached by travelling over the spillway and crest of the dam. This access road could provide an access point to the body of the reservoir. However, the maximum load capacity of the bridge over the spillway and the impact of heavy use would need to be determined.

Figure 7-4 Cogswell Reservoir Access Points



7.2.1.3 DAM OUTLETS

In addition to being equipped with a variety of valves, Cogswell Dam is also equipped with a sluiceway controlled by a 6- by 6-foot sluice gate at the bottom of the outlet structure.

7.2.1.4 DOWNSTREAM FLOOD CONTROL AND WATER CONSERVATION SYSTEM COMPONENTS

Downstream of Cogswell Dam, along San Gabriel River, there are a total of four other dams. San Gabriel and Morris Dams are located within San Gabriel Canyon. Further downstream are Santa Fe and Whittier Narrows Dams, which are owned and operated by the Army Corps of Engineers.

Water released from Cogswell Dam travels along the West Fork for approximately seven miles until it enters San Gabriel Reservoir. Between Cogswell Dam and San Gabriel Reservoir, the West Fork retains its natural characteristics apart from the embankment of Forest Route 2N25, its crossings, and a series of concrete fishing platforms. Between San Gabriel Dam and Morris Dam, the river is fully contained within Morris Reservoir. Below Morris Dam, the San Gabriel River has an earth bottom, which allows for in stream infiltration. The water released from Cogswell Reservoir contributes to the quantities infiltrated in stream or captured for conservation at downstream facilities. Downstream of Whittier Narrows Flood Control Basin, the river is contained in a concrete channel until it outlets at the Pacific Ocean.

There are multiple spreading facilities along the San Gabriel River as well as the Rio Hondo that receive water from all three of the reservoirs along the San Gabriel River.

7.2.1.5 SEDIMENT ACCUMULATION AND REMOVAL HISTORY

Figure 7-5 shows the approximate quantities of sediment accumulated in Cogswell Reservoir since the reservoir's first debris season in 1935. As discussed in Section 3, it is the Flood Control District's policy to retain enough storage capacity within reservoirs used for flood risk management for two incoming design debris events (DDEs), which are calculated and determined for each specific reservoir. Two DDEs for Cogswell Reservoir is approximately 6.7 MCY, allowing for maximum sediment storage of approximately 13.1 MCY. However, as discussed in Section 7.1, the reservoirs in the San Gabriel Canyon need to provide a total of 50,000 acre-feet (AF), or 80 MCY, of combined flood storage for flood risk management. As the Flood Control District utilizes Cogswell and San Gabriel Reservoirs to meet this storage requirement, the combined volume of sediment in storage at these two facilities must not exceed 23.5 MCY.

As of October 2010, the estimated capacity at Cogswell Reservoir was 17.4 MCY. Sediment removal at Cogswell Reservoir to date has been achieved with both sluicing and dry excavation. Approximately 6 MCY of sediment have been removed since 1935. A summary of the historical sediment removal projects can be found in Table 7-2.

Figure 7-5 Graph of Historical Sediment Storage at Cogswell Reservoir

Table 7-2 Cogswell Reservoir Historical Sediment Accumulation and Removal

Survey Date		Reservoir Capacity (MCY)	Quantity Sluiced (MCY)	Quantity Excavated (MCY)	Sediment Accumulation Between Surveys (MCY)	Sediment in Storage (MCY)
October	1935	19.84	-	-	-	-
May	1938	17.40	-	-	2.44	2.44
November	1939	17.79	0.39	-	-	2.05
November	1940	17.91	0.12	-	-	1.93
November	1941	17.61	-	-	0.30	2.23
October	1943	16.94	-	-	0.67	2.90
January	1945	17.00	0.06	-	-	2.84
September	1946	17.10	-	0.14	0.05	2.74
September	1947	17.16	-	0.20	0.14	2.68
December	1957	17.08	-	-	0.08	2.76
October	1958	16.85	-	-	0.22	2.99
November	1962	16.50	-	-	0.35	3.34
June	1966	16.10	0.01	-	0.40	3.74
September	1966	16.13	0.03	-	-	3.71
March	1969	15.07	-	-	1.06	4.77
May	1973	15.04	-	-	0.03	4.80
April	1978	14.46	-	-	0.58	5.38
April	1980	14.22	-	-	0.24	5.62
May	1981	14.78	0.56	-	-	5.06
August	1981	14.49	-	-	0.30	5.35
September	1981	14.65	0.16	-	-	5.19
April	1983	14.28	-	-	0.37	5.56
December	1984	14.50[a]	-	-	-	5.56
December	1991	14.43	-	-	0.07	5.63
May	1992	14.70	-	0.56	0.29	5.36
July	1995	15.21	-	0.47	-	4.89
December	1996	17.97	-	3.05	0.29	2.13
November	1999	18.59[b]	-	-	-	2.13
December	2009	18.23	-	-	0.36	2.49
July	2010	17.35	-	-	0.87	3.37
August	2011	16.84	-	-	0.513	3.88

Notes:

a. Based on recalculation performed after the survey, information was refitted into the 1985 map that was designated as the new base map.

b. No sediment removal occurred between December 1996 and November 1999. Change in capacity is the result of a new base map designation.

Past Sluicing Projects

Approximately 1.3 MCY of sediment have been removed via sluicing from Cogswell Reservoir during approximately 7 sluicing events, the last which occurred in 1981. Sediment sluiced from Cogswell Reservoir has been captured in the San Gabriel Reservoir.

Past Excavation Projects

Approximately 4.3 MCY of sediment have been excavated from Cogswell Reservoir during 3 cleanout projects. During the first project, which occurred between 1945 and 1947, approximately 0.34 MCY of sediment were excavated from the area near the outlet towers and moved about a quarter of a mile upstream to an area adjacent to the reservoir. Between August 1991 and December 1991, approximately 0.56 MCY of sediment were removed and taken to Cogswell SPS. Both trucks and conveyor belt were used during this removal project, although trucks performed most of the sediment transport due to technical and regulatory difficulties with the conveyor belt and its generator. Between May 1994 and December 1996, approximately 3 MCY of sediment were removed and taken to Cogswell SPS. All of the sediment transport was performed by trucks.

7.2.1.6 SPECIAL CONDITIONS

Cogswell Dam and Reservoir are part of the West Fork Working Group Agreement, an agreement made between the Flood Control District, the California Department of Fish and Game, the U.S. Forest Service, Main San Gabriel Basin Watermaster, San Gabriel Valley Protective Association (which owns the rights to the water stored in the reservoir), San Gabriel River Water Committee (which has diversion rights to the natural flow in San Gabriel Canyon), and California Trout. The agreement was developed to optimize flood risk management, water conservation, fish habitat, stream conditions, and recreation along the West Fork. A main focus of the agreement is to maintain a stream habitat below Cogswell Dam that supports trout and native non-game fish populations at levels that would ensure their survival. To ensure such a habitat, the minimum recommended release for a normal water year ranges from 10 to 20 cubic feet per second (cfs) or 3 to 10 cfs for a dry water year, depending on the month. Fish species inhabiting the West Fork include rainbow trout, Santa Ana sucker, speckled dace, and arroyo chub. The West Fork also contains species that are considered invasive, such as largemouth bass and green sunfish.

Although there are no official restrictions, the outflow from Cogswell Reservoir is limited to 2,000 cfs, when possible, to avoid damage to the Forest Route 2N25.

7.2.2 PLANNING QUANTITY & APPROACH

As described in Section 5, the projected 20-year sediment accumulation at Cogswell Reservoir is 2.4 MCY. The Flood Control District is also planning to remove approximately 3.3 MCY of sediment already in the reservoir. Therefore, a total of approximately 5.7 MCY of sediment are planned for removal over the 20-year planning period.

Based on the alternatives analysis, it was concluded that managing the entire 20-year planning quantity using one alternative would not be feasible for Cogswell Reservoir. Thus, the following discussion of alternatives assumes some of Cogswell Reservoir's planning quantity would be managed one way while the remaining portion another way.

As discussed in Section 6, smaller-sized sediment can be removed from a reservoir by any of the removal alternatives considered while the only feasible removal alternative for larger-sized sediment is dry excavation. Given the assumption that approximately 60 percent, or 3.4 MCY, of Cogswell Reservoir's 5.7-MCY planning quantity has the appropriate gradation to be dredged or sluiced and the long-term benefit of conserving as much capacity as possible at Cogswell SPS for removal projects past the 20-year planning period, it was assumed that 3.4 MCY of sediment would be dredged or sluiced from Cogswell Reservoir while the remaining would be dry excavated and placed at Cogswell SPS.

7.2.3 POTENTIAL STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

No staging or temporary sediment storage areas outside of Cogswell Reservoir are needed for the alternatives being considered for the reservoir.

7.2.4 REMOVAL

The following section discusses impacts and costs of sediment removal at Cogswell Reservoir by means of dry excavation, dredging, sluicing, and flow-assisted sediment transport. Discussion of the transportation and placement alternatives is presented in Sections 7.2.5 and 7.2.6, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 7.2.7.

7.2.4.1 DRY EXCAVATION

Under regular operating conditions, Cogswell Reservoir is never completely dry, even outside of the storm season. Therefore, in order to access and excavate sediment from the inundated area, the reservoir would have to be drained. As explained previously, it is assumed that 2.3 MCY of Cogswell Reservoir's 5.7-MCY planning quantity would be excavated.

Access for Dry Excavation Equipment & Operation

As discussed in Section 7.2.1.2, Cogswell Reservoir can be reached from Forest Route 2N25 and access to the body of the reservoir could be established on both the northern and southern sides of the reservoir. The stretch of Forest Route 2N25 between San Gabriel Canyon Road and Cogswell Dam is very narrow and sinuous but is still adequate to transport excavation equipment into the reservoir.

Dry Excavation - Environmental Impacts

As mentioned in Section 6, dewatering a reservoir could impact habitat downstream of the reservoir. Dewatering Cogswell Reservoir in preparation for dry excavation is not expected to greatly impact water conservation as the water released from Cogswell Reservoir would be captured at San Gabriel Reservoir.

Dry excavation would impact the aquatic habitat within Cogswell Reservoir. Arroyo chub, Santa Ana speckled dace, rainbow trout, largemouth bass, and channel catfish have been found within the reservoir. Largemouth bass and channel catfish are non-native, invasive fish. Dry excavation would directly impact the fish habitat. However, relocation and other mitigation measures would lessen impacts.

Depending on the vegetation present at the chosen access point to the reservoir, there could also be some environmental impacts at the access point. The environment along the reservoir would need to be taken into consideration when planning the removal operation.

During past reservoir cleanouts, the most recent of which was completed between 1994 and 1996, environmental regulators required monitoring of the condition of biological resources and water quality before, during and after the completion of the project. Such requirements are thus anticipated.

There would be an impact to air quality as a result of the equipment necessary for excavation.

Dry Excavation - Social Impacts

Cogswell Reservoir is located in a very remote area of the Angeles National Forest, is not in the viewshed of houses or buildings, and does not serve a recreational purpose. However, there would be social impacts by dry excavation activites within the reservoir due to the recreational resources near there. While Forest Route 2N25 is not open to public motor vehicular traffic, the route and trails near the reservoir are frequently used by bicyclists, hikers, campers, and fishermen. The scenic and visual impacts of having excavation equipment in the reservoir would be minimal and temporary for recreational users. Noise from excavation equipment could be a disturbance to recreational users in areas closest to the reservoir.

Dry Excavation - Implementability

Dry excavation has been used to remove sediment from Cogswell Reservoir in the past thereby making it technical certain that dry excavation could be implemented. Environmental regulatory permits would need to be obtained prior to excavation.

In order to dry excavate Cogswell Reservoir, the reservoir would first have to be dewatered. As discussed in Section 6, dry excavation could only be conducted outside of the storm season. This would leave approximately six months to excavate. It could be possible for work to continue into the storm season until rain is forecasted.

Dry Excavation - Performance

The effectiveness of dry excavation would be determined by the transportation mode removing the sediment from the reservoir. It is expected that the excavation equipment would be able to match the rate of removal by any mode of transportation being considered.

Dry Excavation - Cost

As discussed in Section 6, the estimated unit cost to excavate material under dry conditions from a facility such as Cogswell Reservoir is $3 per cubic yard. The total cost of dry excavating 2.3 MCY of sediment from the reservoir is estimated to be $7 million. This cost does not include the cost of transporting or placing the sediment.

7.2.4.2 DREDGING

As discussed in Section 6, dredging has not been used to remove sediment from the reservoirs under the Flood Control District's jurisdiction. In order to accurately determine the technical feasibility of a dredging operation at Cogswell Reservoir, detailed analysis would need to be conducted.

The following analysis is based on the assumptions detailed in Section 6 and the assumption that approximately 60 percent of Cogswell Reservoir's 5.7-MCYplanning quantity, or 3.4 MCY, has the appropriate gradation to be dredged. Furthermore, it was assumed that the dredge could be connected to a slurry pipeline downstream of the dam. The remaining 2.3 MCY of larger-sized sediment would have to be dry excavated.

Dredging - Environmental Impacts

An environmental concern with dry excavation is the impact on the aquatic habitat within Cogswell Reservoir. Arroyo chub, Santa Ana speckled dace, rainbow trout, largemouth bass, and channel catfish have been found within Cogswell Reservoir. Largemouth bass and channel catfish are non-native, invasive fish. Dredging could impact fish habitat, including spawning areas.

Dredging operations could impact water quality by increasing the turbidity of water within the reservoir during operations. Water quality concerns could be partially mitigated with a silt curtain around the dredge. Further study is necessary to determine the level of impact.

Groundwater recharge would not be impacted as the decanted water would be captured downstream at San Gabriel Reservoir.

Dredging - Social Impacts

Dredging would not result in increased traffic in the reservoir's surrounding area.

As discussed previously, Cogswell Reservoir is located in a very remote area of the Angeles National Forest, it is not in the viewshed of houses or buildings, and it does not serve a recreational purpose. However, there are recreational resources near the reservoir. It is expected the presence of the dredge in the reservoir would have minimal and temporary scenic and visual impacts on recreational users. The noise of the dredge would also be a minimal and temporary disturbance.

Dredging - Implementability

While portable cutterhead section dredges are available, transporting a dredge to Cogswell Reservoir could be difficult on Forest Route 2N25. Even if the dredge could be transported to the reservoir in pieces, there might not be sufficient space around the reservoir to assemble and launch a dredge.

In order for a cutterhead dredge to be operational, the water level in the reservoir would need to be less than 50 feet. This requirement could necessitate drawing down the water level in the reservoir.

As with other projects within Cogswell Reservoir, dredging would require environmental regulatory permits.

Dredging - Performance

Considering the capabilities of the dredging equipment and slurry pipeline discussed in Section 6, it would take approximately nine (9) 6-month dredging operations to remove the entire 3.4 MCY of smaller-sized material that could potentially be dredged of the 5.7-MCY planning quantity for Cogswell Reservoir for the 20-year planning period.

Dredging - Cost

It is estimated that dredging 3.4 MCY of sediment from Cogswell Reservoir would cost $36 million. This cost does not include the cost of transporting or placing the sediment.

7.2.4.3 SLUICING (AS A REMOVAL METHOD)

It is assumed that approximately 60 percent of Cogswell Reservoir's 5.7-MCY planning quantity, or 3.4 MCY, consists of material with particle sizes small enough to potentially be sluiced. Thus, another removal method would have to be employed to remove the larger-sized material that cannot be sluiced. Dry excavation is the only feasible method to remove the larger-sized material from the reservoir.

This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within Cogswell Reservoir only. For the impacts of sluicing downstream of the dam refer to Section 7.2.5.1.

Sluicing (Removal) - Environmental Impacts

Cogswell Reservoir would first have to be dewatered in order to sluice. As discussed, several fish species have been found within Cogswell Reservoir. Additional studies could be needed in order to determine if other species are present and the potential impacts sluicing would have on habitat within the reservoir. It could be necessary to relocate species present in the reservoir in order to avoid or reduce impacts.

Given the Flood Control District's previous sluicing projects, it is expected that minimal equipment would need to be employed, so emissions are not anticipated to be significant.

Sluicing (Removal) - Social Impacts

Since Cogswell Reservoir does not serve a recreational purpose, sluicing operations would not have any impacts on recreational users within the reservoir. The only expected traffic impacts within the vicinity of Cogswell Reservoir would be during the mobilization and demobilization of the sluicing operation along Forest Route 2N25. This would temporarily impact users of the recreational resources along the road. Noise could impact recreational users temporarily during the sluicing operation. Impacts are not expected to be significant. The scenic and visual impacts of having excavation equipment in the reservoir as part of sluicing operations would be minimal and temporary for recreational users.

Sluicing (Removal) - Implementability

Given that sluicing projects have been conducted at Cogswell Reservoir in the past, it is technically certain that sluicing could be used to remove sediment from Cogswell Reservoir. However, the ability to sluice would still be dependent on inflow into the reservoir, which is entirely dependent on the weather. In addition to inflow, another factor that limits sluicing is the capacity of the West Fork to receive sediment-laden flows.

Similar to other methods of sediment removal already discussed, sluicing Cogswell Reservoir would require environmental regulatory permits.

Sluicing (Removal) - Performance

It was assumed that if sluicing were to be employed for Cogswell Reservoir, approximately 400,000 CY of sediment could be sluiced in a given year. At this rate, sluicing would have to be performed approximately 9 of the 20 years in the planning period in order to sluice 3.4 MCY of sediment from the reservoir.

As discussed in Section 6, it has been assumed that overall the water-sediment mixture sluiced from a reservoir could have a nine-to-one water-to-sediment ratio. Approximately 19,000 AF of water would be required to sluice 3.4 MCY of sediment from Cogswell Reservoir during the 20-year planning period. All water used to sluice would be captured at San Gabriel Reservoir.

Sluicing (Removal) - Cost

Based on the estimated unit cost for sluicing, sluicing 3.4 MCY would cost approximately $8.5 million. This does not include the cost of downstream removal.

7.2.4.4 FLOW ASSISTED SEDIMENT TRANSPORT

As discussed in Section 6, flow assisted sediment transport (FAST) involves operating a dam in a manner that facilitates movement of sediment through the valves during rainfall events, thus mimicking natural processes. Unlike sluicing, FAST would not remove sediment, but instead would minimize sediment accumulation in the reservoir and slow down the rate of sediment accumulation therein.

In the late 1990s, the Flood Control District did a study of FAST at Cogswell Dam and Reservoir that consisted of developing models of a FAST operation at the dam and analyzing the potential sediment pass-through volumes and impacts to biological resources in the West Fork downstream of the dam. The results of the study indicated that FAST had the potential to be an effective means to pass significant volumes of sediment inflow through the reservoir, thus greatly slowing down the rate of sediment accumulation in the reservoir and significantly decreasing the frequency of reservoir cleanouts. The study results also indicated that by timing sediment-laden flows to occur during the storm season, as would happen under natural conditions, a FAST regime would likely not adversely impact the sensitive native non-game fish species (Santa Ana sucker, Santa Ana speckled dace, arroyo chub).

Some regulatory agencies expressed tentative support for trying a pilot FAST regime, provided the regime was initiated with the reservoir cleaned down to template. However, other regulatory agencies and recreational stakeholders expressed opposition to FAST due to concerns about impacts to trout fishing, which is allowed year-round in the West Fork. One concern was regarding FAST resulting in increased turbidity during the winter season trout fishing activities. Another was whether the FAST regime would allow enough water to be stored in the reservoir at the end of the storm season to be released during the summer and fall to enhance flows and support trout during those seasons.

Due to the high degree of uncertainty surrounding the FAST alternative in regards to flow availability and impacts to downstream facilities and the environment, FAST is not considered as part of this Strategic Plan. However, in the future, such operations would be considered and evaluated based on the impacts.

7.2.5 TRANSPORTATION ALTERNATIVES

The following section discusses transportation of the sediment removed from Cogswell Reservoir. Discussion of the removal alternatives was presented in the previous section (Section 7.2.4). The placement alternatives are presented in 7.2.6. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 7.2.7.

7.2.5.1 SLUICING (AS A TRANSPORTATION METHOD)

This section discusses the impacts sluicing would have along the West Fork as sediment moves downstream from Cogswell Reservoir to San Gabriel Reservoir. The impacts sluicing would have within Cogswell Reservoir were discussed in Section 7.2.4.3.

Sluicing (Transport) - Environmental Impacts

Species known to exist within the West Fork include Santa Ana sucker, arroyo chub, Santa Ana speckled dace, rainbow trout, southwestern pond turtle, coast range newt, California red-legged frog, and mountain yellow-legged frog. Vegetation communities observed along the stream channel include Southern Sycamore-Adler Riparian Woodland, White Adler Woodland, Southern Willow Scrub, Southern Coast Live Oak Riparian Forest, and Coastal Sage-Chaparral Scrub.

In general, sluicing activities could cause erosion in certain areas of the West Fork and create deposits along the channel banks in other areas. A previous sluicing event from Cogswell Reservoir had environmental impacts to the downstream habitat in the West Fork that were deemed by many stakeholders to be significant. It is expected that any large quantities of sediment released from the dam would have similar impacts and trigger similar stakeholder concerns. During past reservoir cleanouts, environmental regulators required monitoring of the condition of biological resources and water quality before, during, and after the completion of the project. Such requirements are thus likely for future projects.

Releases from Cogswell Reservoir travel downstream without any significant stream flow losses because the West Fork is primarily in bed rock and shallow alluvium. The water and sediment that pass through the West Fork are captured at the San Gabriel Reservoir.

Sluicing (Transport) - Social Impacts

Some recreational activities are permitted along the West Fork including fishing, hiking, camping, and bicycling. The increased quantities of sediment in the West Fork, as a result of sluicing, would impact fish habitat and spawning areas and thus affect fishing. The sediment-laden flows would impact the scenic and visual characteristics of the West Fork.

Additionally, the US Forest Service permits off-highway vehicle (OHV) use for recreational purposes in an area called the San Gabriel Canyon OHV Area, which is near where the West Fork and San Gabriel Reservoir meet. Further investigation is necessary to determine if sluicing would impact the recreation in this area.

Sluicing (Transport) - Implementability

Sediment from Cogswell Reservoir has been sluiced along the West Fork in the past, so it is known to be technically feasible. In any case, the ability to sluice sediment downstream is dependent on the inflows to Cogswell Reservoir.

As with any other operation within a stream course, sluicing would require environmental regulatory permits. It is anticipated that obtaining permits to move any large quantities of sediment through the West Fork would be difficult.

Sluicing (Transport) – Performance

As discussed in Section 7.2.2, it was assumed that approximately 400,000 CY of sediment could be sluiced from Cogswell Reservoir in a year. As discussed in Section 6, it was assumed that sluice flows would have an approximate 9-to-1 water-to-sediment ratio. Therefore, sluicing sediment along the West Fork would mean 4,000,000 CY of the water-sediment mixture would be sent down the West Fork. The ability of the stream course to handle the sediment and accompanying water volume would need to be considered. Also, sediment deposition locations and the possibility of flushing the stream course to remove the deposits will need to be analyzed if sluicing is to be employed.

Sluicing (Transport) - Cost

The cost of transporting sediment via sluicing is minimal.

7.2.5.2 <u>TRUCKING</u>

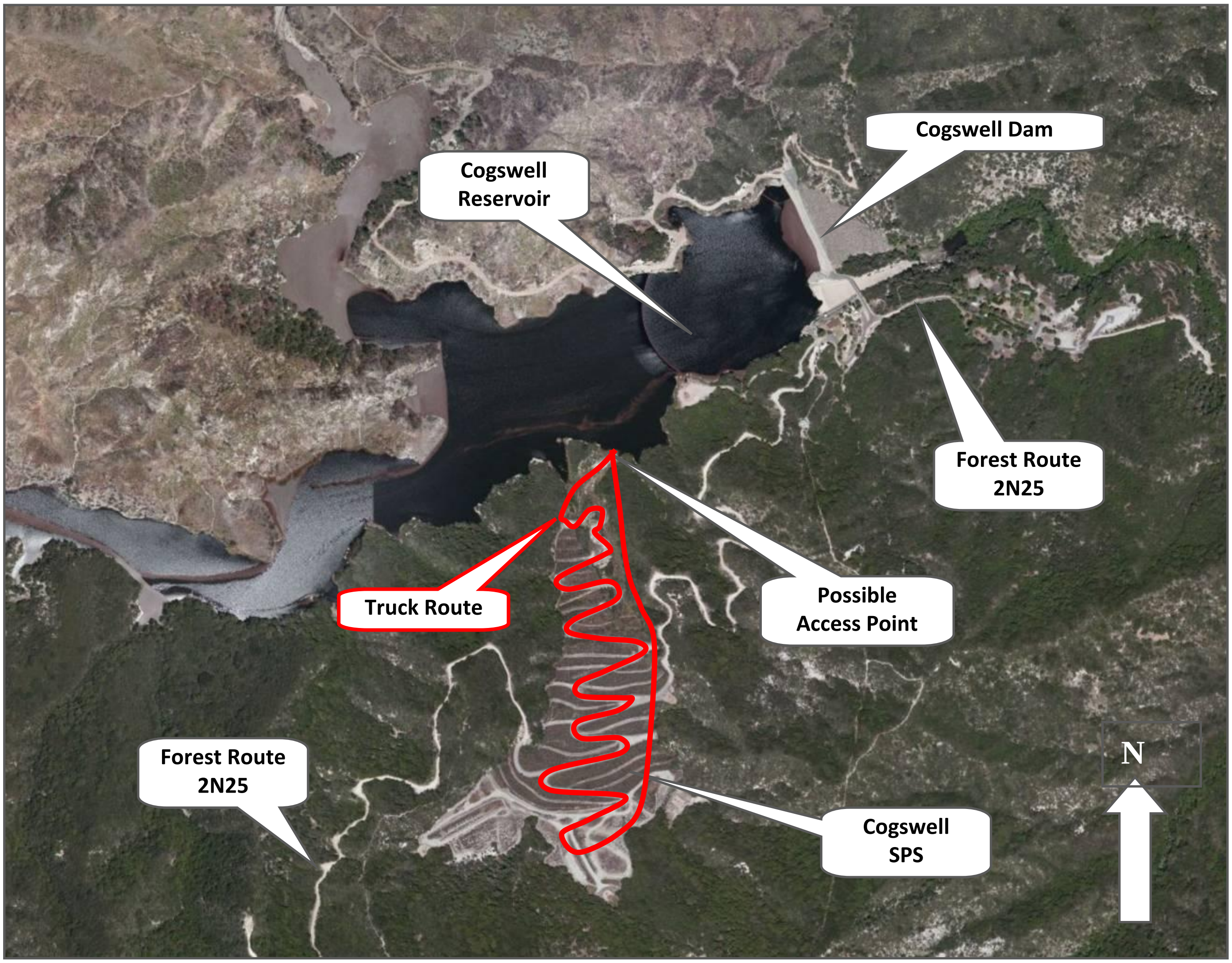
Trucking is a transportation alternative that is suitable for generally dry material. Therefore, it could potentially be used in conjunction with dry excavation. The material would be loaded directly on to trucks and driven to its destination.

Because Forest Route 2N25 is the only way in and out of the reservoir, the use of trucks is limited by the characteristics of this road. The road is adequate for one-way truck traffic, but it is not for two-way truck traffic. Therefore, trucking was determined not to be a feasible transportation alternative out of the canyon. The analysis discussed in the next pages assumes trucks would travel to Cogswell Reservoir via Forest Route 2N25, transport sediment from the reservoir to Cogswell SPS (located adjacent to the reservoir, approximately 0.5 miles upstream from the dam), then travel out of the canyon the same way they went in.

<u>Access and Route for Trucking</u>

The lowest portion of the SPS has been filled during previous cleanout projects at Cogswell Reservoir, leaving the remaining capacity available approximately 0.5 miles uphill from the reservoir. Given that the access road to the top of the SPS is sinuous, the driving distance is increased to 1 mile. The access point and potential trucking route from the reservoir to the top of Cogswell SPS is shown in Figure 7-6. An access ramp would need to be established to use this access road.

Figure 7-6 Cogswell SPS Trucking Route and Access Point



Trucking - Environmental Impacts

Since trucks would utilize Forest Route 2N25 and the existing access road through the SPS, there would be no new impacts to habitat. Minimal impact is expected from the construction of an access ramp into the reservoir.

There would be an impact to air quality as a result of the emissions from trucks. The use of low emission trucks would result in lower air quality impacts than if standard trucks were used.

Trucking - Social Impacts

Truck traffic in Cogswell SPS would impact existing recreational activities, such as bicycling or hiking, along Forest Route 2N25, through the SPS.

Cogswell Reservoir is not in the viewshed of houses or buildings. However, there is a possibility Cogswell SPS could be partially viewed from State Route 2 (Angeles Crest Highway). Trucking sediment between the reservoir and the SPS would have some scenic and visual impacts for recreational users.

Trucking – Implementability

The access road in Cogswell SPS is approximately 15 feet wide and very sinuous, allowing only for one way truck traffic. As done during the sediment removal project in the mid-1990s, an additional temporary access road and ramp could be constructed in the SPS to form a loop for the trucks.

As will be discussed with the placement section, environmental regulatory permits would be needed to utilize Cogswell SPS as a placement site.

Trucking – Performance

Double dump trucks would not be able to be used because of the winding conditions of the access road through Cogswell SPS.

If single dump trucks were used, approximately 400,000 CY of sediment could be moved during a 6-month operation. At this rate it would take approximately six (6) 6-month trucking operations to transport the 2.3 MCY of non-sluiceable material from the reservoir to the SPS.

Since trucking would only occur between the reservoir and the SPS, it could be possible to use off-highway trucks, which have a larger capacity than single dump trucks, as done during the last cleanout in 1996. Employing off-highway trucks could result in fewer or shorter-duration trucking operations.

It was assumed trucks would travel at an average speed of 10 miles per hour, whether single or off-highway trucks were to be employed.

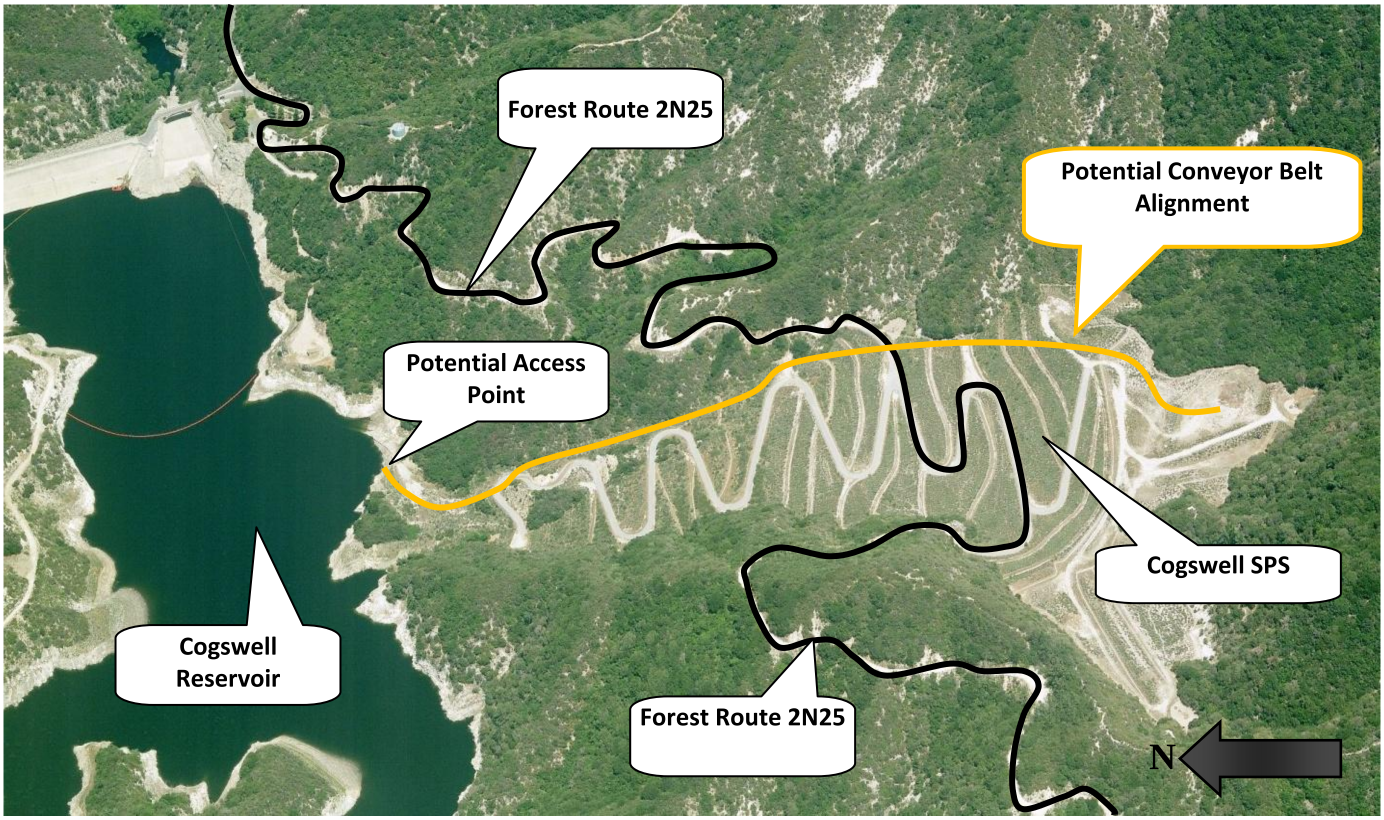
Trucking - Cost

Given the distance from Cogswell Reservoir to Cogswell SPS and assuming the use of single dump trucks, the estimated trucking cost is around $3 million for 2.3 MCY of sediment. Cost savings could be achieved through the use of the larger capacity off-highway trucks.

7.2.5.3 CONVEYOR BELTS

A conveyor belt could be used in conjunction with dry excavation. For this analysis, it is assumed the conveyor belt would extend from Cogswell Reservoir to Cogswell SPS, as shown in Figure 7-7. Since the lowest portion of the SPS has been filled during previous removal projects, the remaining capacity is located approximately 0.5 miles uphill from the reservoir. Forest Route 2N25 would be used to mobilize the conveyor components.

Figure 7-7 Cogswell SPS Aerial



Conveyor Belts - Environmental Impacts

No new environmental impacts to habitat are expected from utilizing Forest Route 2N25 to mobilize the conveyor components.

Placement of the conveyor belt within Cogswell SPS would likely impact habitat within the existing fill area. California buckwheat scrub, hoary-leaf ceanothus chaparral, and black willow thickets have recently been identified along the slope of the existing fill. The following birds are considered common inhabitants of the project vicinity: California quail, northern flicker, California towhee, spotted towhee, oak titmouse, belted, kingfisher, western scrub jay, stellar jay, mourning dove, band-tailed pigeon, red-tailed hawk, common raven, northern mockingbird, Anna's hummingbird, wrentit, American coot, mallard and housefinch. Additionally, western gray squirrel, mule deer, raccoon, and black bear have been previously observed on the site. Studies would be needed to determine if any other species are present in the area and the specific impacts placement and operation of a conveyor would have on habitat.

Conveyor Belts - Social Impacts

The conveyor belt would be installed during cleanouts and removed between subsequent cleanouts.

Placement and operation of conveyor belts within Cogswell SPS could impact recreational activities along Forest Route 2N25 through the SPS. It could be possible to either elevate or trench the conveyor belt to maintain access through Forest Route 2N25 and avoid or reduce impacts.

The scenic and visual impacts of placing and operating a conveyor within Cogswell Reservoir and Cogswell SPS are expected to be minimal and temporary for recreational users.

Conveyor Belts - Implementability

The conveyor components could be tranported to and from Cogswell Reservoir and SPS along Forest Route 2N25.

Once sediment is excavated from Cogswell Reservoir, it could then be loaded into a hopper inside the body of the reservoir. Sediment would then be conveyed to Cogswell SPS. Given that the minimum curve radius for a conveyor is 300 feet and the access road through the SPS has several turns with a radius less than that, a conveyor belt could not be placed along the access road. However, the conveyor belt could be placed over the existing fill at Cogswell SPS, as shown in Figure 7-7. Further investigation would be needed to determine the exact alignment of the conveyor belt.

It is expected that permitting the use of a conveyor within Cogswell SPS would be included in the environmental regulatory permits to use the SPS for sediment placement. Separate air quality permits could be needed to operate generators to power the conveyor if insufficient electrical power capacity is available in the vicinity of the project site.

Conveyor Belts - Performance

Assuming average or minimal delays due to mechanical difficulties with the conveyor belt or the generators, the conveyor belt would be able to transport approximately 800 CY of sediment per hour. Given this and other assumptions discussed in Section 6, a 6-month conveyor operation could move approximately 800,000 CY of sediment. At this rate it would take approximately three (3) 6-month conveyor operations to transport the 2.3 MCY of non-sluiceable material between Cogswell Reservoir and Cogswell SPS.

Conveyor Belts - Cost

The estimated cost for constructing and operating a conveyor belt from Cogswell Reservoir to Cogswell SPS is approximately $4.2 million.

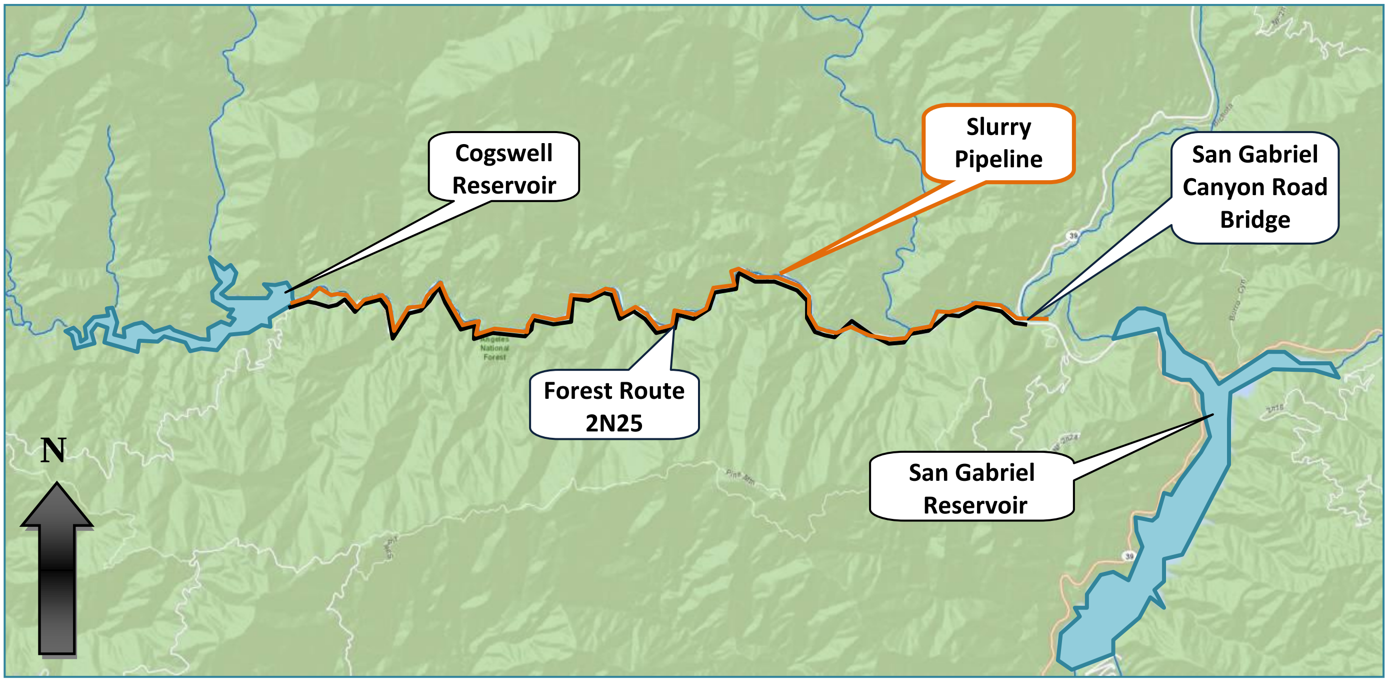
7.2.5.4 SLURRY PIPELINE

As discussed in Section 6, slurry pipelines would be used in conjunction with the dredging removal alternative. A slurry pipeline could be constructed to transport dredged slurry from Cogswell Reservoir to San Gabriel Reservoir. Removal of the material accumulated at San Gabriel Reservoir will be evaluated in Section 7.3.

Route for Slurry Pipeline

Detailed analysis would be needed to determine the specific alignment of a slurry pipeline to transport sediment from Cogswell Reservoir to San Gabriel Reservoir. For the purposes of this Strategic Plan, it was assumed the potential pipeline alignment described here and shown in Figure 7-8 would be feasible. The slurry pipeline would begin at the end of the dredge line on the downstream face of Cogswell Dam. Once the West Fork meets with Forest Route 2N25, the slurry pipeline could be constructed along Forest Route 2N25. Further investigation will be needed to determine the best method to transport the dredged material from the face of the dam to Forest Route 2N25 where the pipeline will begin. Because Forest Route 2N25 is a very sinuous and narrow, portions of the slurry pipeline could encroach into the West Fork in order for the road to continue to accommodate traffic. Approximately 7 miles downstream, where Forest Route 2N25 meets with San Gabriel Canyon Road (State Route 39), the slurry pipeline would likely be placed under the San Gabriel Canyon Road bridge over the West Fork. The slurry pipeline would then travel approx 1.5 miles along the West Fork, until meeting San Gabriel Reservoir.

Figure 7-8 Cogswell Slurry Pipeline Alignment



Slurry Pipeline - Environmental Impacts

There would be impact to habitat where the slurry pipeline would encroach on the West Fork. If required, the area needed to construct booster stations would cause additional impact. Other than construction impacts, a slurry pipeline is not expected to impact the environment along the West Fork. However, the discharge of sediment into San Gabriel Reservoir would increase turbidity and possibly affect the habitat there.

In order to identify and minimize the potential environmental impacts of placing and operating a slurry pipeline from Cogswell Dam to San Gabriel Reservoir, the habitat along the potential alignments would have to be studied.

Water quantity and air quality would not be expected to be impacted.

Species known to exist within the West Fork include Santa Ana sucker, arroyo chub, Santa Ana speckled dace, rainbow trout, southwestern pond turtle, coast range newt, California red-legged frog, and mountain yellow-legged frog. Vegetation communities observed along the stream channel include Southern Sycamore-Adler Riparian Woodland, White Adler Woodland, Southern Willow Scrub, Southern Coast Live Oak Riparian Forest, and Coastal Sage-Chaparral Scrub. A slurry pipeline is not expected to greatly impact any of these species. Further study is needed to determine the extent of environmental impact from slurry pipelines.

In past reservoir cleanouts, the most recent of which was in 1994-96, environmental regulators required monitoring of the condition of biological resources and water quality before, during, and after the completion of the project. Such requirements are thus likely for future projects.

Slurry Pipeline - Social Impacts

If constructed, a slurry pipeline would be a permanent structure for moving sediment from Cogswell Reservoir to San Gabriel Reservoir. Depending on the exact alignment of the slurry pipeline along Forest Route 2N25 and the West Fork, fishing could be impacted. Other recreational activities would be expected to be impacted only during construction of the pipeline.

Slurry Pipeline - Implementability

As mentioned previously, the slurry pipeline transportation alternative would be used in conjunction with the dredging removal alternative. Assuming that dredging is determined to be feasible, it is expected the dredge upstream of the dam would be connected to the slurry pipeline downstream of the dam. Pumps could be needed to move the slurry either over the dam or through a valve on the dam.

As discussed in Section 6, the slurry pipeline would be flexible; therefore, it would be able to handle the turning radii necessary to reach San Gabriel Reservoir.

Booster stations could be needed every mile to keep the slurry moving down the pipeline. Further study is needed to determine if there is sufficient space to place booster stations along the slurry pipeline alignment. Further study is also needed to determine the level of effort that would be required to keep booster stations operational.

Placement of a slurry pipeline along the proposed route would present significant right-of-way and permitting issues.

Slurry Pipeline – Performance

As mentioned previously, a slurry pipeline would be used in conjunction with the dredging alternative. Therefore, if 9 dredging operations were to be conducted during the 20-year planning period to remove the entire 60 percent, or 3.4 MCY, of smaller-sized sediment of Cogswell Reservoir's 5.7-MCY planning quantity, then the slurry pipeline would be used a total of nine times during the 20-year planning period. As discussed in Section 6, the slurry pipeline would need to transport approximately 2,000 CY of the water-sediment slurry per hour or approximately 15 cubic feet of the slurry per second. In total, during a 6-month dredging operation, the slurry pipeline would need to handle a total of 4 MCY or 2,500 acre-feet of slurry. It is expected that the type of slurry pipeline that would be used would be able to perform during the 20-year planning timeline.

For planning purposes, it was assumed that a total of nine lift stations would be required for the 8.5-mile long slurry pipeline between Cogswell Dam and San Gabriel Reservoir.

Slurry Pipeline - Cost

The estimated cost for a slurry pipeline, including the cost of the lift stations, is approximately $48 million. This does not include the cost of dredging material into the slurry pipeline or removal of sediment downstream.

7.2.6 PLACEMENT ALTERNATIVES

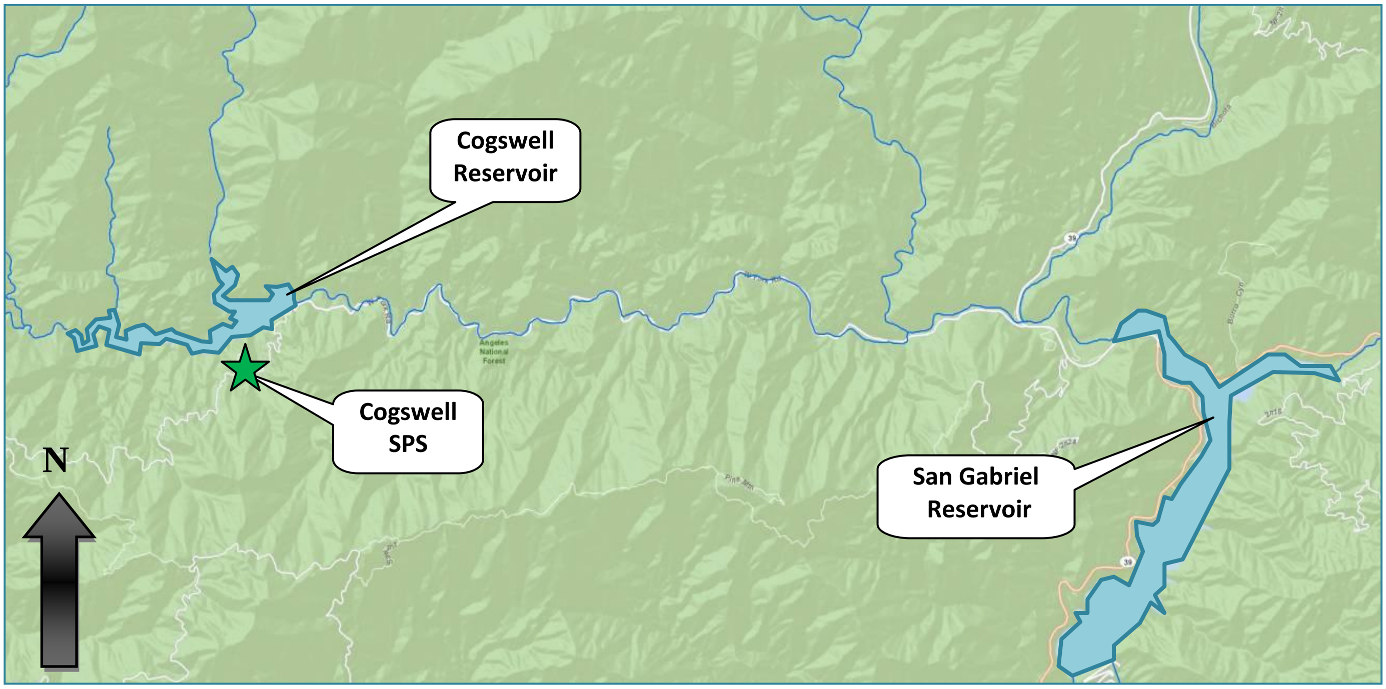
This section discusses potential placement alternatives for sediment removed from Cogswell Reservoir. Given the remote location of Cogswell Dam and the difficult access along Forest Route 2N25, only Cogswell SPS and San Gabriel Reservoir are being considered for placement. Sediment that is transported to San Gabriel Reservoir via sluicing, slurry pipeline, or other method would be removed and placed at sites deemed feasible for San Gabriel Reservoir.

7.2.6.1 COGSWELL SEDIMENT PLACEMENT SITE

This section discusses the impacts associated with employing the remaining capacity at Cogswell SPS for the permanent placement of sediment from Cogswell Reservoir. This placement alternative could potentially be used for sediment excavated from the reservoir and transported either by trucks or a conveyor system to the SPS.

Cogswell SPS is an existing SPS that covers an area of approximately 36.5 acres and currently holds less than 5 MCY of sediment due to previous cleanout activities.

Figure 7-9 Cogswell SPS Location



Cogswell SPS – Environmental Impacts

California buckwheat scrub, hoary-leaf ceanothus chaparral, and black willow thickets have recently been identified along the slope of the existing fill at the SPS. Interior live oak woodland, black willow thickets, mulefat thickets, riparian herbaceous, canyon live oak forest are located at the back of the SPS, where new fill would potentially be placed.

The following birds are considered common inhabitants of the project vicinity: California quail, northern flicker, California towhee, spotted towhee, oak titmouse, belted, kingfisher, western scrub jay, stellar jay, mourning dove, band-tailed pigeon, red-tailed hawk, common raven, northern mockingbird, Anna's hummingbird, wrentit, American coot, mallard and housefinch. Additionally, western gray squirrel, mule deer, raccoon, and black bear have been identified in the site. Further study would be needed to determine any other habitat in the area.

Equipment used to place sediment in the SPS could impact on air quality.

Cogswell SPS – Social Impacts

Cogswell SPS is not in the viewshed of any houses or buildings. However, it is possible the site could be partially viewed from State Route 2. The scenic and visual impacts of having equipment in the reservoir would be minimal and temporary for recreational users.

Cogswell SPS – Implementability

Use of Cogswell SPS would require environmental regulatory permits. Vegetation would need to be removed to place sediment at Cogswell SPS. Environmental permitting is a major implementability issue.

Cogswell SPS is also located near a National Forest Inventoried Roadless Area. This land is protected from road construction, reconstruction, and timber harvest so as not to alter and fragment landscapes. Therefore, expansion of the SPS into these areas would not be a consideration.

Cogswell SPS – Performance

It is estimated that 3.2 MCY of capacity remains at Cogswell SPS. There is not enough capacity to hold the 20-year planning quantity of 5.7 MCY. Since not all of the material could be sluiced or slurried downstream and trucking and conveying out of the West Fork do not appear likely, the Flood Control District would attempt to conserve as much capacity as possible for those materials with no feasible transport alternative out of the West Fork.

Cogswell SPS – Cost

For cost analysis it is assumed that the 2.3 MCY of non-sluiceable sediment would be placed at Cogswell SPS. Again, up to 3.2 MCY of sediment could be placed at Cogswell SPS.

The cost of placing 2.3 MCY of sediment at Cogswell SPS would be approximately $4.6 million.

7.2.6.2 SAN GABRIEL RESERVOIR (AS A PLACEMENT LOCATION)

For planning purposes, it was assumed that a slurry pipeline transporting sediment from Cogswell Reservoir would terminate in San Gabriel Reservoir. It was also assumed that sediment sluiced from Cogswell Reservoir would be captured in San Gabriel Reservoir. This sediment would impact water quality and increase the amount of sediment that would need to be managed within San Gabriel Reservoir. Section 7.3 discusses the sediment management alternatives for San Gabriel Reservoir.

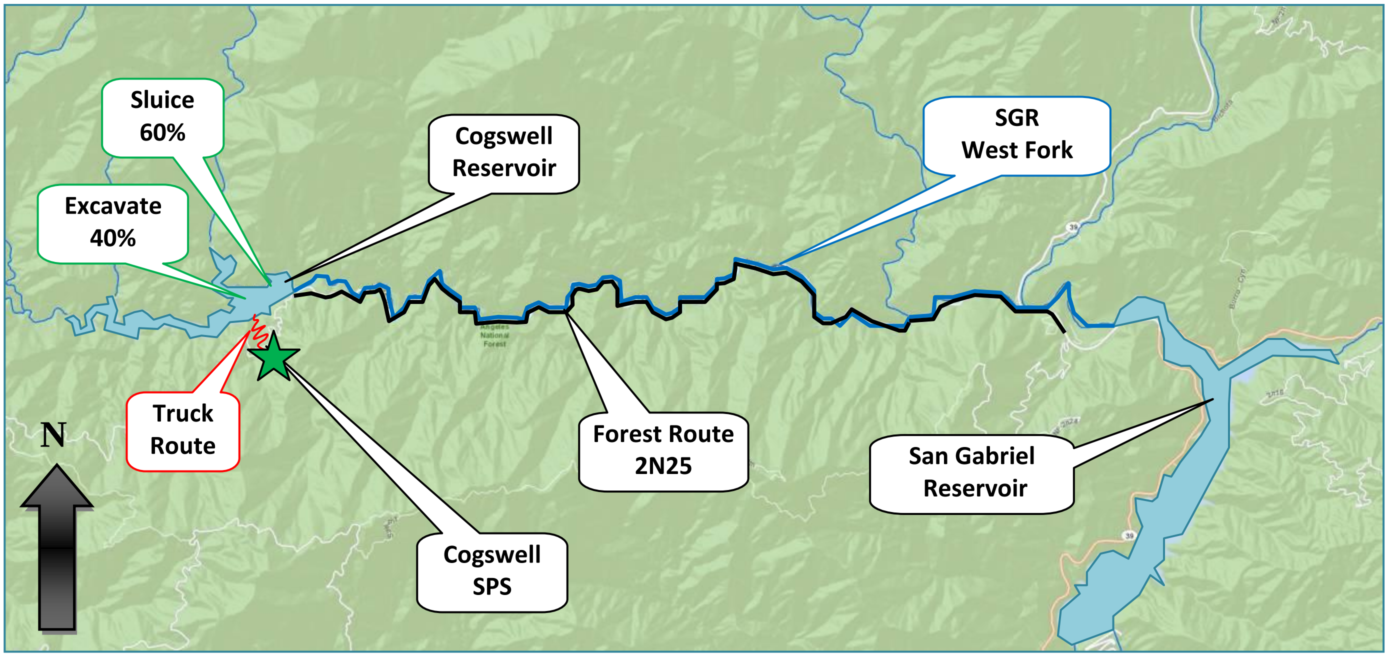
7.2.7 COMBINED SEDIMENT MANAGEMENT ALTERNATIVES

Combining the removal and transportation alternatives for Cogswell Reservoir, there are four sets of feasible options. A description of each of these combined sediment management alternatives is given below.

7.2.7.1 COMBINED ALTERNATIVE 1A: SLUICE (3.4 MCY) → SAN GABRIEL RESERVOIR + DRY EXCAVATE (2.3 MCY) → TRUCKS → COGSWELL SPS

Combined Alternative 1A would involve sluicing sediment to San Gabriel Reservoir as well as excavating material from Cogswell Reservoir and placing at Cogswell SPS. It was assumed that sediment sluiced to San Gabriel Reservoir would be managed with the material to be removed from San Gabriel Reservoir. Figure 7-10 illustrates Combined Alternative 1A.

Figure 7-10 Cogswell Reservoir Combined Alternative 1A



Approximately 400,000 CY of sediment would be sluiced from Cogswell Reservoir to San Gabriel Reservoir in a given year. At this rate, sluicing would have to be performed approximately 9 of the 20-year planning period in order to sluice 3.4 MCY of sediment from the reservoir. In order to address the 2.3 MCY of sediment that is not suitable for sluicing, 6 dry excavation and trucking operations would be necessary.

Sluiced material would travel approximately 8.5 miles down the West Fork to San Gabriel Reservoir. Material being sluiced would impact habitat along the West Fork.

The remaining 2.3 MCY of material would need to be excavated from Cogswell Reservoir in order to truck to the SPS. This would require draining of the reservoir.

One of the limitations of this alternative is the remaining capacity at Cogswell SPS. Dry excavation of the total 5.7 MCY of sediment would not be possible because there is neither enough capacity at Cogswell SPS for this material nor a feasible transportation method to remove this material from the West Fork. Up to 3.2 MCY of sediment could be placed at Cogswell SPS. However, it would be assumed that only 2.3 MCY of the material that is not suitable for sluicing would be placed at the SPS. Another limitation is the impact to sensitive habitat in the unused area of the SPS which is also on Forest Service land. It would be necessary and possibly difficult to obtain environmental regulatory permits.

There is an existing road that travels through the SPS from the edge of the reservoir to the top of the existing fill. Utilizing the existing road minimizes new impact to habitat. If a temporary haul route is constructed along the side of the reservoir to create a haul loop, habitat that has grown on the existing fill would be impacted. An access ramp into the reservoir would need to be reestablished. There would also be some impacts to air quality.

Employing this alternative to remove 2.3 MCY on non-sluiceable material during the 20-year planning period would require six (6) 6-month operations over the 20-year period. This is based on the assumptions that 3200 CY of sediment could be transported during the 8 operating hours per day, 5 days a week, for 6 months a year.

Implementation of this alternative would cost an estimated $25 million. The breakdown of estimated costs is provided in Table 7-3 below.

Table 7-3 Estimated Costs for Combined Alternative 1A

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Sluice from Cogswell Reservoir to San Gabriel Reservoir	3.4	$9
Excavate material at Cogswell Reservoir that is not sluiceable		$7
Truck non-sluiceable material from Cogswell Reservoir to Cogswell SPS on single-dump trucks	2.3	$3
Place sediment at Cogswell SPS		$5
Total	**5.7**	**$25**[(a)]

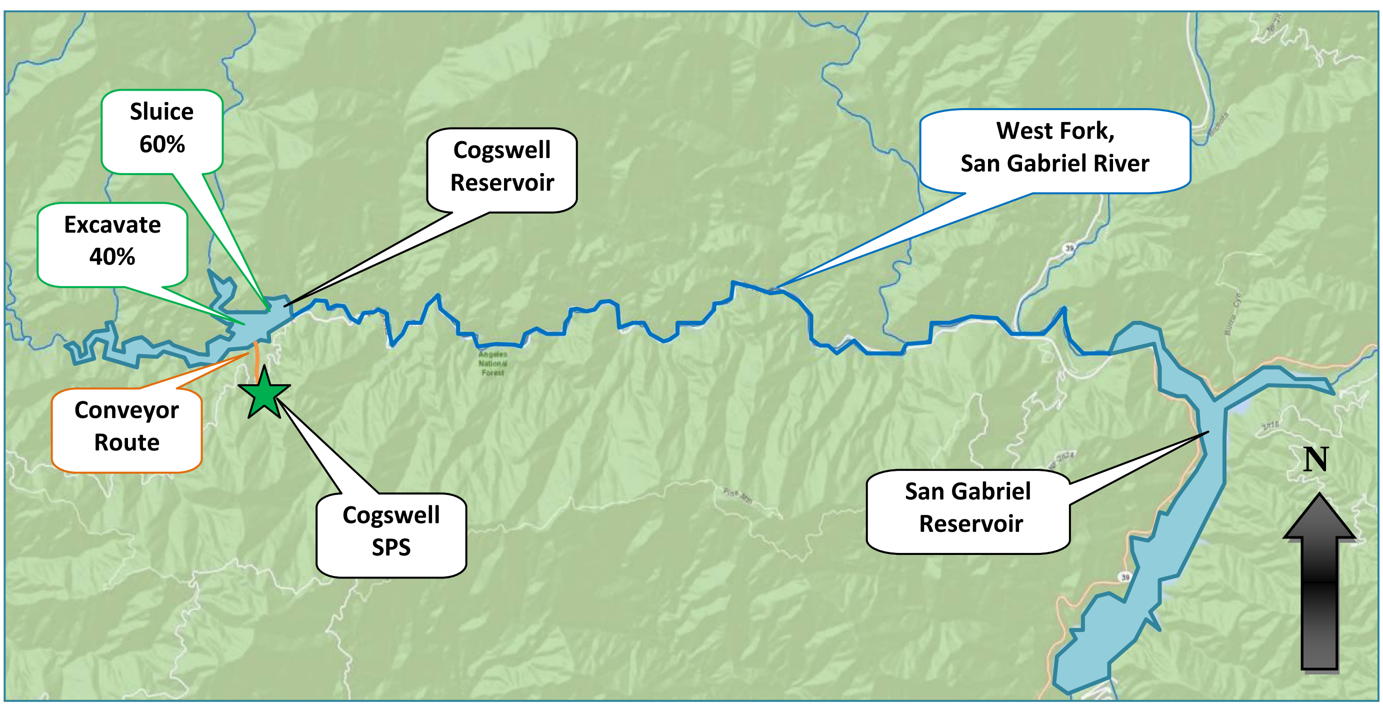
Notes

a. Does not include the removal of 3.4 MCY of material from San Gabriel Reservoir

7.2.7.1 COMBINED ALTERNATIVE 1B: SLUICE (3.4 MCY) → SAN GABRIEL RESERVOIR + DRY EXCAVATE (2.3 MCY) → CONVEYOR → COGSWELL SPS

Combined Alternative 1B is essentially the same as Combined Alternative 1A, except that the 2.3 MCY of non-sluiceable material would be transported to Cogswell SPS using a conveyor belt instead of trucks. Figure 7-11 illustrates Alternative 1B.

Figure 7-11 Cogswell Reservoir Alternative 1B



A limitation of conveying sediment through the SPS is the impact to sensitive habitat in the unused area of the SPS, which is also on US Forest Service land. The conveyor belts would also be routed in a relatively straight alignment from the edge of the reservoir through the SPS to the top of the existing fill. Some habitat that has since grown on the existing fill would be impacted by the placement of a conveyor belt. An access ramp into the reservoir would need to be reestablished. It would be necessary and possibly difficult to obtain environmental regulatory permits.

Employing this combined alternative would require that sluicing be conducted during 9 of the 20 years in the planning period in order to remove the 3.4 MCY of smaller-sized material from Cogswell Reservoir. Additionally, three (3) 6-month dry excavation and conveyor operations would be required to remove the remaining 2.3 MCY of larger-sized material that cannot be sluiced.

Implementation of this alternative would cost an estimated $25 million. The breakdown of estimated costs is provided in Table 7-4 below.

Table 7-4 Estimated Costs for Combined Alternative 1B

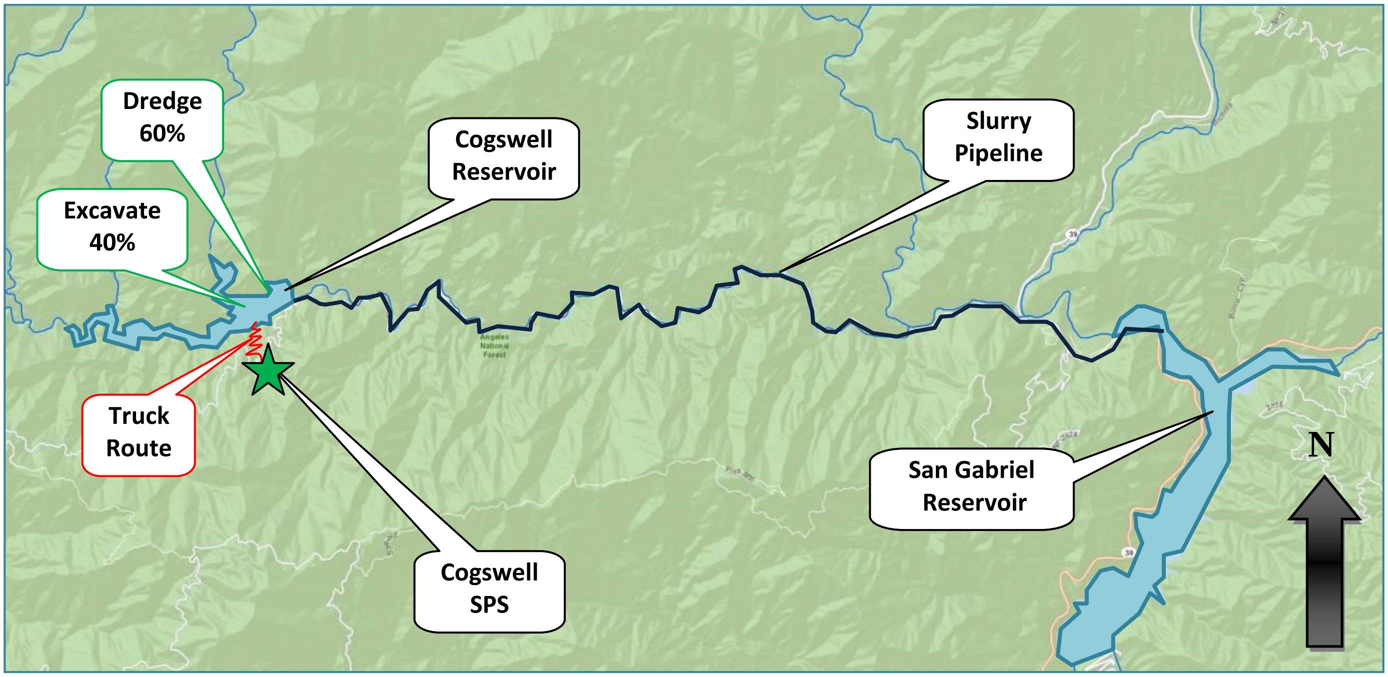
Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Sluice from Cogswell Reservoir to San Gabriel Reservoir	3.4	$9
Excavate material at Cogswell Reservoir that is not sluiceable		$7
Conveyor belt non-sluiceable material from Cogswell Reservoir to Cogswell SPS	2.3	$4
Place sediment at Cogswell SPS		$5
Total	**5.7**	**$25[(a)]**

Notes:
a. Does not include the removal of 3.4 MCY of material from San Gabriel Reservoir

7.2.7.2 Combined Alternative 2A: Dredge and Slurry to San Gabriel Reservoir + Trucking to Cogswell SPS

Combined Alternative 2A would involve dredging sediment from Cogswell Reservoir and sending it via slurry pipeline to San Gabriel Reservoir. As all of the sediment would not be eligible for transport via slurry pipeline, remaining material would be excavated and brought to Cogswell SPS. It was assumed that sediment slurries to San Gabriel Reservoir would be managed with the material to be removed from San Gabriel. Figure 7-12 illustrates Combined Alternative 2A.

Figure 7-12 Cogswell Reservoir Combined Alternative 2A



As discussed in previously, dredging could occur once the reservoir has been lowered to such a level that the maximum depth to the sediment to be dredged is 50 feet. It is assumed that the slurry line could either be directed through a valve in the dam or over the top of the dam. Further study would be needed to determine if there is adequate water to dredge material while keeping a lower reservoir elevation.

From the downstream face of the dam the slurry pipeline would be constructed along Forest Route 2N25. At some points along Forest Route 2N25, the slurry pipeline could encroach on the river. Booster stations would be needed for every mile of slurry line to keep the mixture moving. The pipeline would outlet into the San Gabriel Reservoir, therefore, no dewatering area is necessary. Approximately 8.5 miles of pipeline would be needed to construct this alignment.

Given the assumptions made regarding dredging operations it would take nine (9) 6-month dredging operations during the 20-year planning period to remove the 3.4 MCY of dredgeable material from Cogswell Reservoir. If the operations could be conducted on a regular basis, dredging operations would be conducted approximately every other year.

Just as with the 2.3 MCY non-sluiceable material from Combined Alternative 1A, the remaining 2.3 MCY of larger, non-dredgeable material could be excavated and trucked to Cogswell SPS. This would take approximately six (6) 6-month operations over the 20-year period.

Implementation of this combined alternative would cost an estimated $145 million. The breakdown of estimated costs is provided in Table 7-5 below.

Table 7-5 Estimated Costs for Combined Alternative 2A

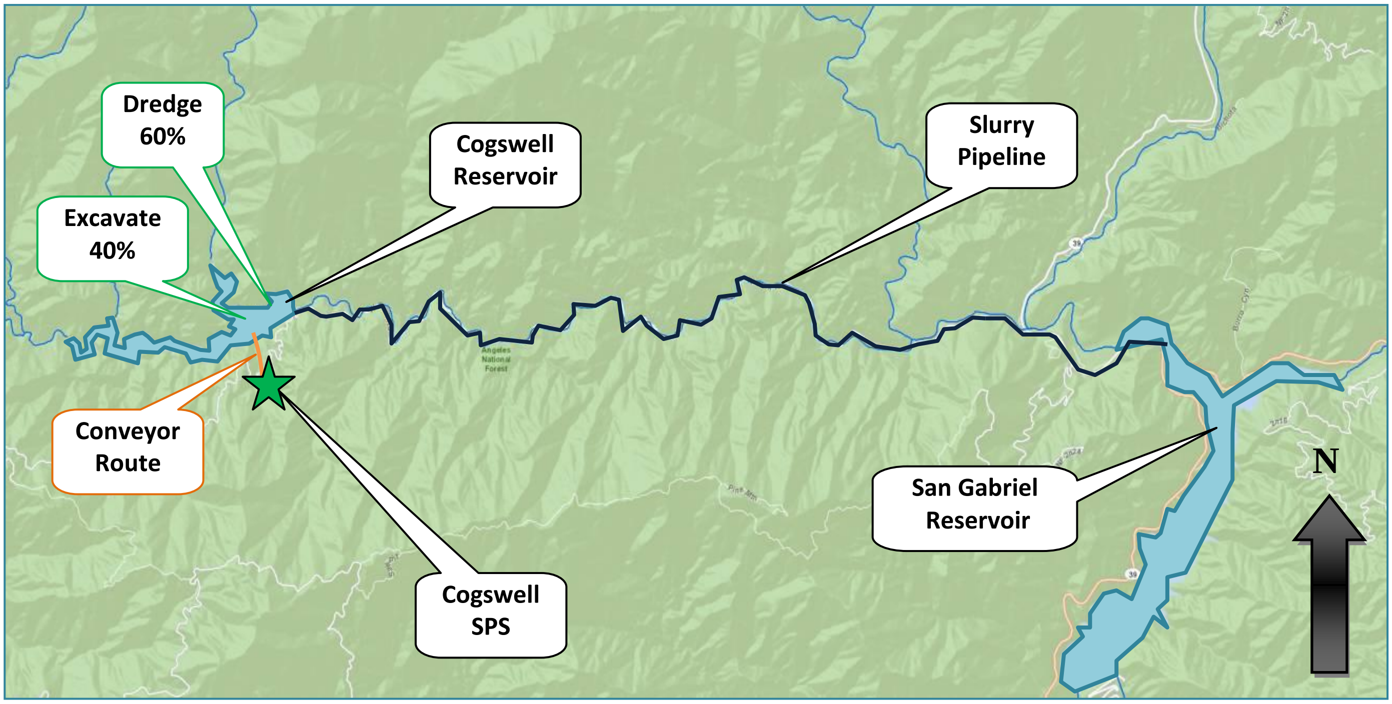
Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Dredge material from Cogswell Reservoir to San Gabriel Reservoir	3.4	$36
Slurry dredgeable material from Cogswell Reservoir to San Gabriel Reservoir		$48
Booster station every mile from Cogswell Reservoir to San Gabriel Reservoir		$46
Excavate material at Cogswell Reservoir that is not sluiceable	2.3	$7
Truck non-sluiceable material from Cogswell Reservoir to Cogswell SPS on single-dump trucks		$3
Place sediment at Cogswell SPS		$5
Total	**5.7**	**$145[(a)]**

Notes:
a. Does not include the removal of 3.4 MCY of material from San Gabriel Reservoir

7.2.7.3 COMBINED ALTERNATIVE 2B: DREDGE AND SLURRY TO SAN GABRIEL RESERVOIR + CONVEYOR BELT TO COGSWELL SPS

Combined Alternative 2B is essentially a combination of Combined Alternative 2A and Combined Alternative 1B. The dredging aspect of this alternative is the same as for Combined Alternative 2A, meaning that 3.4 MCY of sediment would be dredged and transported via slurry pipeline from Cogswell Reservoir to San Gabriel Reservoir. Similar to Combined Alternative 1B, the 2.3 MCY of larger-sized material would be excavated and conveyed to Cogswell SPS.

Figure 7-13 Cogswell Reservoir Combined Alternative 2B



Employing this combined alternative would require that sluicing be conducted during 9 of the 20 years in the planning period in order to remove the 3.4 MCY of smaller-sized material from Cogswell Reservoir. Addressing the 2.3 MCY of larger-sized material that cannot be sluiced would require three (3) 6-month dry excavation and conveyor operations.

Implementation of this combined alternative would cost an estimated $145 million. The breakdown of estimated costs is provided in Table 7-6 below.

Table 7-6 Estimated Costs for Combined Alternative 2B

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Dredge material from Cogswell Reservoir to San Gabriel Reservoir	3.4	$36
Slurry dredgeable material from Cogswell Reservoir to San Gabriel Reservoir		$48
Booster station every mile from Cogswell Reservoir to San Gabriel Reservoir		$46
Excavate material at Cogswell Reservoir that is not sluiceable	2.3	$7
Conveyor belt non-sluiceable material from Cogswell Reservoir to Cogswell SPS		$4
Place sediment at Cogswell SPS		$5
Total	**5.7**	**$145[(a)]**

Notes:
a. Does not include the removal of 3.4 MCY of material from San Gabriel Reservoir

7.2.8 COGSWELL RESERVOIR SUMMARY AND RECOMMENDATIONS

7.2.8.1 SUMMARY

Over the next 20 years, 5.7 MCY of sediment are planned to be removed from Cogswell Reservoir. For planning purposes, it is assumed that 60 percent of the 5.7 MCY, or 3.4 MCY, is smaller-sized material that could be sluiced or dredged. The remaining 40 percent, or 2.3 MCY, would need to be managed separately. The different sediment management alternatives are briefly explained below and the impacts are shown in Table 11-1.

Sediment Management Alternatives

1A Sluice (3.4 MCY) → San Gabriel Reservoir
+ Dry excavate (2.3 MCY) →Trucks → Cogswell SPS
Alternative 1A consists of two components. One component consists of sluicing 3.4 MCY of sediment from Cogswell Reservoir to San Gabriel Reservoir, which would result in habitat and water quality impacts on the West Fork of the San Gabriel River. The other component consists of dry excavating the 2.3 MCY of larger-sized sediment in Cogswell Reservoir and trucking it to Cogswell SPS. There would be air quality impacts from the trucks and habitat impact to the undeveloped portion of Cogswell SPS.

1B Sluice (3.4 MCY) → San Gabriel Reservoir
+ Dry Excavate (2.3 MCY) →Conveyor → Cogswell SPS
This alternative is similar to 1A except the 2.3 MCY of dry excavated material would be transported to Cogswell SPS using a conveyor belt. There would be some impacts to the habitat on the existing fill at the SPS where the conveyor belts would be placed.

2A Dredge (3.4 MCY) → Slurry Pipeline → San Gabriel Reservoir
+ Dry Excavate (2.3 MCY) →Trucks → Cogswell SPS
This alternative consists of dredging the 3.4 MCY of smaller-sized material from Cogswell Reservoir and transporting via slurry pipeline to San Gabriel Reservoir. Construction of the slurry pipeline would have some habitat impacts on the West Fork of the San Gabriel River. The 2.3 MCY of larger-sized material in Cogswell Reservoir would be dry excavated and transported via a conveyor to Cogswell SPS.

2B Dredge (3.4 MCY) → Slurry Pipeline → San Gabriel Reservoir
+ Dry Excavate (2.3 MCY) →Conveyor → Cogswell SPS
This Alternative is similar to Alternative 2A except the 2.3 MCY of larger-sized material would be transported to Cogswell SPS using a conveyor belt. There would be some impacts to the habitat on the existing fill at the SPS where the conveyor belts would be placed.

Recommendations

It is recommended that Alternatives 2A and 2B be considered first due to the high environmental impacts sluicing would have on the West Fork. Alternative sluicing methods, like flow assisted sediment transport, should also be considered for this location as additional study is completed.

Table 7-7 Summary of Sediment Management Alternatives for Cogswell Reservoir

Alternative		Quantity Removed (MCY)	Environmental				Social			Implementability	Performance		Cost
			Habitat	Water Quality	Groundwater Recharge	Air Quality[a]	Traffic	Visual	Noise	Special Permit/ Agreement Required[b]	Previous Experience	# of operations required in next 20 years	$ Millions
1A	Sluice to SG Reservoir	3.4	●	●				○			Yes	9	25
	Dry Excavation from Cogswell	2.3	◑			◑		○	○			6	
	Trucks					●		○					
	Cogswell SPS		●			○		○	○	Yes			
1B	Sluice to SG Reservoir	3.4	●	●				○			Yes	9	25
	Dry Excavation from Cogswell	2.3	◑			◑		○	○			3	
	Conveyor Belt		◑					○	○				
	Cogswell SPS		●			○		○	○	Yes			
2A	Dredge	3.4	◑	◑							No	9	145
	Slurry Pipeline to SG Reservoir		◑					◑					
	Dry Excavation from Cogswell	2.3	◑			◑		○	○		Yes	6	
	Trucks					●		○					
	Cogswell SPS		●			○		○	○	Yes			
2B	Dredge	3.4	◑	◑				○	○		No	9	145
	Slurry Pipeline to SG Reservoir		◑					◑					
	Dry Excavation from Cogswell	2.3	◑			◑		○	○		Yes	3	
	Conveyor Belts		◑					○	○				
	Cogswell SPS		●			○		○	○	Yes			

Legend:

●	significant impact
◑	some impact
○	possible impact
	no impact

Notes:
(a) Use of low-emission trucks would reduce air quality impacts from significant impact (●) to some impact (◑).
(b) All options require environmental regulatory permits.

7.3 SAN GABRIEL RESERVOIR

7.3.1 BACKGROUND

San Gabriel Dam, shown in Figure 7-14, is a compacted earthfill and rockfill embankment with a concrete cutoff wall. The dam was constructed in 1937 by the Flood Control District for flood control, drinking water supply, and water conservation, with power generation uses added later. The original storage capacity at spillway is 86.1 million cubic yards (MCY). With an uncontrolled drainage area 163.5 square miles and a controlled drainage area (from upstream Cogswell Reservoir) of 39.2 square miles, San Gabriel Reservoir has a total drainage area of 203 square miles.

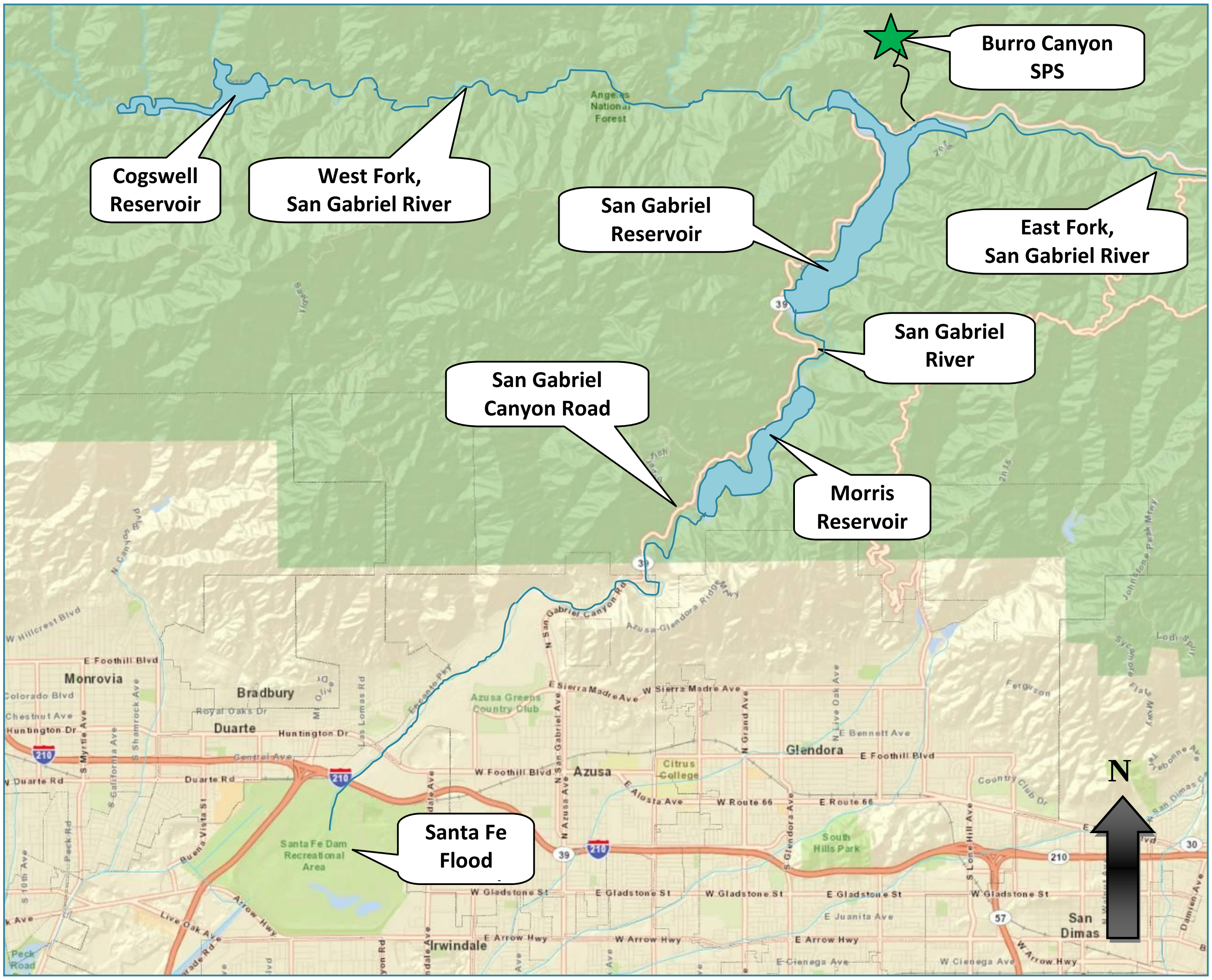
The principal functions of San Gabriel Dam are flood control and water conservation. Water captured behind the dam during the storm season is gradually released into the upper end of Morris Reservoir. The outlet works at San Gabriel Dam also direct reservoir releases to a 5 megawatt power plant owned and operated by the Flood Control District and also into the Azusa Conduit on the lower left abutment. The Azusa Conduit is a pipeline owned by the City of Pasadena that directs flows to Pasadena's power plant in Azusa and to a water distribution system that has its headworks in Azusa.

Figure 7-14 Photo of San Gabriel Dam

7.3.1.1 LOCATION

San Gabriel Reservoir is located in San Gabriel Canyon approximately eight miles north of the City of Azusa. The dam and reservoir are located within Flood Control District-owned right of way. As discussed in Section 7.1, San Gabriel Dam is located between Cogswell Dam and Morris Dam.

Figure 7-15 San Gabriel Reservoir Vicinity Map



7.3.1.2 ACCESS

Access to the reservoir is available via San Gabriel Canyon Road (State Route 39) and Burro Canyon, located off the East Fork Road. State Route 39 and East Fork Road are paved, two-lane roads. East Fork Road is connected to San Gabriel Canyon Road by means of a 2-lane bridge. Access to the downstream maintenance area of the dam is available by means of San Gabriel Canyon Road as well.

From East Fork Road there is a maintenance road that runs to Burro Canyon SPS. Just inside the Burro Canyon entrance is the starting point of a corrugated metal lined access tunnel that goes under the East Fork Road; the access ramp (unpaved) continues down into the reservoir bottom. (See Figure 7-16). A portion of the ramp into the reservoir could need to be reestablished due to the possibility of fluctuating water levels of the reservoir making contact with the ramp.

Access could be established upstream of the dam along San Gabriel Canyon Road. There is currently no specified access point that is capable of accommodating large equipment, so it would be necessary to construct an access ramp. Some adjacent vegetation could be impacted. Further study would be necessary to determine the optimal location for such an access point. Lastly, the access to the maintenance area on the downstream side of the dam is available by existing access roads as seen in Figure 7-17.

Figure 7-16 San Gabriel Reservoir Access Points

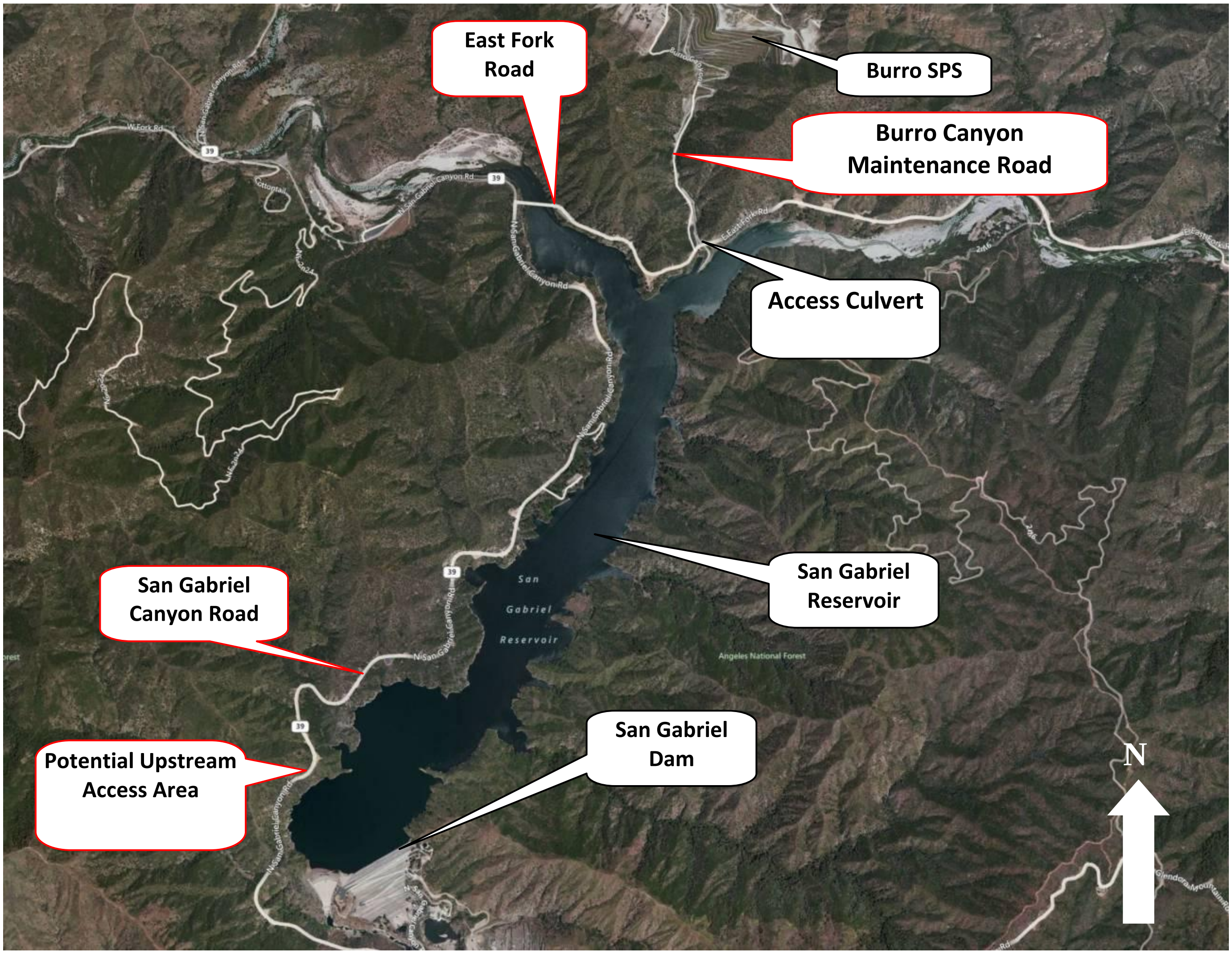
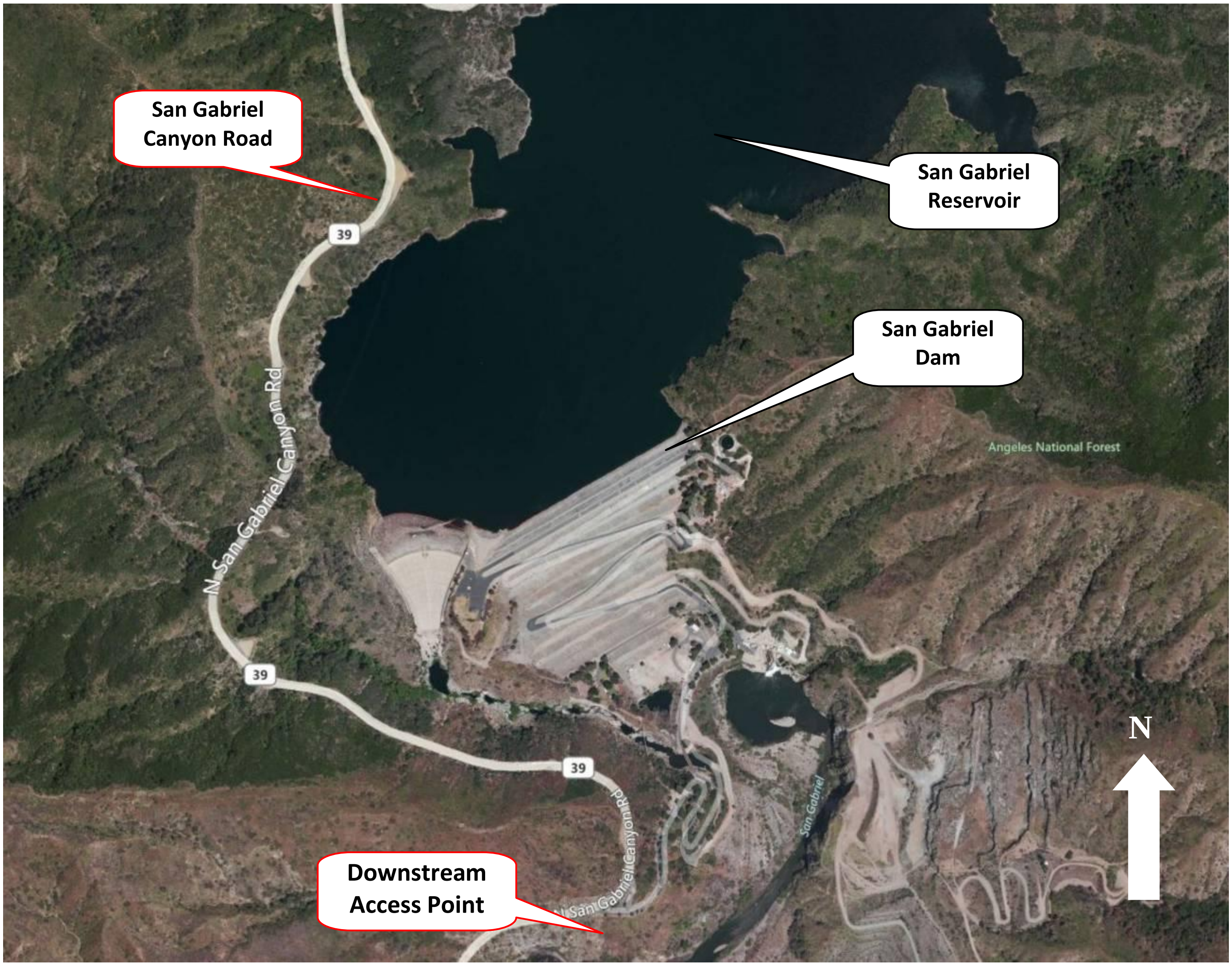


Figure 7-17 San Gabriel Dam and Reservoir Downstream Access Point



7.3.1.3 Dam Outlets

In addition to being equipped with a variety of valves, San Gabriel Dam is also equipped with a sluiceway controlled by 6- by 6-foot sluice gate that feeds into a 7-foot diameter tunnel through the dam.

The outlet works at San Gabriel Dam also direct reservoir releases into the Azusa Conduit on the lower left abutment and to a 4.97 megawatt power plant owned and operated by the Flood Control District. The Azusa Conduit is owned by the City of Pasadena and is used to supply its Azusa power plant and the San Gabriel Valley River Water Committee with a portion of the water to which they have rights.

7.3.1.4 Downstream Flood Control and Water Conservation System Components

Flood control releases flow directly into the upstream end of Morris Reservoir. Further discussion can be found in Section 7.4.

7.3.1.5 Sediment Accumulation and Removal History

The San Gabriel Mountains are highly erosive. The watershed of San Gabriel Reservoir is contained in one of the greatest sediment-producing areas in the San Gabriel Mountains. Due to the naturally erosive nature of the watershed and the continued potential for fires, it is not feasible to significantly reduce its sediment-producing potential. Figure 7-18 shows the approximate sediment storage in San Gabriel Reservoir since the reservoir's first debris season in 1937.

It is the Flood Control District's practice to retain enough storage capacity within reservoirs used for flood control for two incoming design debris events (DDEs), which are calculated and determined for each specific reservoir. However, per the LACDA study discussed in Section 7.1, the San Gabriel Canyon needs to provide a total of 50,000 AF, or 80 MCY, of combined flood control storage. As the Flood Control District utilizes Cogswell Reservoir and San Gabriel to meet this storage requirement, the combined volume of sediment in storage at these two facilities must not exceed 23.5 MCY.

As of December 2006, the remaining capacity at San Gabriel Reservoir was 71.7 MCY, reflecting the sediment accumulation in and removal from the reservoir since the dam's construction. Sediment removal at San Gabriel to date has been achieved with both sluicing and dry excavation. Approximately 36 MCY have been removed since 1937. A summary of the historical sediment removal projects can be found in Table 7-8.

Figure 7-18 Graph of Historical Sediment Storage at San Gabriel Reservoir

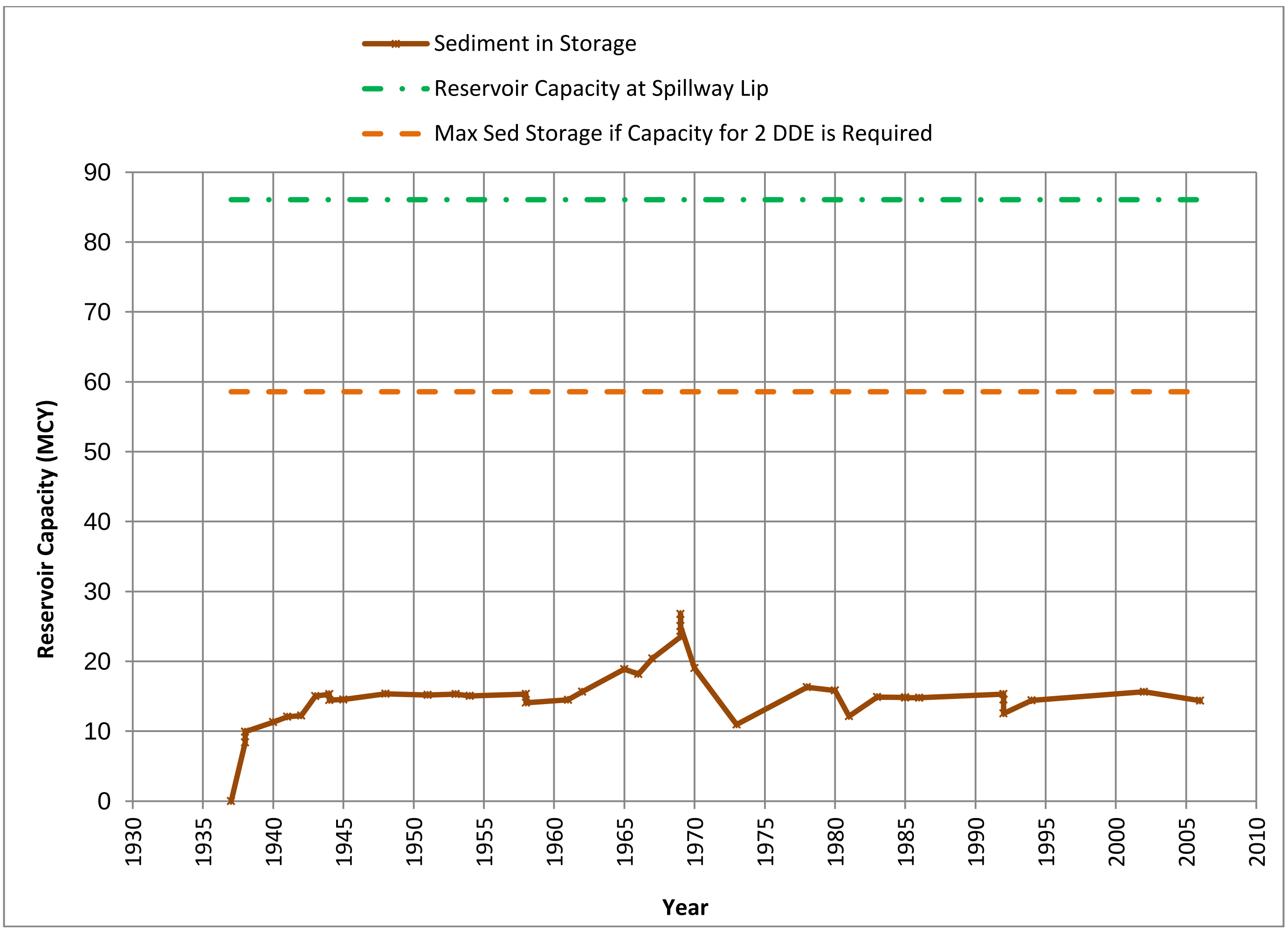


Table 7-8 San Gabriel Reservoir Historical Sediment Accumulation and Removal

Survey Date		Reservoir Capacity (MCY)	Quantity Sluiced (MCY)	Quantity Excavated (MCY)	Sediment Accumulation Between Surveys (MCY)	Sediment in Storage (MCY)
October	1937[a]	86.06	-	-	-	-
April	1938	77.67	-	-	8.39	8.39
October	1938	76.13	-	-	1.53	9.93
November	1940	74.75	-	-	1.38	11.31
September	1941	73.99	-	-	0.76	12.07
October	1942	73.82	0.28	-	0.45	12.24
September	1943	71.04	0.46	-	3.25	15.02
July	1944	70.76	-	-	0.28	15.30
October	1944	71.61	0.92	-	0.06	14.45
November	1945	71.54	0.17	-	0.24	14.52
November	1948	70.70	0.27	-	1.10	15.36
November	1951	70.87	0.34	-	0.18	15.19
January	1953	70.75	0.32	-	0.44	15.31
May	1954	71.01	0.46	-	0.20	15.05
July	1958	70.74	-	-	0.27	15.32
August	1958	71.98	1.27	-	0.04	14.08
September	1961	71.58	-	-	0.40	14.48
November	1962	70.41	-	-	1.17	15.65
December	1965	67.18	-	-	3.23	18.88
April	1966	67.88	2.46	-	1.76	18.18
August	1967	65.66	-	-	2.22	20.40
February	1969	62.56	-	1.26	4.35	23.50
May	1969	59.29	-	-	3.27	26.77
October	1969	61.02	0.14	1.59	-	25.04
October	1970	67.03	2.62	3.40	-	19.03
October	1973	75.11	-	8.07[b]	0.86	10.95
March	1978	69.76	-	-	5.35	16.30
March	1980	70.23	-	2.21	1.74	15.83
February	1981	73.91	-	3.68	-	12.15
April	1983	71.18	-	-	2.73	14.89
January	1985	71.22	0.05	-	-	14.84
August	1985	71.25	0.03	-	-	14.81
September	1986	71.28	0.03	-	-	14.78
March	1992	70.74	-	-	0.54	15.32
August	1992	71.53[c]	-	-	-	14.53
December	1992	73.52	1.98	-	-	12.54
December	1994	71.65	-	-	1.86	14.41
November	2002	70.43	-	-	1.22	15.63
December	2006	71.69	-	4.07[d]	2.80	14.37

Notes:

a. First debris season was assumed to be 1937-38.

b. Approximately 536 AF of sediment entered the reservoir during the cleanout. The contractor removed the 536 AF, but the pre-cleanout and post cleanout surveys did not reflect this amount.

c. No sediment removal occurred between the March 1992 and August 1992 survey dates. To offset this error in sedimentation volumes the comparisons were split. Sediment accumulation was based on the difference b/w the September 1986 and March 1992 surveys. Sluicing volume was based on the difference between the August 1992 and December 1992 surveys.

d. Approximately 6.1 million tons of sediment was removed by a contractor during the 3-yr cleanout project (Summer 2004 to Fall 2006). Using a factor of 1.5tons/CY, the approximate volume is 4.07 MCY.

Past Sluicing Projects

The first sluicing event at San Gabriel Dam was conducted in 1942. From 1942 to 2006, 11.4 MCY of sediment were sluiced to Morris Reservoir immediately downstream. While detailed impacts are not available for other events, the 1992 sluicing event resulted in sediment accumulation in the riparian habitat immediately downstream of the sluice tunnel called Brown's Gulch. Flows from major storms that occurred afterward in 1993, 1995, and 1998 scoured out this sediment, along with the riparian vegetation. These events demonstrated that habitat conditions in Browns Gulch are dynamic.

Past Excavation Projects

Approximately 24.3 MCY of sediment has been excavated from San Gabriel Reservoir. Burro Canyon SPS, located north of the San Gabriel Reservoir, was used to dispose at least 14.5 MCY of the excavated sediment.

7.3.1.6 SPECIAL CONDITIONS

San Gabriel Dam discharges directly into Morris Reservoir. Therefore, operations take into account conditions at Morris Dam to minimize water conservation losses. Additionally, the San Gabriel River Water Committee has a water right to the normal flow of the river up to 135 cfs. The Committee takes its water from both the Azusa Conduit and an intake at the mouth of the canyon downstream of Morris Reservoir. The Azusa Conduit has intakes at San Gabriel Dam and at Morris Dam. The intake at San Gabriel Dam allows its use under most reservoir pool levels, except when the reservoir pool is extremely low or the reservoir is completely drained. The intake at Morris Dam could only be used when the pool in Morris Reservoir is extremely high. The water treatment facilities for the San Gabriel River Water Committee have regulatory restrictions that prohibit intake of water with elevated levels of turbidity.

The U.S. Forest Service operates an Off-Highway Vehicle (OHV) recreation area in San Gabriel Reservoir. The OHV Staging Area is located at the reservoir's uppermost reach in the West Fork. OHV activities in the reservoir occur primarily at the confluence of the West and East Forks, although the Forest Service allows OHV activities could go down further in the reservoir when reservoir pool levels expose more area.

7.3.2 PLANNING QUANTITIES & APPROACH

As described in Section 5.3, the 20-year projected sediment inflow to San Gabriel Reservoir is 20.4 MCY. For planning purposes, it is assumed that in addition to that quantity 3.4 MCY of sediment would be sluiced or slurried from Cogswell Reservoir to San Gabriel Reservoir. As a result, the 20-year planning quantity for San Gabriel Reservoir is 23.8 MCY.

7.3.3 POTENTIAL STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

No outside staging or stockpile areas are needed for the alternatives being considered for San Gabriel Reservoir.

7.3.4 REMOVAL

The following section discusses the impacts and costs of sediment removal at San Gabriel Reservoir by means of dry excavation, dredging, and sluicing. Discussion of the transportation and placement alternatives is presented in Sections 7.3.5 and 7.3.6, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 7.3.7.

7.3.4.1 DRY EXCAVATION

Excavation has been conducted at San Gabriel Reservoir in the past. Under regular operating conditions, San Gabriel Reservoir is never completely dry, even outside of the storm season. Therefore, the reservoir must be drained in order to excavate and remove sediment near the dam.

Access is available from a maintenance road and ramp to Burro Canyon. From this maintenance road, access into the reservoir is achieved through a corrugated metal-lined tunnel that crosses under East Fork Road into the reservoir. This location would be optimal for sediment that would be excavated and brought to Burro Canyon SPS.

For sediment that is proposed to go elsewhere downstream, it could be necessary to establish new access roads into the reservoir further downstream. Further study would be needed to determine an optimal location for access that would minimize impact to habitat surrounding the reservoir.

Dry Excavation - Environmental Impacts

An environmental concern with dry excavation is the impact on the aquatic habitat within San Gabriel Reservoir. Fish rescues have been conducted as an element of past projects.

Based on previous fish removal activities, the species in the pool consist almost entirely of non-native species such as largemouth bass, catfish, crappie, and bluegill. When complete draining of the reservoir is necessary, these fish are removed and disposed of in a manner specified by the California Department of Fish and Game. Fish from upstream in the East and West Forks of the San Gabriel River could migrate into the flow path in the exposed reservoir bottom areas and thus enter project activity areas. To prevent harm to these fish, especially the threatened Santa Ana sucker, blocking nets are set up in the flow path; native fish in the flow path below these nets are captured and relocated upstream of the nets; the nets prevent their re-entry into the project area. Any invasive fish caught below the nets removed and disposed of in a manner specified by the California Department of Fish and Game. The impacts on fisheries in San Gabriel Reservoir are not expected to be significant after mitigation measures are applied. Further study would be needed to determine any additional species that could be impacted.

Depending on vegetation present at the access points there could be some additional environmental impacts. San Gabriel Canyon Road is very close to the reservoir, so minimal, if any, impact is expected. The environment along the reservoir would be taken into consideration when choosing the precise access point.

While some losses are expected, most of the water released while draining the reservoir would likely be captured in downstream facilities resulting in minimal impact to water conservation.

As discussed earlier, there would also be an impact to air quality as a result of the equipment necessary for excavation. However, it should be noted that the U.S. Forest Service operates an Off-Highway Vehicle (OHV) area in San Gabriel Reservoir, so activities within which would also produce emissions

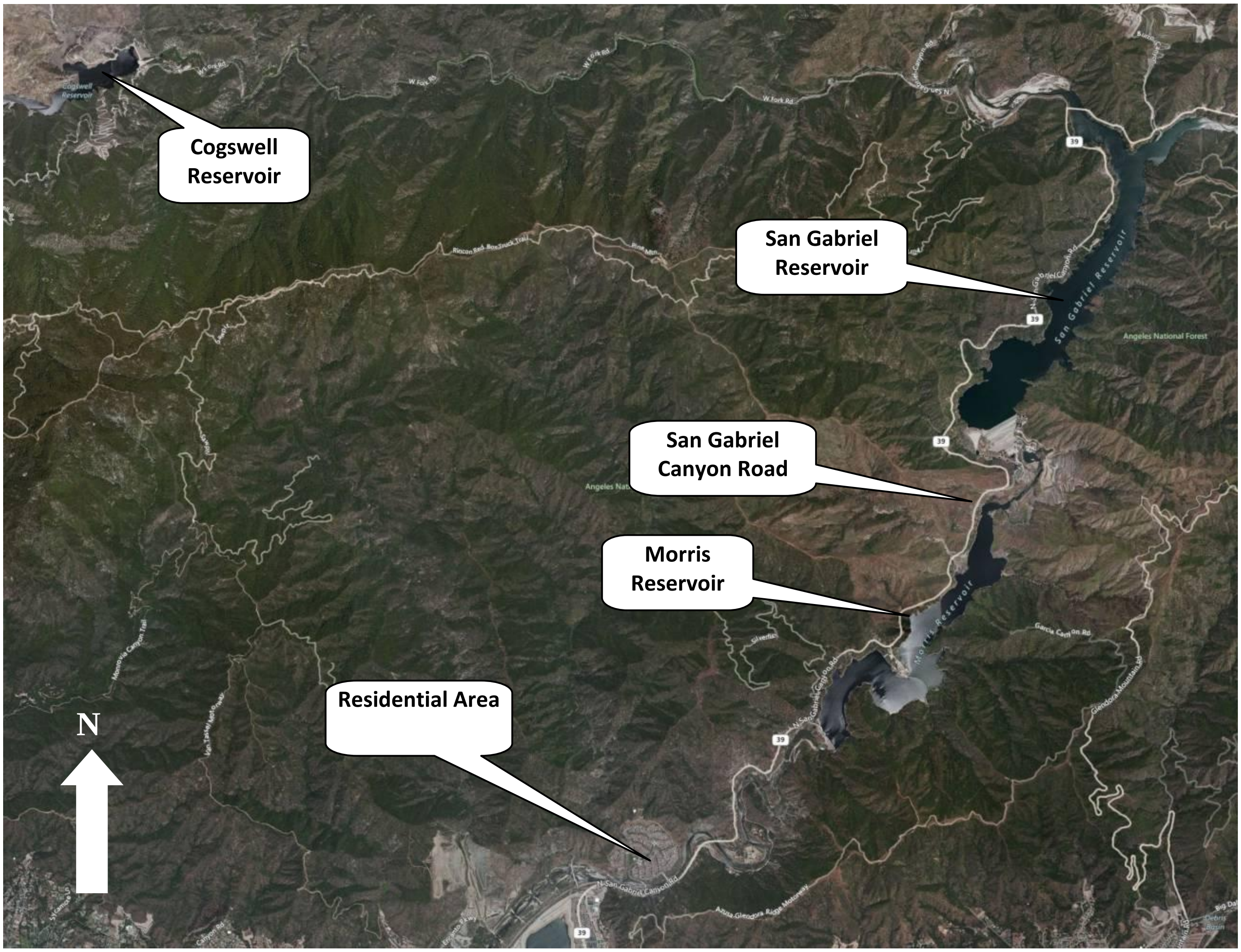
In past reservoir cleanouts, the most recent of which was in 2004-06, environmental regulators required monitoring of the condition of biological resources and water quality before, during and for several years after the completion of the project. Such requirements are thus likely for future projects.

Dry Excavation - Social Impacts

Dry excavation would occur within the reservoir itself. For the excavation portion alone, there would be no increase in traffic in the surrounding area.

The nearest residential area to San Gabriel is 5 miles downstream, as shown in Figure 7-19. San Gabriel Canyon Road is frequented by members of the public travelling to recreational areas further upstream. The noise from excavation equipment is not expected to impact the downstream residential area.

Figure 7-19 Residential Area near Morris Reservoir



San Gabriel Reservoir is not in the viewshed of any houses or buildings. However, the reservoir is located alongside San Gabriel Canyon Road, which is frequented by recreational users, most of whom are on their way to recreational areas in San Gabriel Canyon that are out of the reservoir's viewshed. The scenic and visual impacts of dry excavation on recreational users would be minimal and the operation would be temporary.

The Forest Service permits off-highway vehicle (OHV) operation in an area at the confluence of the West Fork and San Gabriel Reservoir called the San Gabriel Canyon OHV Area. Access to water within the reservoir is prohibited, but removal of sediment from this area could impact recreation in the OHV Area. Shoreline fishing is allowed at the back edge of the reservoir pool. Sediment removal operations would impact this activity. Sediment removal operations would make the reservoir pool inaccessible to recreational users, either by lowering it to be well within the excavation work area, or completely draining it.

Dry Excavation - Implementability

Since sediment has been removed via dry excavation at San Gabriel Reservoir in the past, there is technical certainty that dry excavation could be successfully implemented.

There are no right of way concerns related to excavating sediment from San Gabriel Reservoir since the Flood Control District has full rights for the maintenance and operation of the San Gabriel Dam and Reservoir. However, a dry excavation operation would require environmental regulatory permits.

Dry Excavation - Performance

In order to dry excavate the San Gabriel Reservoir, the reservoir must first be dewatered. As discussed in Section 6.3.1, dry excavation could only be conducted over the summer months. Therefore, dewatering would begin no earlier than mid-April, after the conclusion of the storm season. The reservoir level would remain low or be completely drained until the next storm season starts in mid-October. Additionally, flows coming into the reservoir have to significantly decrease before the necessary fish blocking nets could be installed, which further reduces the period available to excavate. It could be possible for work to continue into the storm season until rain is forecasted. During the cleanout project conducted in 2004-06, excavation had to wait as late as August and had to end as early as mid-October (due to forecasted rains).

It is expected that the excavation equipment would be able to match the rate of removal by any mode of transportation being considered. However, the restrictions imposed by the fish protection requirements significantly impact the performance effectiveness of dry excavation to the point that this alternative might not be able to completely remove San Gabriel Reservoir's 23.8-MCY planning quantity.

Dry Excavation - Cost

As discussed previously, the estimated unit cost to excavate material under dry conditions from a facility such as San Gabriel Reservoir is $3 per cubic yard. Excavating 23.8 MCY of sediment would cost approximately $69 million.

7.3.4.2 <u>DREDGING</u>

As discussed in Section 6, dredging has not been used to remove sediment from the reservoirs under the Flood Control District's jurisdiction. In order to accurately determine the technical feasibility of a dredging operation at Cogswell Reservoir, detailed analysis would need to be conducted.

The following analysis is based on the assumptions detailed in Section 6 and the assumption that approximately 2 MCY of San Gabriel Reservoir's 23.8 MCY planning quantity would be dredged. As discussed previously, the remaining 21.8 MCY of larger-sized sediment would have to be dry excavated.

Dredging - Environmental Impacts

It is expected that there would be an impact to water quality by increasing turbidity during dredging. Further study is necessary to determine the level of impact to other areas of concern.

Groundwater recharge would not be impacted as the decanted water would be captured downstream at Morris Reservoir and/or groundwater recharge facilities.

The fish previously found in San Gabriel Reservoir consist of largemouth bass, catfish, crappie and bluegill, all of which are non-native invasive species that environmental regulators would like to see removed. Therefore, impacts from dredging to their spawning areas or habitat are not anticipated to be considered a significant adverse impact. Further study would be needed to determine any additional species that could be impacted.

Additional studies would also be needed in order to identify the potential impacts dredging would have on vegetation and fauna.

The slurry would be sent directly into Morris Reservoir and possibly result elevated turbidity in the reservoir, which could impact the water supply operations of the San Gabriel River Water Committee if the Committee is unable to take its water from the Azusa Conduit intake at San Gabriel Dam.

Dredging - Social Impacts

The nearest residential area to San Gabriel is 5 miles downstream. San Gabriel Canyon Road is frequented by members of the public, most of who are travelling to recreational areas further upstream. The noise of the dredge is not expected to be a disturbance nor would it impact traffic.

OHV activities within the reservoir would potentially be impacted when reservoir pool levels are high. Shoreline fishing activities would potentially be impacted when reservoir pool levels are so low that the exposed, relatively soft reservoir bottom renders safe access to the reservoir pool edge infeasible. This soft bottom condition would also render safe conditions for OHV activities infeasible; however, the effect is not a reduction in available area for OHV activities, merely no increase in available area.

San Gabriel Reservoir is not in the viewshed of any houses or buildings. However, the reservoir is located alongside San Gabriel Canyon Road, which is frequented by recreational users, most of who are travelling to other recreational areas in San Gabriel Canyon that are out of the reservoir's viewshed. The scenic and visual impacts of dredging operations on recreational users would be minimal and temporary.

Dredging - Implementability

No additional right of way is required for implementation of a dredging operation within San Gabriel Reservoir. As discussed in Section 6, dredging sediment (and transporting it via a slurry pipeline) could affect water conservation.

From past studies completed for the Flood Control District including consultation with dredging professionals, it has been determined that portable cutterhead suction dredges are available in a size suitable for use at the Flood Control District's reservoirs. As the dredge could reach a maximum depth of 50 feet, the reservoir water level would need to be lowered. From there, the material could be dredged to a slurry pipeline either through or over the dam.

Similar to other sediment management activities, dredging would require environmental regulatory permits.

Dredging - Performance

San Gabriel Reservoir's entire 23.8-MCY planning quantity cannot be handled by dredging alone. For planning purposes, it is assumed that only 2 MCY would be dredged, since the ability to remove the sediment from Morris Dam would be very limited. Management alternative for Morris Reservoir are discussed in Section 7.4.

Considering the capabilities of the dredging equipment and slurry pipeline discussed in Section 6, it would take approximately seven (7) dredging operations to dredge 2 MCY of sediment from San Gabriel Reservoir.

Dredging - Cost

Based on the estimated unit cost for dredging, dredging 2 MCY of sediment would cost approximately $21 million.

7.3.4.3 SLUICING (AS A REMOVAL METHOD)

This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within San Gabriel Reservoir only. For impacts of sluicing downstream of the dam refer to Section 7.2.6.1.

Sluicing (Removal) - Environmental Impacts

Within San Gabriel Reservoir itself, the impacts on vegetation and animal species would be expected to be similar to the impacts associated with dry excavating sediment from the reservoir, since in both cases the reservoir would need to be drained. For a discussion of the expected impacts, refer to Section 7.2.5.1.

Largemouth bass, catfish, crappie, and bluegill have been previously found in San Gabriel Reservoir. These fish are non-native invasive species. As with dry excavation, these fish would need to be removed and disposed of as specified by the California Department of Fish and Game. Blocking nets would need to be installed upstream of the work area to protect native and non-invasive fish, and such fish found downstream of the nets captured and relocated upstream of the nets. Further study would be needed to determine any additional species that could be impacted.

If mechanical agitation of material is to be conducted there would be an air quality impact from equipment emissions. However, given the Flood Control District's previous sluicing projects, only a few pieces of equipment would be necessary within the reservoir, so air quality impacts in the reservoir are not expected to be significant, especially considering that an Off-Highway Vehicle Area is already operating in the reservoir.

Impacts to water quality for the stream course within the reservoir are unavoidable when sluicing. Water deliveries to the Azusa Conduit would have to occur at the intake at Morris Dam. There would be minimal impacts to groundwater recharge because the water used for the sluicing operation would be captured behind Morris Dam and (when decanted by Morris Dam) at groundwater recharge facilities downstream.

The elevated turbidity in Morris Reservoir, though minimal in regards to groundwater recharge operations, could impact the water supply operations of the San Gabriel River Water Committee, as its treatment plants have stringent regulatory restrictions on the turbidity of the water the facilities could take in. State water quality regulators oppose treating the sluice water coming out of San Gabriel Dam or treating the water in Morris Reservoir. Therefore, the Flood Control District entered into agreements with the Committee to coordinate reservoir and groundwater recharge operations with the Committee's member entities to reduce impacts to them.

The Flood Control District also entered into an agreement with the City of Azusa (a Committee member entity) to partially fund the City's construction of additional wells and pipelines in the lower San Gabriel Canyon. These additional facilities were designed and constructed to work in unison with groundwater recharge operations to provide supplementary water to Committee member entities for direct use or blending with turbid water during periods when sluicing activities at San Gabriel Reservoir elevate turbidity levels in Morris Reservoir. With the use of these additional facilities, water quality impacts from sluicing on the San Gabriel River Water Committee are anticipated to be minimized.

Sluicing (Removal) - Social Impacts

San Gabriel Reservoir is not in the viewshed of any houses or buildings. However, the reservoir is located along San Gabriel Canyon Road, which is frequented by recreation users. The scenic and visual impacts of dredging operations on recreational users would be minimal and temporary.

The Forest Service permits off-highway vehicle (OHV) operation in an area at the confluence of the West Fork and San Gabriel Reservoir called the San Gabriel Canyon OHV Area. Access to water within the reservoir is prohibited, but removal of sediment from the reservoir could impact this form of recreation by restricting OHV access to areas being worked.

Shoreline fishing is allowed at the back edge of the pool in San Gabriel Reservoir. Sluicing would impact this activity.

Sluicing (Removal) - Implementability

Given that sluicing projects have been conducted at San Gabriel Reservoir in the past, it is technically certain that sluicing could be used to remove sediment from San Gabriel Reservoir. Though proven, the alternative still necessitates water availability. For planning purposes, a water-to-sediment ratio of 9-to-1 is being used. Being downstream of Cogswell Reservoir there could be water released to assist with sluicing, but the amount available is limited by the West Fork Management Plan's instream flow foals for fisheries in the West Fork. It is expected that most of the water for sluicing at San Gabriel would be from recession flows.

As stated above for dry excavation, implementation of the fish blocking nets has to wait until flows coming into the reservoir are low enough to allow for net installation and the nets to block fish without impinging them against the nets. Waiting for the proper flow conditions could delay sediment removal operations well into the summer, significantly reducing the window for sediment removal operations and the flow with which to implement sluicing.

Environmental regulatory permits would be needed prior to any sluicing events.

Sluicing (Removal) - Performance

The entire planning quantity cannot be handled by sluicing alone. For planning purposes, it is assumed that 2 MCY would be sluiced, limited by the ability to remove the sediment from Morris Dam.

In order to sluice San Gabriel Reservoir, the reservoir must first be completely dewatered. Material sluiced from San Gabriel would go directly into Morris Reservoir.

Sluicing (Removal) - Cost

Based on the estimated unit cost for sluicing, the cost of sluicing 2 MCY is approximately $5 million, not including the cost of mitigation measured to be taken within the reservoir and payments to the City of Azusa to provide supplemental water to the San Gabriel Canyon River Water Committee member entities.

7.3.5 TRANSPORTATION

The following section discusses the impacts and costs of transporting sediment removed from San Gabriel Reservoir by means of sluicing, trucking, and conveyor belt. Discussion of the removal alternatives was presented in Section 7.3.4. The placement alternatives are presented in 7.3.6. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 7.3.7.

7.3.5.1 SLUICING (AS A TRANSPORTATION METHOD)

The following section explains the impacts of sluicing after sediment has passed through the dam.

Sluicing - Environmental Impacts

As seen in Figure 7-20, the sluice tunnel from San Gabriel Reservoir empties into Brown's Gulch. Brown's Gulch is the lowest 0.5-mile reach of Browns Canyon. The area of the watercourse is approximately 3 acres. Its confluence with the San Gabriel River is located downstream of the plunge pool that is at the base of the dam. Brown's Gulch is known to have fish, amphibian, insects, reptiles, and many birds and mammals. A study would need to be conducted to determine the current state of this area and other habitat that could be impacted.

It should be noted that flows from major storms could be expected to scour out and thus remove habitat from Brown's Gulch. Future sluicing would be expected to impact habitat only when the watercourse has not been recently scoured out. It could be possible under such conditions to construct an earthen sluice channel from the San Gabriel Reservoir sluice gates to the upstream end of Morris Reservoir. This channel would prevent the sluice flows from excessively scouring the riparian habitat and otherwise damaging existing habitat. Approximately 0.8 acres of riparian habitat would be impacted by the sluice channel compared to the impact on the full 3 acres during sluicing without the channel. This loss of habitat is still considered a potential adverse impact; however, the potential impact could be less significant after application of other mitigation measures, such as removal and relocation of native fish, amphibians and reptiles.

Once sluice flows reach the confluence below the plunge pool impacts to habitat should be greatly diminished. From here the sluiced material would continue directly into Morris Reservoir but increased turbidity in Morris Reservoir from the addition of sluiced material could still cause impacts in regards to water quality, as described previously.

Also discussed previously, there would be minimal impacts to groundwater recharge because the water used for the sluicing operation would be captured behind Morris Dam and (when decanted by Morris Dam) at groundwater recharge facilities downstream.

Figure 7-20 San Gabriel Dam Sluicing Schematic

Sluicing - Social Impacts

No social impacts (e.g., traffic, recreation, aesthetics) are expected as a result of sluicing material from San Gabriel Reservoir to Morris Reservoir.

Sluicing – Implementability

Sluicing has been conducted from San Gabriel Reservoir in the past, so it is known to be technically feasible. The ability to sluice sediment is dependent on the inflows to San Gabriel Reservoir which could be supplemented by releases from Cogswell Reservoir, provided those releases do not impact the West Fork Management Plan's instream flow goals for fisheries in the West Fork. Based on the assumption stated in Section 6 and previous experiences at San Gabriel Reservoir, it was estimated that between 300,000 to 500,000 CY of sediment could possibly be sluiced from San Gabriel Reservoir during one sluicing operation.

As discussed, environmental regulatory permits would be needed prior to any sluicing events.

Sluicing – Performance

Given the assumptions discussed in Section 6 and historic events, it was estimated that if sluicing was to be conducted at San Gabriel Reservoir, approximately 400,000 CY of sediment could be sluiced from San Gabriel

Reservoir to Morris Reservoir in a year. It is also assumed that adequate water supply is available to sluice and that material within San Gabriel Reservoir would be mechanically agitated to move sediment downstream.

At this rate, sediment would have be to sluiced from San Gabriel Reservoir to Morris Reservoir during 9 years of the 20-year planning period in order to sluice a total of 2 MCY of sediment.

Sluicing – Cost

As discussed previously, sluicing 2 MCY would cost approximately $5 million, not including the cost of mitigation measures taken within the reservoir, payments to the City of Azusa to provide supplemental water to the San Gabriel River Water Committee member entities, and mitigation measures taken within Brown's Gulch.

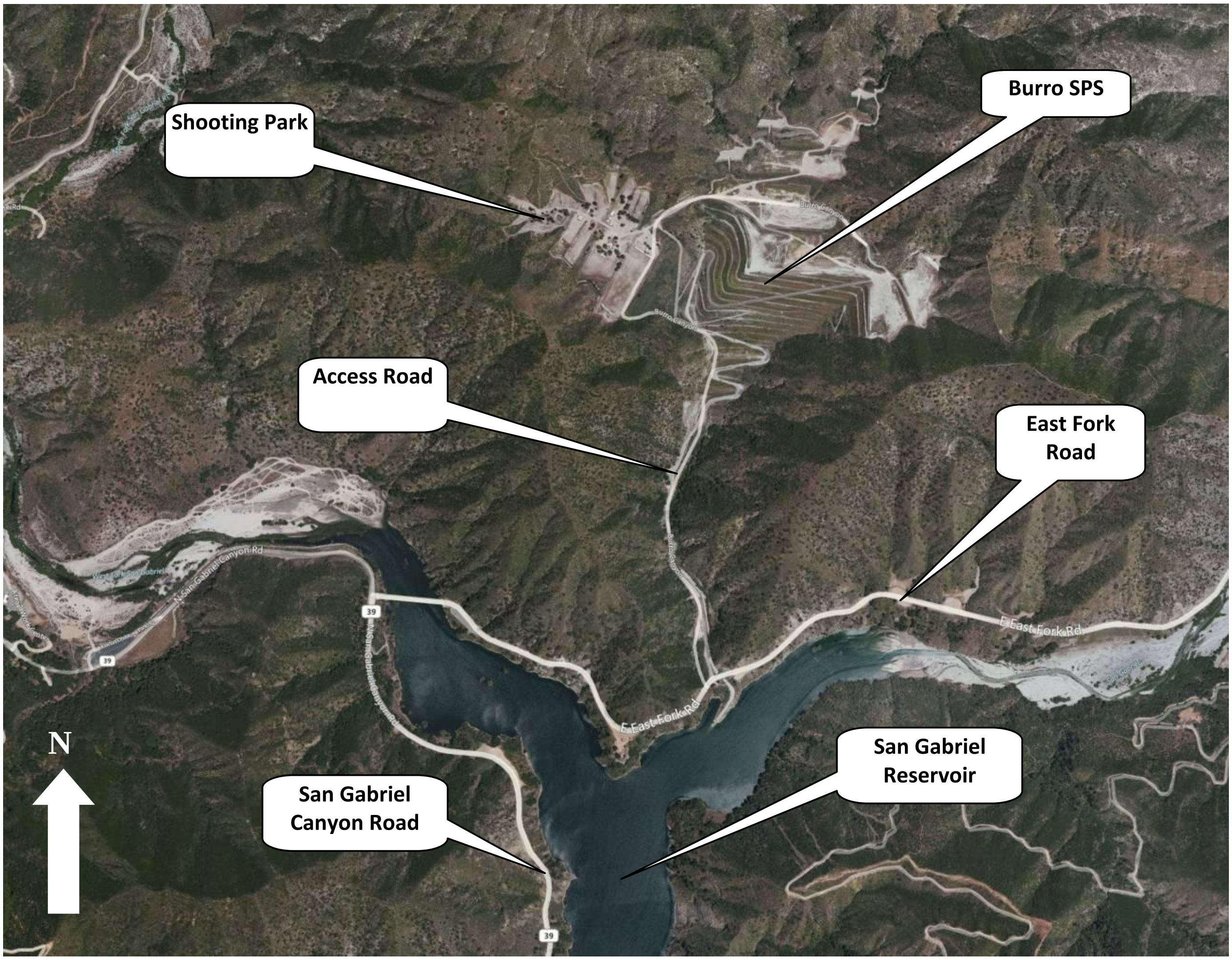
7.3.5.2 TRUCKING

If trucking is to be used for sediment removal from San Gabriel Reservoir, trucks would be used in conjunction with dry excavation. The material would be loaded directly on to the truck and driven to its final placement location. Two locations are being considered for this analysis; Burro Canyon SPS and the Irwindale Pits. Depending on the final placement location, different access points into the reservoir could be used.

Trucking - Access and Route for Trucking

Access for trucks into San Gabriel Reservoir could be made through the access points described previously. If trucks are driving to Burro Canyon SPS, the access point on the East Fork would be utilized. Burro Canyon SPS is approximately 1.5 miles from the East Fork access point to the top of Burro Canyon SPS as seen in Figure 7-21.

Figure 7-21 Trucking Access to Burro Canyon SPS



If sediment is to be trucked to the Irwindale Pits, constructing an access point along San Gabriel Canyon Road closer to the dam would be recommended. For this analysis it is assumed an access point would be established approximately 0.5 mile upstream of San Gabriel Dam. Trucks would then travel south along San Gabriel Canyon Road. In an effort to avoid the impact to the communities downstream, it is proposed to use an access road for the San Gabriel Canyon Spreading Ground as well as the access road to a conveyor belt owned by Vulcan Materials Company to travel down to Foothill Boulevard, away from the residential areas. Access into the spreading ground is available through the entrance to the parking lot for the bike trail at the north end of the spreading grounds, as seen in Figure 7-22. These access roads are parallel to the Gabriel Bike Trail.

Figure 7-22 San Gabriel Trucking Route to Irwindale

Trucking - Environmental Impacts

The trucks used for sediment removal would utilize San Gabriel Canyon Road, East Fork Road, and an existing maintenance road. There would be no impact to habitat from the trucking aspect of the removal as both of the roads are established. There could be some impact to habitat where new access points need to be established. Further study would be needed to make this determination.

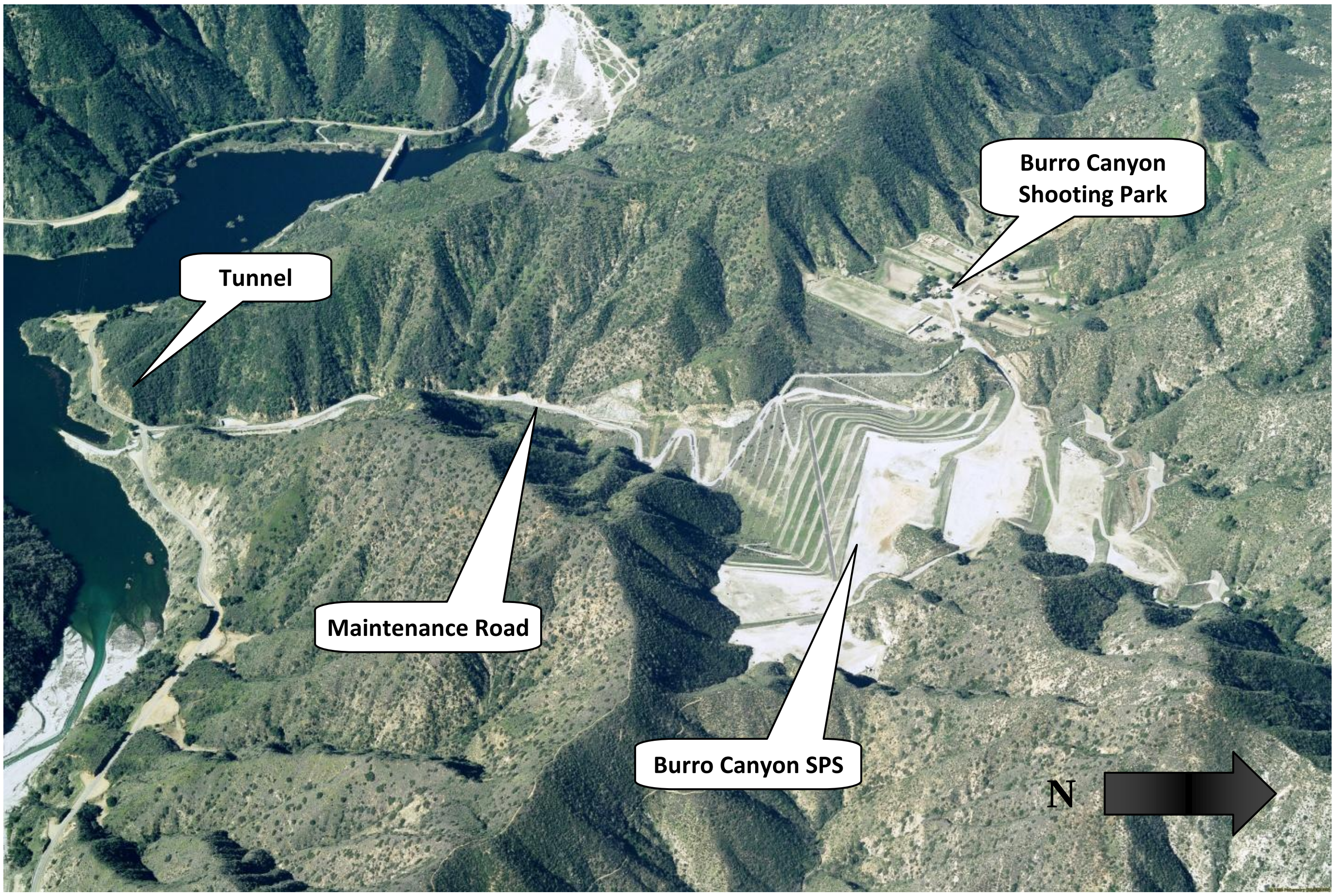
As discussed previously, trucking would impact air quality. The use of low emission trucks would result in lower air quality impacts than if standard trucks were used.

Trucking - Social Impacts

To Burro Canyon SPS

The maintenance route to Burro Canyon SPS is also the access route to the Burro Canyon Shooting Park which is adjacent to the SPS as seen in Figure 7-23. There would be an increase to traffic, noise, and scenic impacts to the recreational users of the shooting park.

Figure 7-23 Burro Canyon SPS



To Irwindale Pits

Trucks would need to enter San Gabriel Canyon Road, which is frequently used by recreational users on their way to recreational facilities upstream of the reservoir. Traffic controls would need to be utilized to prevent hazards at the trucks' entry/exit from the reservoir. There would be traffic impacts to recreational users during hauling operations.

In using the access route described earlier, trucks would avoid driving through downtown Azusa. However, there are two neighborhoods, as seen in Figure 7-24, along San Gabriel Canyon Road that would be affected by the truck traffic for sediment removal.

The proposed route also intersects an access path to the San Gabriel River Gabriel Bike Trail. If trucking is utilized, access from that path could be temporarily limited for the safety of bike path users. Given that there are several nearby access points to the bike path, this is not expected to be a large problem.

Additionally, there is a Geology Area & Park currently proposed for the area where the bike path meets with Todd Avenue, as seen in Figure 7-25. This project site would need to be taken into consideration if trucking is proposed along this route as the increased truck traffic and noise would affect the facility. This would also remove Todd Avenue from consideration as the route to Foothill Boulevard.

Figure 7-24 Residential Area Impact on San Gabriel Canyon Road

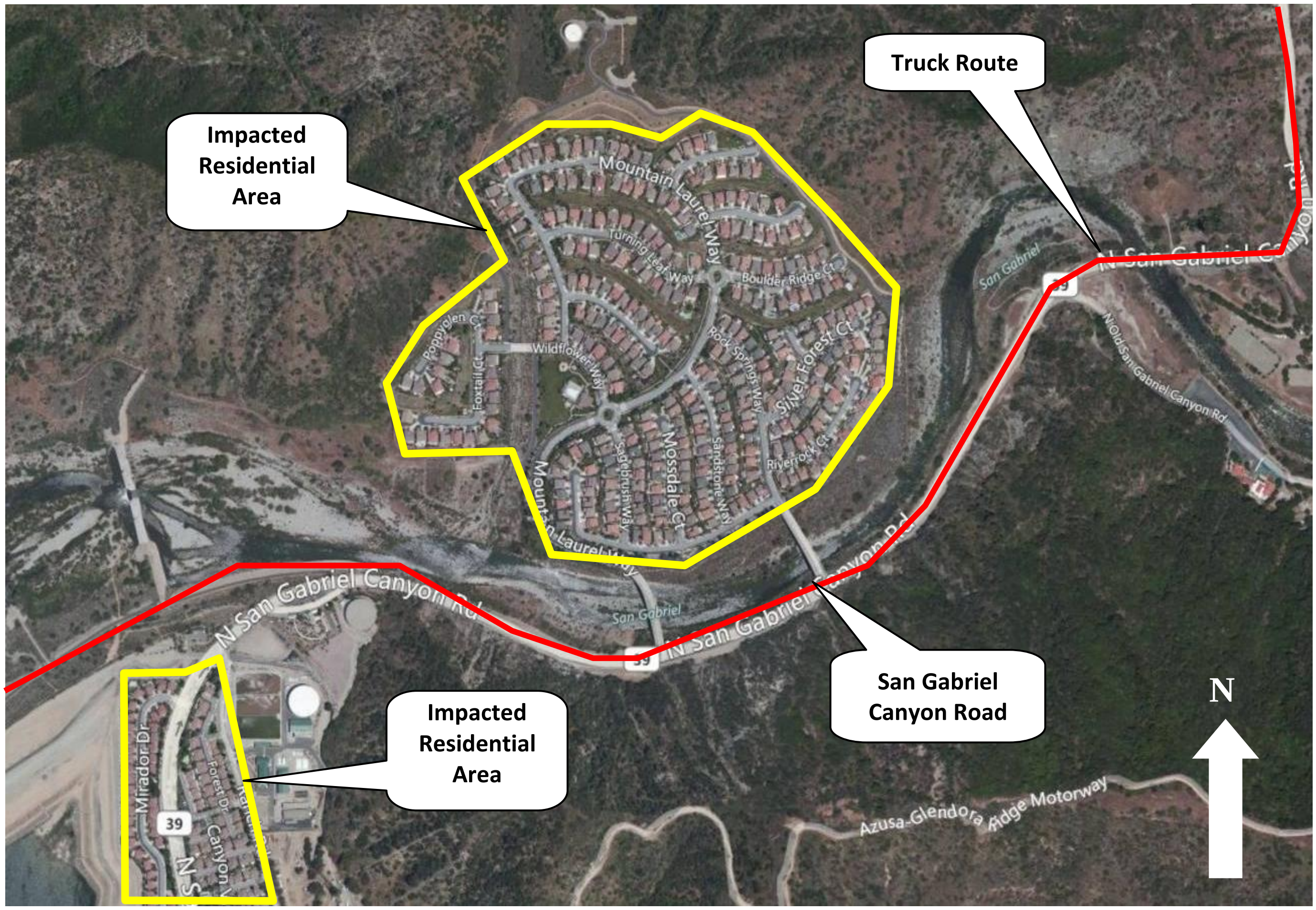
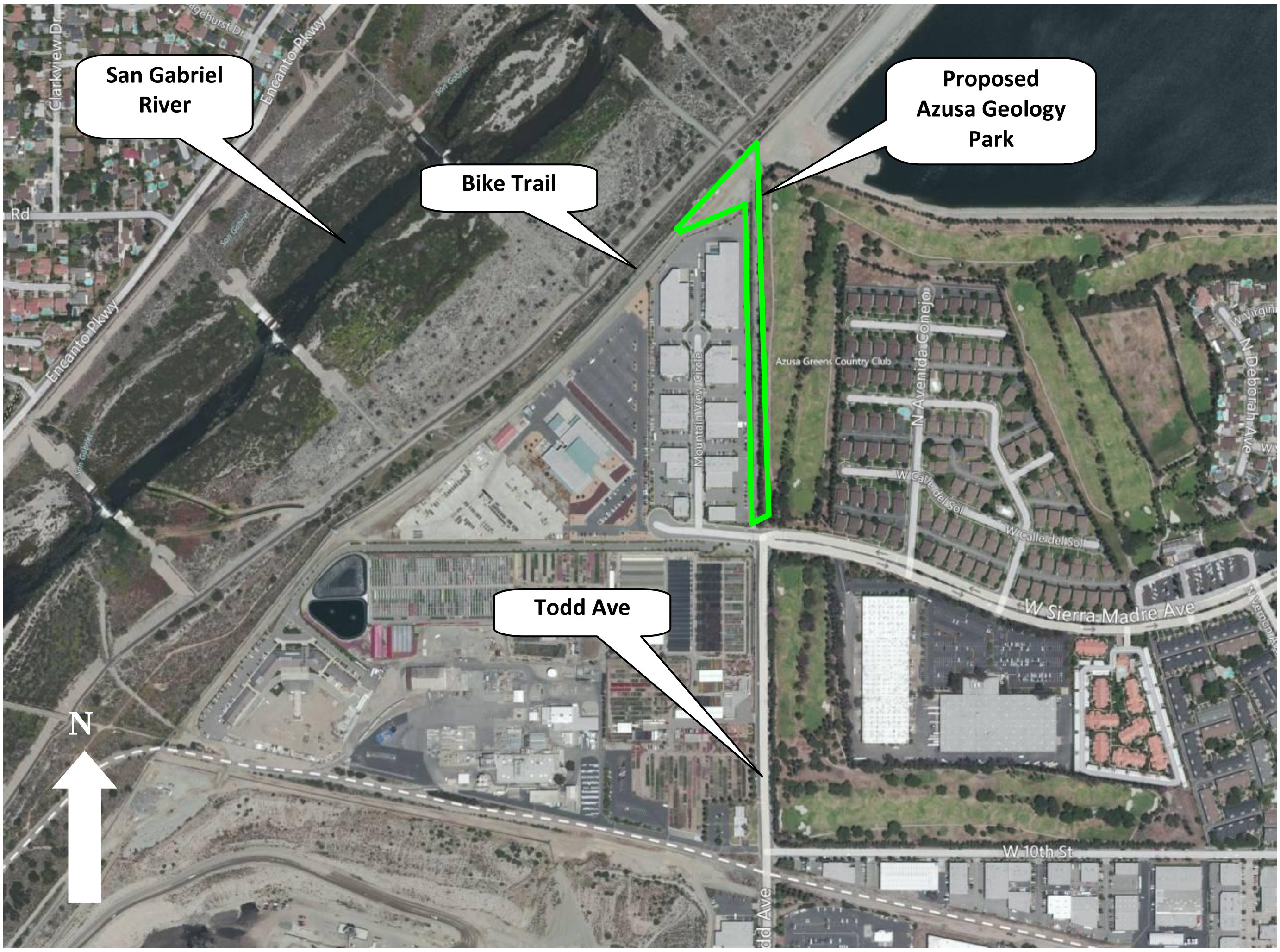


Figure 7-25 Trucking Impact to Proposed Azusa Geology Park and Trail



Trucking - Implementability

At San Gabriel Reservoir access allows for double-dump trucks with a capacity of 16 CY to be utilized. As discussed previously, these trucks are standard for construction projects and should be readily available. Traveling from the East Fork access point to Burro Canyon SPS there could be some complications traveling through the East Fork Road undercrossing. Further investigation would be necessary to determine if any modifications would need to be made.

From the San Gabriel Canyon Road access point headed south no restrictions are expected until diverting to the access road near the bike path. Further investigation is needed to determine if there are any limitations with the use of this proposed route.

Trucking - Performance

Given the following assumptions, it was determined that if dry excavation and trucking were to be implemented for San Gabriel Canyon Reservoir, approximately 400,000 CY could be removed per cleanout. In order to manage the full 23.8 MCY of sediment using trucking alone, both placement sites, Burro Canyon SPS and the Irwindale Pits, would need to be utilized. For planning purposes it is assumed that approximately two thirds of the material or 15.9 MCY of sediment would be taken from the East Fork access point to Burro Canyon SPS and that the remaining one third or 7.9 MCY would be taken to the pits in Irwindale. A smaller quantity of sediment was assumed to be taken to Irwindale, as sediment from Morris Reservoir could be concurrently transported using trucks on the same route. The alternatives for Morris Reservoir are explained in Section 7.4. Additionally, these quantities were established for planning purposes only. Further investigation should be made to optimize transportation of sediment using trucks as specific removal projects are planned.

To Burro Canyon SPS

Approximately 14.9 MCY of sediment would be brought to Burro SPS. This is a 5-mile roundtrip from San Gabriel Reservoir. Assuming double-dump trucks are used, there would be a total of approximately 400 trips per day, totaling 6,400 CY per day or approximately 800,000 CY over the 6 operating months. Given that the East Fork access point is located upstream in the reservoir it could be possible to extend the cleanout until rain is forecasted.

At this rate it would take approximately twenty (20) 6-month removal projects to place the 14.9 MCY.

To Irwindale Pits

Approximately 8 MCY of sediment would be brought to the pits in the Irwindale area. This is a 14 mile roundtrip from San Gabriel Reservoir. Assuming double-dump trucks are used, there would be a total of approximately 400 trips per day, totaling 6,400 CY per day or approximately 800,000 CY over the 6 operating months.

At this rate it would take approximately ten (10) 6-month removal projects to place the 8 MCY.

Trucking - Cost

Given the distance from San Gabriel Reservoir to Burro Canyon SPS and assuming the use of double-dump trucks, the estimated trucking cost is approximately $112 million for 14.9 MCY of sediment. This does not include the cost for any possibly needed modifications to the East Fork access point.

From San Gabriel Reservoir to the Irwindale Pits, assuming the use of double-dump trucks as well, the estimated trucking cost is approximately $168 for 8 MCY.

This makes the estimated cost for trucking the total 23.8-MCY planning quantity approximately $288 million, excluding access modifications and environmental and social impact mitigation.

7.3.5.3 CONVEYOR BELTS

The use of a conveyor belts would be in conjunction with dry excavation and would only be brought to Burro Canyon SPS.

Access and Route for Conveyor Belt

If a conveyor belt is to be used to remove sediment from sediment from San Gabriel Reservoir to Burro Canyon SPS, the East Fork access point would be utilized. Taking this route, the conveyor belt would travel through the tunnel under East Fork Road and be aligned alongside the maintenance road to the SPS as shown in Figure 7-26 below. Burro Canyon SPS is approximately 1.5 miles from the East Fork access point to the top of Burro Canyon SPS.

Figure 7-26 San Gabriel Conveyor Alignment to Burro Canyon SPS

Conveyor Belts - Environmental Impacts

Additional study would need to be conducted to determine if there is habitat, especially in the drainage along the access road to Burro Canyon SPS/Shooting Park that would be impacted by the proposed conveyor belt route. However, with the utilization of existing access ramps and roads, the habitat impacts are expected to be minimal.

Conveyor Belts - Social Impacts

The conveyor alignment could adversely impact the tunnel located beneath East Fork Road at the mouth of Burro Canyon.

Since the conveyor belt would utilize the access road to the Burro SPS, the road width available for the recreational users of the Burro Canyon Shooting Park would be restricted. There would also be a noise and a scenic impact from the conveyor belt along the access road for these recreational users.

Conveyor Belts - Implementability

If a conveyor belt is used for sediment removal from San Gabriel Reservoir, it would be installed during cleanouts and removed between subsequent cleanouts. Once sediment is excavated, it could then be loaded into a hopper inside the body of the reservoir. Approximately 1.5 miles of conveyor belt would need to be constructed along

Burro Canyon SPS maintenance road. Sediment would then be conveyed through a tunnel under the East Fork Road to the maintenance road and then alongside the maintenance road to Burro Canyon SPS. If necessary, it would be possible to either trench or elevate the conveyor belt in location crossing the maintenance road.

Environmental regulatory permits would be needed prior to any conveyor activities.

Conveyor Belts – Performance

<u>Conveyor Belts Alone</u>

Given the following assumptions as well as those described in Section 6, it was determined that if two conveyor belts were to be used at San Gabriel Reservoir approximately 1,600,000 CY could be removed per cleanout. It was determined that if conveyor belts were to be used to convey the full 23.8-MCY planning quantity, it could be necessary to use a large conveyor than described in Section 6. For this planning document it was assumed that 2 conveyor belts as described in Section 6 would be used simultaneously.

The conveyor belts would have a combined capacity of 1,600 CY/hour. Sediment would be brought to Burro Canyon SPS. The operation would run 8 hours per day, 5 days per week, and 6 months per year. Given that the East Fork access point is located upstream in the reservoir it could be possible to extend the cleanout until rain is forecasted. At this rate it would take approximately fourteen (14) 6-month removal projects to place the 23.8 MCY of material.

<u>Conveyor Belts Combined with Trucking</u>

It would also be possible to combine the conveying operations with trucking from the front of San Gabriel Reservoir to the Irwindale Pits as described previously. Given this scenario, 8 MCY would be trucked from the front of San Gabriel Reservoir leaving 14.9 MCY to be conveyed to Burro Canyon SPS.

Given the same assumption as discussed previously it would take approximately ten (10) 6-month removal projects to place the 14.9 MCY of material. As stated before, removal of 8 MCY of sediment from San Gabriel Reservoir using trucks would take approximately ten (10) 6-month removal projects. As both transportation methods require dry excavation, the projects could be completed simultaneously.

Conveyor Belts - Cost

The estimated cost for constructing and operating a conveyor belt 1.5 miles from San Gabriel Reservoir to Burro Canyon SPS is approximately $6 million.

7.3.5.4 <u>SLURRY PIPELINE</u>

A slurry pipeline is not being considered for the San Gabriel Reservoir alternatives because Morris Reservoir is within such close proximately to San Gabriel. The slurry from the dredge would be discharged directly into Morris Reservoir.

7.3.6 <u>PLACEMENT</u>

This section discusses potential placement alternatives for sediment removed from San Gabriel Reservoir. Specifically, this section discusses the placement of sediment at pits and the existing Burro Canyon Sediment Placement Site. Given the location of San Gabriel Reservoir and the large quantity of sediment to be managed, sediment may be transported into Morris Reservoir. Sediment that is transported to Morris Reservoir via sluicing, slurry pipeline, or other method would be removed and placed at sites deemed feasible for Morris Reservoir.

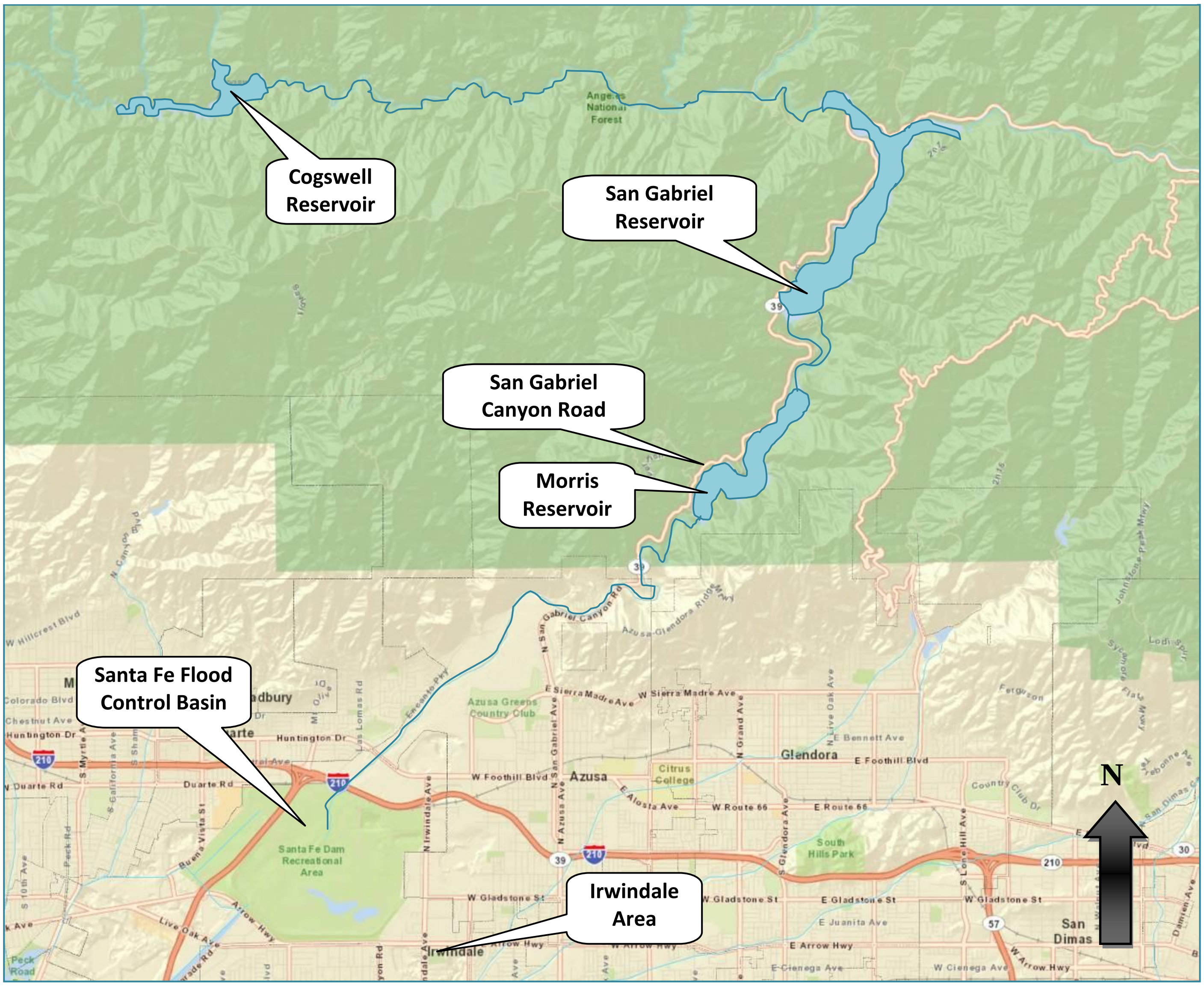
7.3.6.1 LANDFILLS

Although Section 6 identified landfills as a feasible placement alternative for reservoirs, the long distance and limited available capacity prohibit their use for sediment removed from San Gabriel Reservoir.

7.3.6.2 PITS

The general impacts of employing pits for sediment placement were discussed in Section 6. There are multiple pits in Irwindale. Figure 7-9 shows the location of the pits in relation of San Gabriel Reservoir. From San Gabriel Reservoir to the pits, the distance is approximately 14 miles, depending on the specific pit identified for use, the mode of transportation used, and the route.

7-9 Irwindale Pits Location



It is assumed that the entire 8 MCY of material from San Gabriel Reservoir that is proposed for transport out of the canyon would be marketable. Given that assumption and other assumptions discussed in Section 6, it was assumed that pits operated by the gravel industry would accept the entire 8 MCY of sediment from San Gabriel Reservoir free of charge.

As discussed in Section 6, the acquisition of pits for the placement of sediment from facilities under the jurisdiction of the Flood Control District should be pursued. Acquisition of a quarry in Irwindale would be most desirable for sediment management operations related to San Gabriel Reservoir. It would cost a total of $3 per cubic yard to acquire and place the 8 MCY of sediment at the Flood Control District-owned pit.

7.3.6.3 BURRO CANYON SEDIMENT PLACEMENT SITES

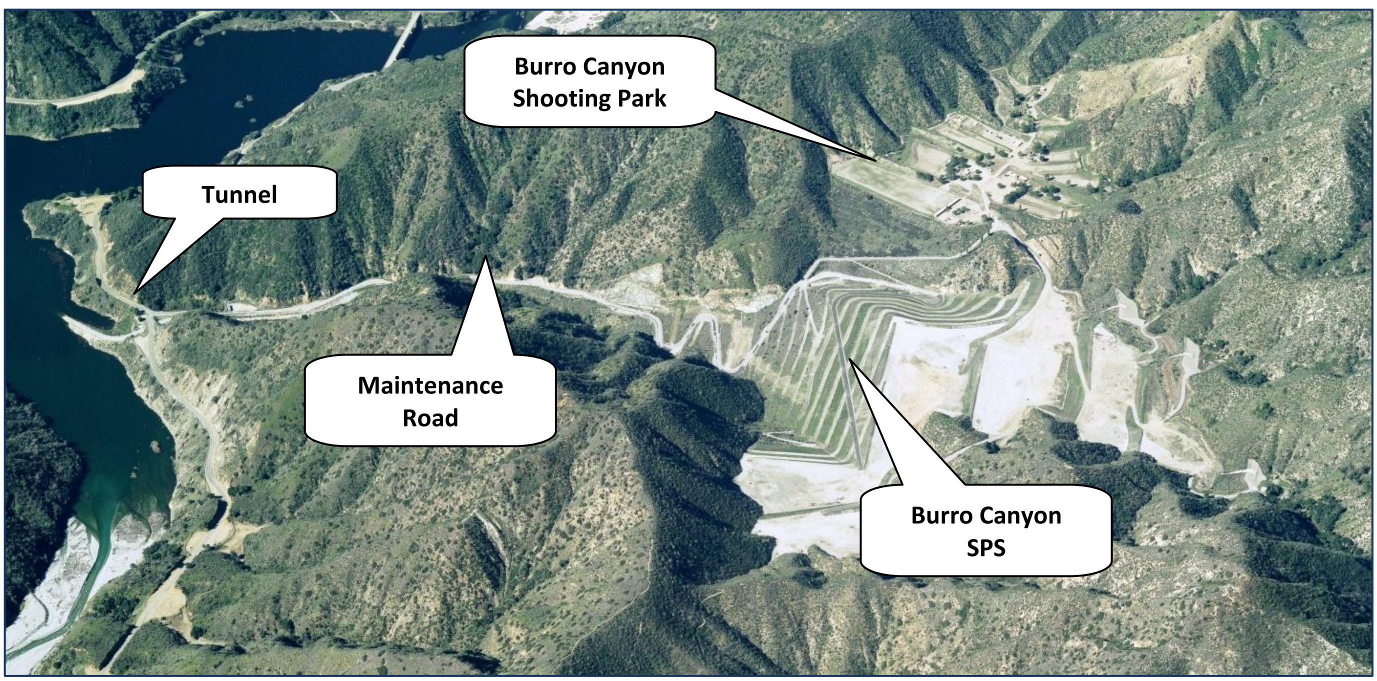
This section discusses the impacts associated with utilizing Burro Canyon SPS for the permanent placement of sediment from San Gabriel Reservoir. This placement alternative could potentially be used for sediment excavated from the reservoir and transported either by trucks or a conveyor system to the SPS.

Cogswell SPS is an existing SPS that currently holds less than 5 MCY of sediment and covers an area of approximately 36.5 acres from a previous cleanout effort.

Burro Canyon SPS, shown in Figure 7-27, is an existing SPS located approximately 1.3 miles upstream from the East Fork access point to San Gabriel Dam. Sediment placement in the SPS began in the later 1960s and continues to be considered for placement of sediment removed from San Gabriel Reservoir.

No other previously-used SPS or new canyon-SPS was considered for disposal of sediment from San Gabriel Reservoir.

Figure 7-27 Burro Canyon SPS



Burro Canyon SPS – Environmental

The Curve and Williams Fires of 2002 consumed all of the vegetation at Burro Canyon SPS. The San Gabriel Reservoir post-fire sediment removal project (2004-06) included hydroseeding the project's hill sloped within the SPS with native species. Since that time it is expected that the hydroseed sprouted and that some vegetation and other habitat above the fill lines have been reestablished. Further study would be needed to determine the extent and potential impacts and need for mitigation.

Burro Canyon SPS – Social

Burro Canyon SPS is located in a relatively remote area except for the Burro Canyon Shooting Park which is located on sediment previously placed in the SPS. The shooting park and the SPS share the same access road. It is expected that recreational users of the shooting park would experience increased traffic, noise, and scenic impact. Experience during the 2004-06 sediment removal project indicates it is also expected recreational users of the Burro Canyon Shooting Park could conflict with trucking or conveyor operations due to the speed that trucks must travel on the access road. It could be necessary to relocate the shooting park within the boundary of the SPS.

Burro Canyon SPS – Implementability

It would be necessary to obtain environmental regulatory permits to use Burro Canyon SPS. It should also be noted that although Burro SPS pre-dates the Burro Canyon Shooting Park, the forced closure of shooting ranges elsewhere in Los Angeles County (including one in Azusa) have made gun users, especially law enforcement and homeland security entities, increasingly reliant on the Burro Canyon Shooting Park for their ongoing training and practice.

Burro Canyon SPS – Performance

Burro Canyon is estimated to have a remaining capacity of 29 MCY. With the total 20-year planning quantity for San Gabriel Reservoir at only 23.8 MCY, there is ample space to meet this need.

Burro Canyon SPS – Cost

If 23.8 MCY of sediment were to be placed at Burro Canyon SPS it would cost approximately $5 million. This accounts only for the cost of placing the sediment in the SPS. Further study would be necessary to determine the cost of mitigation.

7.3.7 COMBINED SEDIMENT MANAGEMENT ALTERNATIVES

Given the sheer quantity of sediment planned to be managed at San Gabriel Reservoir, it is going to be necessary to use multiple sediment management alternatives simultaneously. A description of each of these combined sediment management alternatives is given below. More specific details regarding the environmental impacts, social impacts, feasibility, implementability, and cost for individual alternatives are given in the previous subsections. Combined impacts and costs are described below.

7.3.7.1 COMBINED SEDIMENT ALTERNATIVE 1A: DRY EXCAVATE (23.8 MCY) → TRUCKS → BURRO CANYON SPS (15.8 MCY) & IRWINDALE PITS (8 MCY)

Dry excavation of the total 23.8 MCY of sediment expected to be removed in the next 20-years in conjunction with trucking would need to occur approximately 20 times. Of the 23.8 MCY, 8 MCY would be taken to a pit in Irwindale with approximately 10 removals. The other 15.8 7MCY that would be taken to Burro Canyon SPS would need to be taken approximately every year for the 20 years. It could be possible in some years to take more than planned to Burro Canyon SPS if rain is not forecasted early. It is expected that most dry excavation could only occur over summer months.

Trucking to Irwindale

The trucks performing the removal of 8 MCY to Irwindale would travel partially along San Gabriel Canyon Road and partially on a private access road near the Gabriel Bike Path as shown in Figure 7-28. By routing the trucks along the access road no truck traffic would pass through downtown Azusa. There would be some social impacts to a few neighboring communities and likely to the bike path users.

Utilizing existing roads and access roads minimizes new impact to habitat. There would be some impacts to air quality.

There are several options in the Irwindale area. Sediment that is trucked from the reservoir could be brought to either a privately owned pit or a pit that the Flood Control District could purchase in the future. The Flood Control District intends to pursue the purchase of a new pit as well as the use of those existing.

Trucking to Burro Canyon SPS

The trucks performing the removal of 15.8 MCY to Burro Canyon SPS would travel along the maintenance road to Burro Canyon SPS that is also the access to the Burro Canyon Shooting Park. By routing the trucks along the maintenance road there could be some social impacts to the recreational users of the shooting park and the impacts to transport operations from the recreational users.

Utilizing existing roads and access roads minimizes new impact to habitat. It could be necessary to widen the road which would impact any potential habitat along that corridor. There would be some impacts to air quality.

The sediment would then be placed in the unused area of Burro Canyon SPS. Existing habitat would have to be removed in order to place sediment. Appropriate mitigation would also need to occur.

Implementation of this alternative could cost from an estimated between $375-395 million. The breakdown of estimated costs, not including those for mitigation or the construction of access point modifications, is provided in the following table.

Figure 7-28 San Gabriel Combines Alternative 1A

Table 7-10 Estimated Costs for Combined Alternative 1A

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Excavate Material at San Gabriel	23.8	$72
Truck from San Gabriel to Irwindale	8	$168
Place sediment at an Irwindale Pit		$(17)[(a)]-$5
Truck from San Gabriel to Burro Canyon SPS	15.8	$119
Place sediment at Burro Canyon SPS		$32
Total	**23.8**	**$360-385**

Notes:

a. If 8 MCY of marketable material are brought to an existing quarry, a $17 M credit is assumed. Estimated cost is between a $17 M credit and an actual cost of $5 M.

7.3.7.2 COMBINED SEDIMENT ALTERNATIVE 1B: SLUICE (2 MCY) → MORRIS RESERVOIR + DRY EXCAVATE (21.8 MCY) → TRUCKS → BURRO CANYON SPS (13.8 MCY) & IRWINDALE PITS (8 MCY)

Combined Alternative 1B is essentially the same as alternative 1A except that 2MCY of sediment would be sluiced to Morris Reservoir. Morris Reservoir is directly downstream of San Gabriel Reservoir. Figure 7-29 shows the combined alternatives. There could be some environmental impacts to the area immediately outside of the sluice tunnel and to the water supply system of the San Gabriel River Water Committee; however, there are mitigation measures that could be taken to minimize the impact. If sluicing were added to the alternative the cost is estimated between $355-375 million. The breakdown of estimated costs is provided in Table 7-11.

Figure 7-29 San Gabriel Combined Alternative 1B

Table 7-11 Estimated Costs for Combined Alternative 1B

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Sluice to Morris Reservoir	2	$5
Excavate Material at San Gabriel	21.8	$66
Truck from San Gabriel to Irwindale Pits	13.8	$168
Place sediment at an Irwindale Pit		$(17)[a]-5
Truck from San Gabriel to Burro Canyon SPS	8	$104
Place sediment at Burro Canyon SPS		$28
Total	**23.8**	**$355-375**

Notes:
a. If 8 MCY of marketable material are brought to an existing quarry, a $17 M credit is assumed. Estimated cost is between a $17 M credit and an actual cost of $5 M.

7.3.7.3 COMBINED SEDIMENT ALTERNATIVE 1C: DREDGE (2 MCY) → SLURRY PIPELINE → MORRIS RESERVOIR + DRY EXCAVATE (21.8 MCY) → TRUCKS → BURRO CANYON SPS (13.8 MCY) & IRWINDALE PITS (8 MCY)

Combined Alternative 1C, as shown in Figure 7-30, is essentially the same as alternative 1B except that instead of sluicing 2 MCY of sediment it would be dredged through to Morris Reservoir. Morris Reservoir is directly downstream of San Gabriel Reservoir. If dredging were added to the alternative the cost is estimated between $370-390 million. The breakdown of estimated costs is provided in Table 7-12.

Figure 7-30 San Gabriel Combined Alternative 1C

Table 7-12 Estimated Costs for Combined Alternative 1C

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Dredge to Morris Reservoir	2	$21
Excavate Material at San Gabriel	21.8	$66
Truck from San Gabriel to Irwindale Pits	8	$168
Place sediment at an Irwindale Pit		$(17)[(a)]-5
Truck from San Gabriel to Burro Canyon SPS	13.8	$104
Place sediment at Burro Canyon SPS		$28
Total	**23.8**	**$370-390**

Notes:

a. If 8 MCY of marketable material are brought to an existing quarry, a $17 M credit is assumed. Estimated cost is between a $17 M credit and an actual cost of $5 M.

7.3.7.4 Combined Sediment Alternative 2A: Dry Excavation → Trucks → Irwindale Pits + Dry Excavation to Conveyor Belts → Burro Canyon SPS

Dry excavation of the total 23.8 MCY of sediment expected to be removed in the next 20-years in conjunction with trucking and conveyor belts simultaneously would need to occur approximately 10 times. Of the 23.8 MCY, 8 MCY would be trucked to a pit in Irwindale, as discussed previously.

The remaining 15.8 MCY would be transported by conveyor belt to Burro Canyon SPS using either two conveyor belts approximately 4 feet wide or a larger belt with a capacity to move 1,600 CY/hour would start from inside the basin or at the downstream face of the dam. From here the belt(s) would travel through the existing masonry tunnel and alongside the maintenance road approximately 1.5 miles to Burro Canyon SPS.

The maintenance road is also accessed by recreational users of the Burro Canyon Shooting Park located adjacent to the SPS. There could be some social impacts to those recreational users, and these users could impact transport operations. It could also be necessary to trench or elevate the conveyor system in some areas to maintain access along this road.

Habitat along the maintenance road would be impacted by the construction of a conveyor system. If portions of the conveyor system are trenched there could be more opportunity for habitat to recover along that portion of the alignment.

The sediment would then be placed in the unused area of Burro Canyon SPS. Existing habitat would have to be removed in order to place sediment. Appropriate mitigation would also need to occur.

Implementation of this alternative could cost from an estimated between $275-300 million. The breakdown of estimated costs is provided in Table 7-13.

Figure 7-31 San Gabriel Combined Alternative 2A

Table 7-13 Estimated Costs for Combined Alternative 2A

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Excavate Material at San Gabriel	23.8	$72
Truck from San Gabriel to Irwindale Pits	8	$168
Place sediment at an Irwindale Pit		$(17)[a]-5
Convey Material from San Gabriel to Burro Canyon SPS	15.8	$21
Place sediment at Burro Canyon SPS		$32
Total	**23.8**	**$275-300**

Notes:

a. If 8 MCY of marketable material are brought to an existing quarry, a $17 M credit is assumed. Estimated cost is between a $17 M credit and an actual cost of $5 M.

7.3.7.5 Combined Sediment Alternative 2B: Dry Excavation → Trucks → Irwindale Pits (8 MCY) + Conveyor Belt to Burro Canyon SPS (13.8 MCY) + Sluice to Morris Reservoir (2 MCY)

Combined Alternative 2B is essentially the same as alternative 2A except that 2MCY of sediment that would have been conveyor belted to Burro Canyon would be sluiced to Morris Reservoir. Morris Reservoir is directly downstream of San Gabriel Reservoir. There could be some environmental impacts to the area immediately outside of the sluice tunnel however there are mitigation measures that could be taken to minimize the impact. If sluicing were added to the alternative the cost is estimated between $270-290 million. The breakdown of estimated costs is provided in Table 7-14.

Figure 7-32 San Gabriel Combined Alternative 2B

Table 7-14 Estimated Costs for Combined Alternative 2B

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Sluice to Morris Reservoir	2	$5
Excavate Material at San Gabriel	21.8	$66
Truck from San Gabriel to Irwindale	8	$168
Place sediment at an Irwindale Pit		$(17)[a]-5
Conveyor Belt from San Gabriel to Burro Canyon SPS	13.8	$21
Place sediment at Burro Canyon SPS		$28
Total	**23.8**	**$270-290**

Notes:

a. If 8 MCY of marketable material are brought to an existing quarry, a $17 M credit is assumed. Estimated cost is between a $17 M credit and an actual cost of $5 M.

7.3.7.6 Combined Sediment Alternative 2C: Dry Excavation → Trucks → Irwindale Pits (8 MCY) + Conveyor Belt to Burro Canyon SPS (13.8 MCY) + Dredge to Morris Reservoir (2 MCY)

Combined Alternative 2C is essentially the same as alternative 2B except that instead of sluicing 2 MCY of sediment it would be dredged through to Morris Reservoir. Morris Reservoir is directly downstream of San Gabriel Reservoir. If dredging were added to the alternative the cost is estimated between $285-310 million. The breakdown of estimated costs is provided in the following table.

Figure 7-33 San Gabriel Combined Alternative 2C

Table 7-15 Estimated Costs for Combined Alternative 2C

Activity	Quantity (MCY)	Estimated Costs (in Millions)
Dredge to Morris Reservoir	2	$21
Excavate Material at San Gabriel	21.8	$66
Truck excavated material from San Gabriel to Irwindale	8	$168
Place excavated material at an Irwindale Pit		$(17)[a]-5
Convey excavated material from San Gabriel to Burro Canyon SPS	13.8	$21
Place excavated material sediment at Burro Canyon SPS		$28
Total	**23.8**	**$285-310**

Notes:
a. If 8 MCY of marketable material are brought to an existing quarry, a $17 M credit is assumed. Estimated cost is between a $17 M credit and an actual cost of $5 M.

7.3.8 SAN GABRIEL RESERVOIR SUMMARY AND RECOMMENDATIONS

7.3.8.1 SUMMARY

Over the next 20 years, 23.8 MCY of sediment are planned to be removed from San Gabriel Reservoir, including 3.4 MCY that could potentially be sluiced or delivered by slurry pipeline from Cogswell Reservoir. The different sediment management alternatives are briefly explained below and the impacts are shown in Table 11-2.

Sediment Management Alternatives

1A Dry Excavate (23.8 MCY) → Trucks → Burro Canyon SPS (15.8 MCY) & Irwindale Pits (8 MCY)
Alternative 1A proposes to dry excavate the entire 23.8 MCY of sediment from San Gabriel Reservoir and truck 15.8 MCY to Burro Canyon SPS and the remaining 8 MCY to the Irwindale pits. There would be air quality impacts from the trucks as well as some habitat impact to the undeveloped portion of Burro Canyon SPS. The trucks driving to Irwindale would cause some traffic, noise, and visual impacts.

1B Sluice (2 MCY) → Morris Reservoir
+ Dry Excavate (21.8 MCY) → Trucks → Burro Canyon SPS (13.8 MCY) & Irwindale Pits (8 MCY)
This alternative is similar to 1A except that 2 MCY of the 23.8 MCY would be sluiced from San Gabriel Reservoir to Morris Reservoir and the remaining 21.8 MCY would be dry excavated and trucked. As a result of the sluicing operations, there would be some habitat impacts immediately downstream of the San Gabriel Reservoir sluice tunnel.

1C Dredge (2 MCY) → Slurry Pipeline → Morris Reservoir
+ Dry Excavate (21.8 MCY) → Trucks → Burro Canyon SPS (13.8 MCY) & Irwindale Pits (8 MCY)
This alternative is similar to 1B except instead of sluicing 2 MCY of sediment from San Gabriel Reservoir to Morris Reservoir the sediment would be dredged and transported via a slurry pipeline from San Gabriel Reservoir to Morris Reservoir. Dredging would have some water quality and visual impacts.

2A Dry Excavation (15.8 MCY)→ Conveyor Belts → Burro Canyon SPS
+ Dry Excavate (8 MCY) → Trucks → Irwindale Pits

Alternative 2A is essentially the same as 1A except that instead of trucking 15.8 MCY to Burro Canyon SPS the sediment would be transported via conveyor belts. There may be some habitat impacts over the alignment to Burro Canyon SPS.

2B <u>Sluice (2 MCY) → Morris Reservoir</u>
<u>+ Dry Excavate (13.8 MCY) → Conveyor Belts → Burro Canyon SPS</u>
<u>+ Dry Excavate (8 MCY) → Trucks → Irwindale Pits</u>
This alternative is similar to 2A except that 2 MCY of material would be sluiced to Morris Reservoir. As discussed, this would have some habitat impacts immediately downstream of the San Gabriel sluice tunnel. This would leave 13.8 MCY to be transported by conveyor belt to Burro Canyon SPS and 8 MCY to be trucked to Irwindale pits.

2C <u>Dredge (2 MCY) → Slurry Pipeline → Morris Reservoir</u>
<u>+ Dry Excavate (13.8 MCY) → Conveyor Belts → Burro Canyon SPS</u>
<u>+ Dry Excavate (8 MCY) → Trucks → Irwindale Pits</u>
This alternative is similar to 2B except that instead of sluicing 2 MCY to Morris Reservoir that quantity of sediment would be dredged. As mentioned, dredging would have some water quality and visual impacts.

Recommendations

It is recommended that all the alternatives detailed here be considered for future sediment removal projects at San Gabriel Reservoir.

Table 7-16 Summary of Sediment Management Alternatives for San Gabriel Reservoir

Alternative		Quantity Removed (MCY)	Environmental				Social			Implementability	Performance		Cost
			Habitat	Water Quality	Groundwater Recharge	Air Quality[a]	Traffic	Visual	Noise	Special Permit/ Agreement Required[b]	Previous Experience	# of operations required in next 20 years	$ Millions
1A	Dry Excavation	23.8	◑			◑		◑	◑		Yes	19	370-395
	Trucks to Burro Canyon SPS	15.8				●	○	○	○				
	Burro Canyon SPS		●			○				Yes			
	Trucks to Irwindale Pits	8				●	●	◑	◑			10	
	Irwindale Pits									Yes			
1B	Sluice to Morris Reservoir	2	●	●				○			Yes	5	355-375
	Dry Excavation	21.8	◑			◑		◑	◑			16	
	Trucks to Burro Canyon SPS					●	○	○	○				
	Burro Canyon SPS	13.8	●			○				Yes			
	Trucks to Irwindale Pits	8				●	●	◑	◑			10	
	Irwindale Pits									Yes			
1C	Dredge to Morris Reservoir	2	◑	◑				○	○		No	7	370-390
	Dry Excavation	21.8	◑			◑		◑	◑		Yes	16	
	Trucks to Burro Canyon SPS					●	○	○	○				
	Burro Canyon SPS	13.8	●			○				Yes			
	Trucks to Irwindale Pits	8				●	●	◑	◑			10	
	Irwindale Pits									Yes			
2A	Dry Excavation	23.8	◑			◑		◑	◑		Yes	19	270-290

	Conveyor Belts	15.8	◑					◑	○				
	Burro Canyon SPS		●			○				Yes			
	Trucks to Irwindale Pits	8				●	●	◑	◑			10	
	Irwindale Pits									Yes			
2B	Sluice to Morris Reservoir	2	●	●				○			Yes	5	260-285
	Dry Excavation	21.8	◑			◑		◑	◑				
	Conveyor Belts	13.8	◑					◑	○			16	
	Burro Canyon SPS		●			○				Yes			
	Trucks to Irwindale Pits	8				●	●	◑	◑			10	
	Irwindale Pits									Yes			
2C	Dredge to Morris Reservoir	2	○	◑				○	○		No	7	280-300
	Dry Excavation	21.8	◑			◑		◑	◑		Yes		
	Conveyor Belts	13.8	◑					◑	○			16	
	Burro Canyon SPS		●			○				Yes			
	Trucks to Irwindale Pits	8				●	●	◑	◑			10	
	Irwindale Pits									Yes			

Legend:

●	significant impact
◑	some impact
○	possible impact
	no impact

Notes:

(a) Use of low-emission trucks would reduce air quality impacts from significant impact (●) to some impact (◑).

(b) All options require environmental regulatory permits.

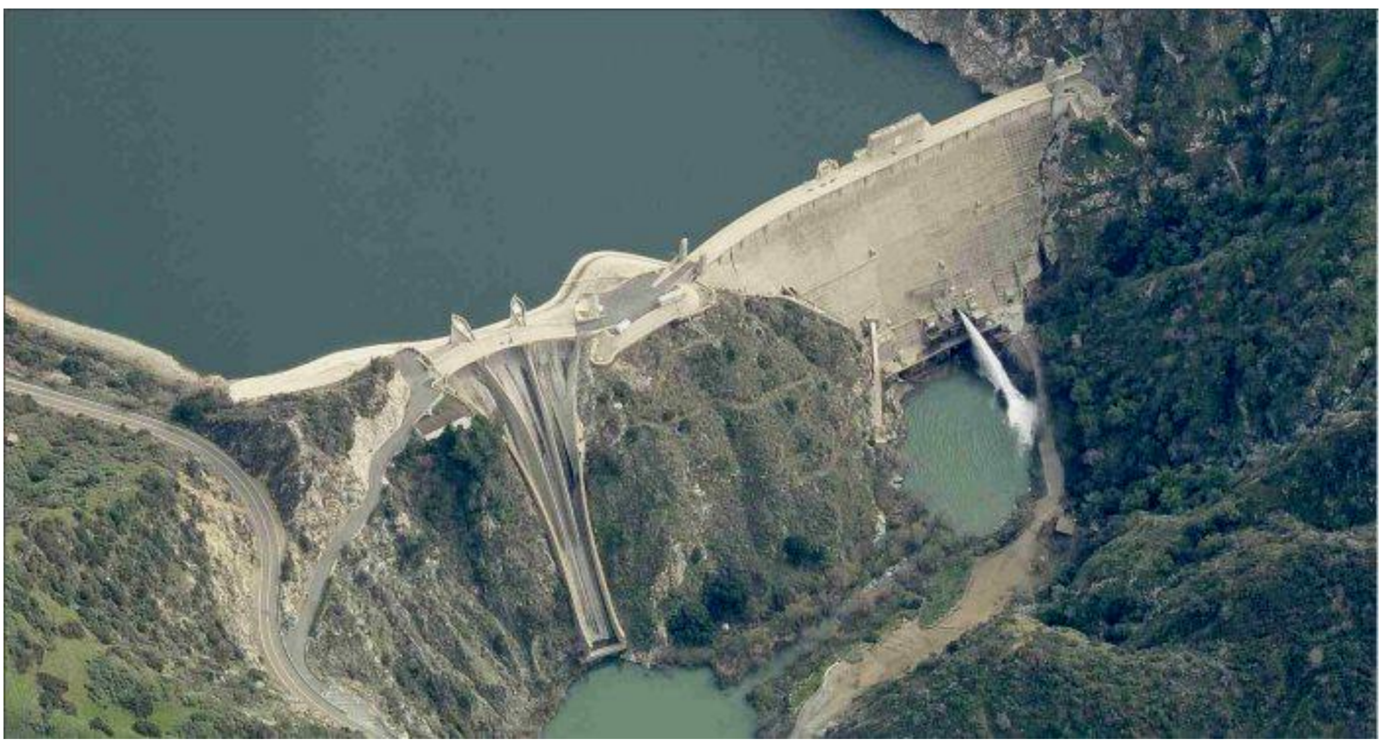
7.4 MORRIS RESERVOIR

7.4.1 BACKGROUND

Morris Dam, shown in Figure 7-34, is a concrete gravity dam that was constructed in 1934 by the City of Pasadena for water supply. The City later transferred the facility to the Metropolitan Water District of Southern California (MWD), which in turn transferred the facility to the Los Angeles County Flood Control District in 1995. The original storage capacity at spillway is 52.1 million cubic yards. With an uncontrolled drainage area 14.3 square miles and a controlled drainage area (from upstream San Gabriel and Cogswell) of 202.7 square miles, Morris has a total drainage area of 217 square miles.

The principal function of Morris Dam is water conservation. Water captured during the storm season behind the dam is gradually released into the San Gabriel River or directed into the Azusa Conduit, if water levels are very high due to the raising of steel radial gates on the spillway to create additional storage capacity. Water released into the river would percolate within the river (since the river bottom is unlined) or be directed into the San Gabriel Canyon Spreading Grounds, and the water supply system of the San Gabriel River Water Committee for treatment and distribution, or to Santa Fe Spreading Grounds. Occasionally, per adjudicated water rights to the lower San Gabriel River, large releases are made for ground water recharge in the Central Basin with flows directed to spreading operations within the San Gabriel River and at San Gabriel Coastal and Rio Hondo Coastal Spreading Grounds.

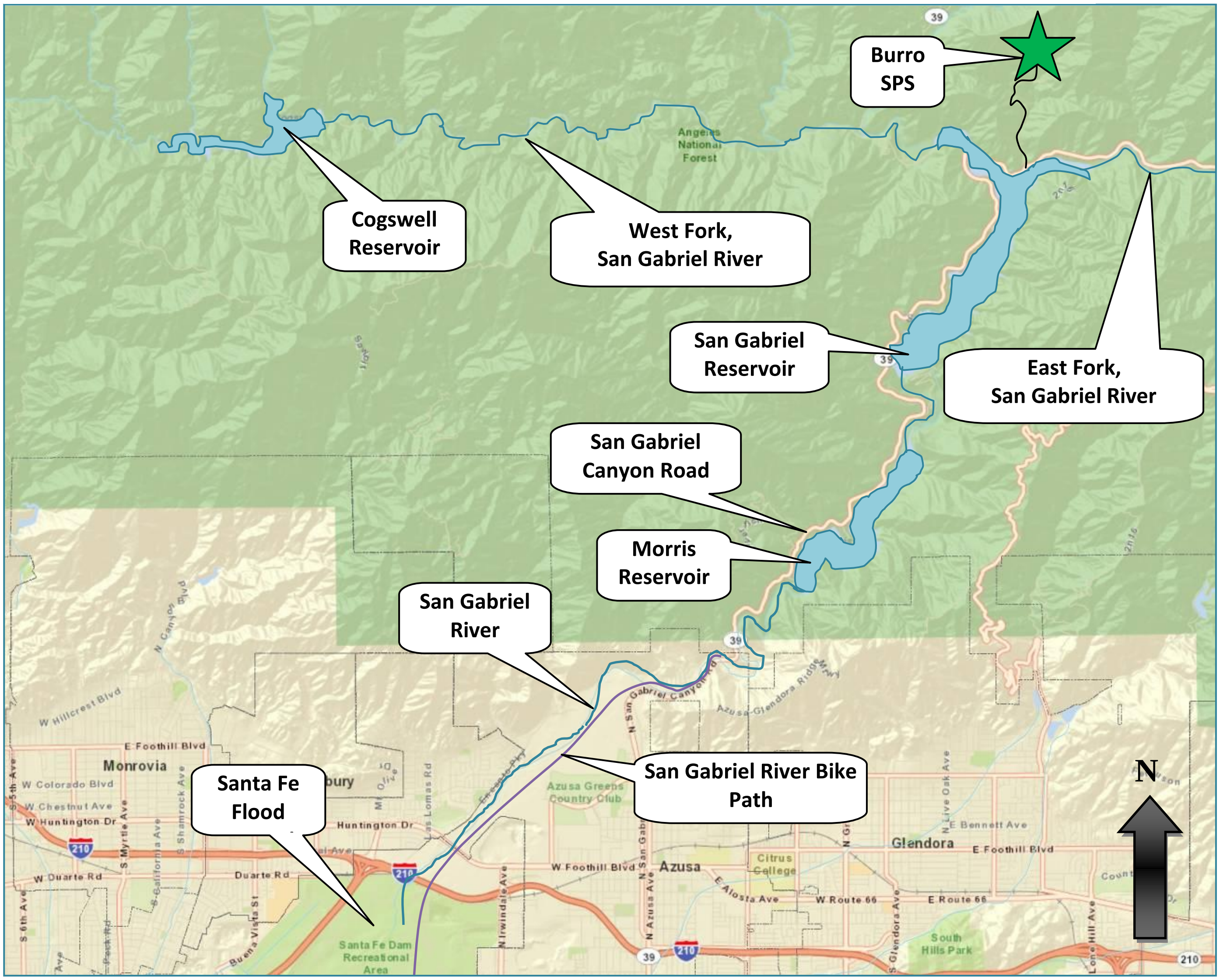
Figure 7-34 Photo of Morris Dam



7.4.1.1 LOCATION

Morris Reservoir is located in the San Gabriel Canyon in the San Gabriel Mountains approximately four miles north of the City of Azusa. The dam and most of the reservoir are located within Flood Control District-owned right of way. The U.S. Forest Service owns a parcel within the reservoir. As discussed in Section 7.1, San Gabriel Dam and Cogswell Dam are both located upstream of Morris Dam.

Figure 7-35 Vicinity Map for Morris Dam

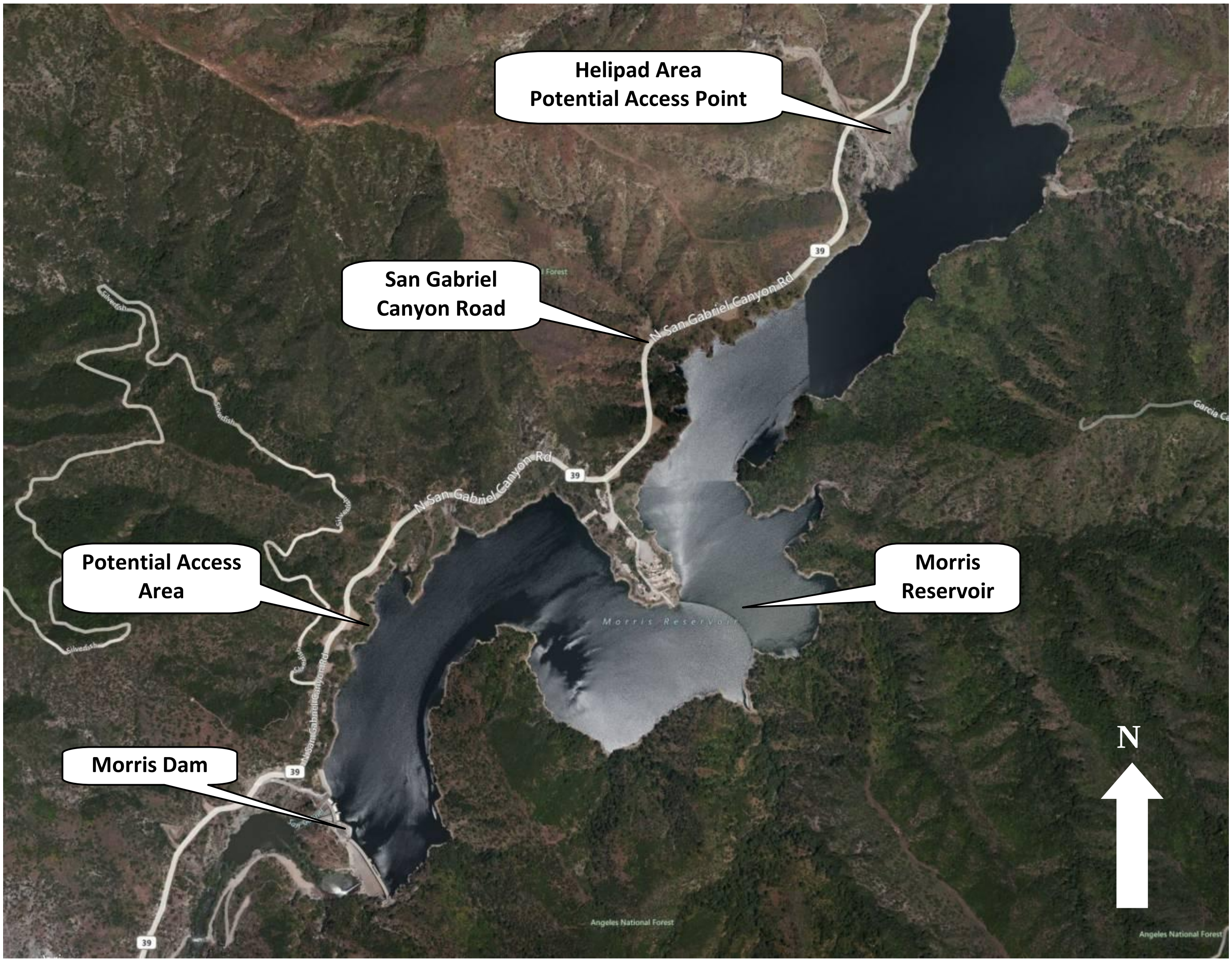


7.4.1.2 ACCESS

Access to the reservoir is available via San Gabriel Canyon Road (State Route 39), a paved, two-way road maintained by Caltrans. From any access point, a road would need to be constructed into the bottom of the reservoir. The elevation difference from San Gabriel Canyon Road to the bottom of the reservoir increases closer to the face of the dam.

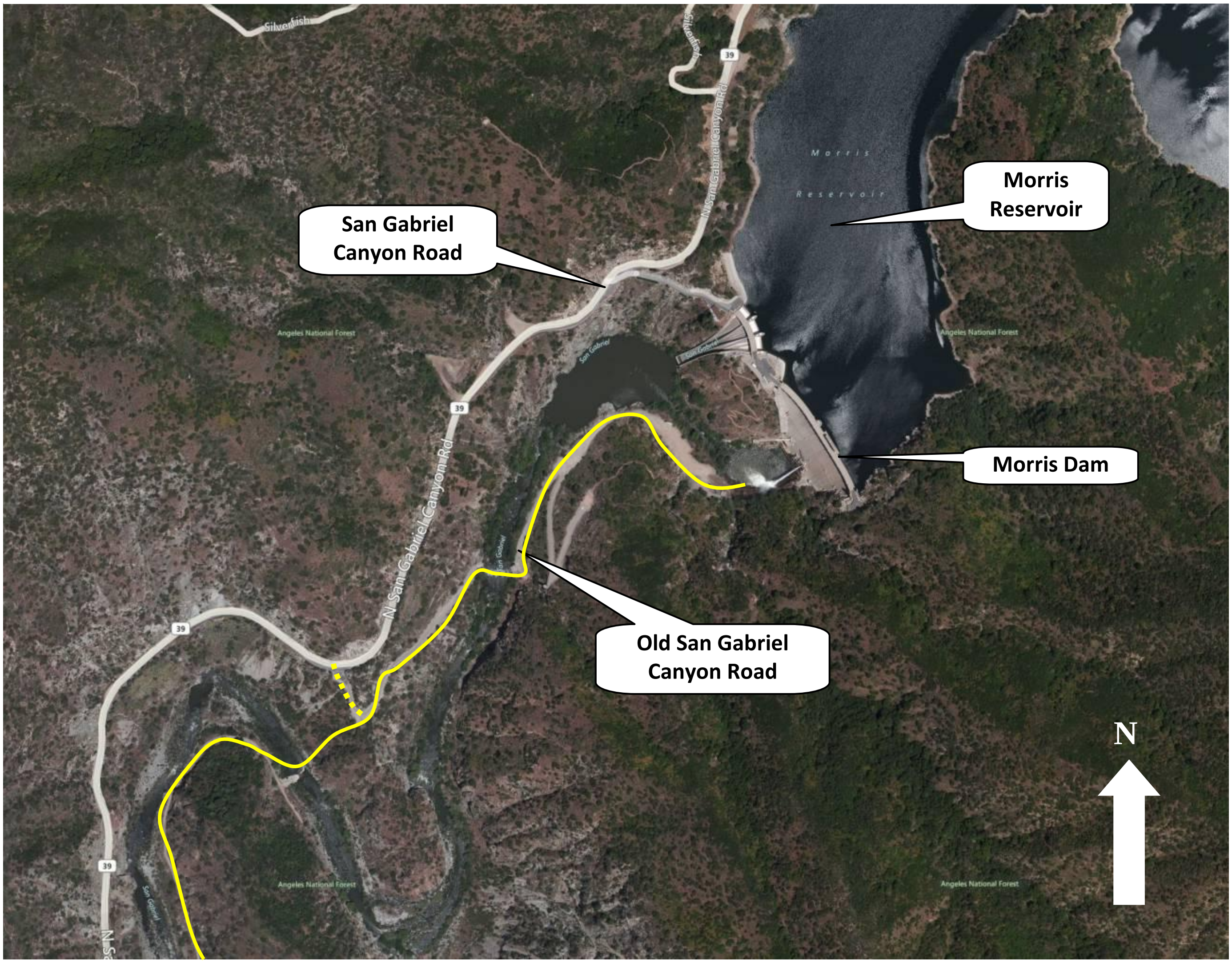
There are two potential access points for Morris Reservoir. The first is located approximately 2 miles northeast of the dam at the upstream access area near the Morris helipad. The second is located approximately 0.5 miles north of the dam. Because it is closer to the dam the access road would likely be steep and difficult to construct. However, it would be valuable to have an access point further downstream in the reservoir. These potential access points are shown in Figure 7-36.

Figure 7-36 Morris Reservoir Upstream Access Points



Access to the downstream maintenance area of the dam is available by means of Old San Gabriel Canyon Road. Old San Gabriel Road is an unpaved roadway beginning at San Gabriel Canyon Road approximately 1.5 miles downstream of the dam. The roadway varies in width. Approximately 3,500 feet of the roadway is washed out and would have to be rebuilt if it is to be used for vehicular access. Currently, the Flood Control District accesses Old San Gabriel Canyon Road upstream of the area that is washed out as seen in Figure 7-37.

Figure 7-37 Morris Reservoir Access at Old San Gabriel Canyon Road



7.4.1.3 Spillway & Dam Outlets Characteristics

Although it also provides flood risk reduction and captures sediment, the principal function of Morris Dam is water conservation. Water captured behind the dam during the storm season is gradually released and redirected to the San Gabriel River, the San Gabriel River Water Committee's water supply.

In addition to controlling water releases, the valves on the dam could also serve as outlets for sluicing and dredging operations. There are no sluice gates at Morris so sluicing was previously conducted using two lower outlet valves. These two outlets are fixed with 48-inch hydraulic gates. Needle valves on both outlets were abandoned as flood release outlets and permanently removed decades ago. In June 2012, as a part of inlet/outlet works rehabilitation, jet flow valves are to be installed to replace the removed valves. Though small amounts of sediment could pass through, the new jet flow valves would need to be removed during any large sluicing operations.

7.4.1.4 DOWNSTREAM FLOOD CONTROL

In addition to releases from San Gabriel Dam, a few streams that traverse the San Gabriel Mountains flow into Morris Reservoir. Downstream, the San Gabriel River flows into Santa Fe Dam and Flood Control Basin, an Army Corps of Engineers facility used to manage the risk of floods. In the length of river between Morris Dam and Santa Fe Flood Control Basin, there are 10 drop structures, also owned by the Army Corps of Engineers, to control the erosion and scouring of the San Gabriel River.

Downstream of Santa Fe Dam, the watercourse is improved with levees and an unlined (soft) bottom for 15.5 miles. The channel then transitions to a reinforced concrete channel. Outflows are controlled by releases from Morris Dam with the exception of major flood events, during which flows often go over the spillway.

7.4.1.5 SEDIMENT ACCUMULATION AND REMOVAL HISTORY

Figure 7-38shows the approximate sediment storage in Morris Reservoir since the reservoir's first debris season in the 1930s. Since Morris Reservoir is not operated for flood risk management, there is not a quantitative storage capacity that must be maintained based on Design Debris Events. Instead, sediment removal events are required to prevent impact to the valves or water conservation.

Table 7-17 shows the reservoir capacity at spillway in addition to the historical sediment storage. As of October 2010, the remaining capacity was 37.2 MCY due to sediment accumulation and removal since the dam's construction. Sediment removal at Morris to date has only been achieved twice and both times during sluicing projects. Approximately 0.5 MCY of sediment were successfully removed during the pilot sluicing project in 1991. During the second sluicing in 1998, approximately 2.1 MCY were removed.

Figure 7-38 Graph of Historical Sediment Storage at Morris Reservoir

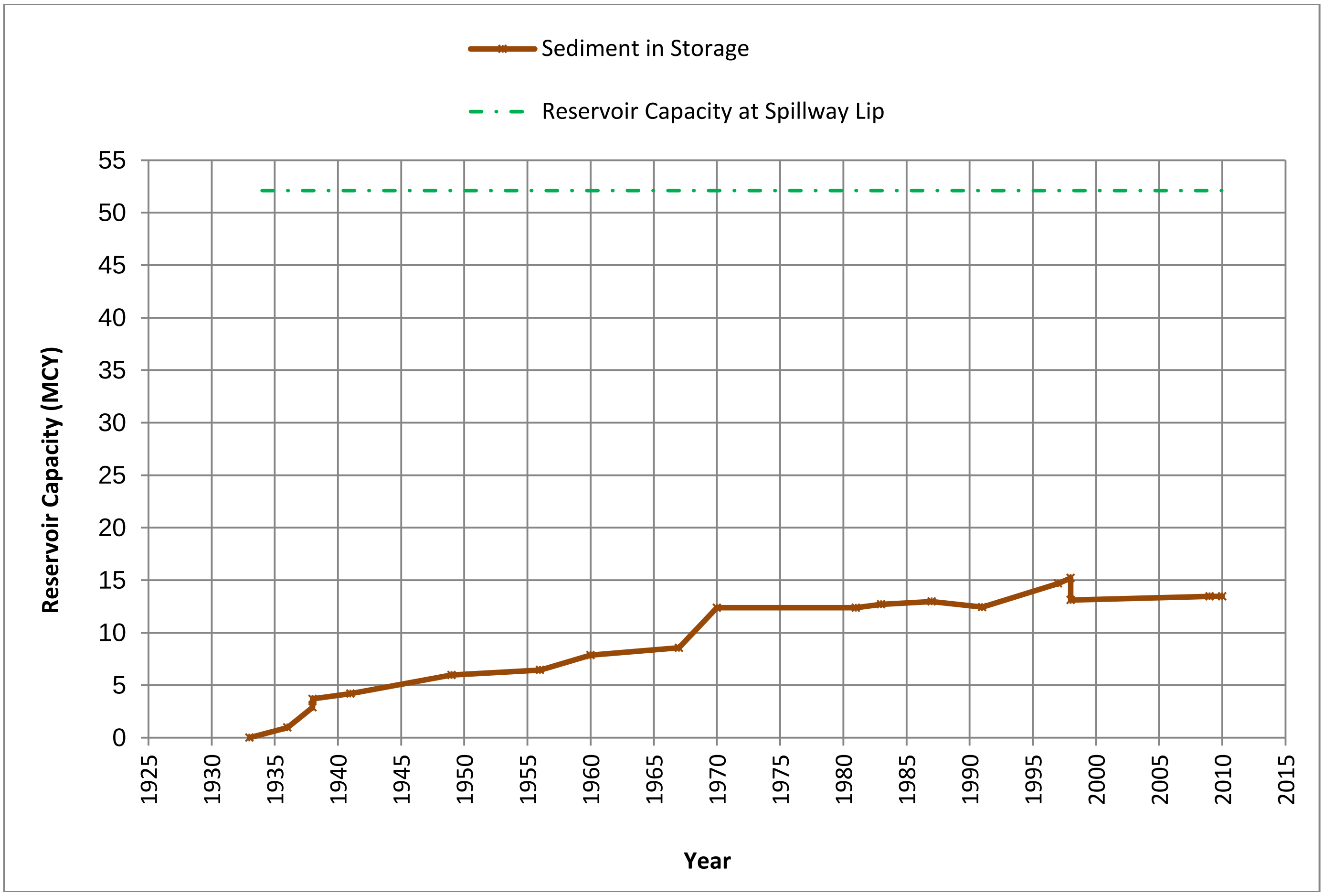


Table 7-17 Morris Reservoir Historical Sediment Accumulation and Removal

Survey Date		Reservoir Capacity[a] (MCY)	Quantity Sluiced (MCY)	Quantity Excavated (MCY)	Sediment Accumulation Between Surveys [b][c] (MCY)	Sediment in Storage (MCY)
October	1933	52.11	-	-	-	-
February	1936	51.14	-	-	0.97	0.97
March	1938	49.23	-	-	1.92	2.88
October	1938	48.43	-	-	0.80	3.68
June	1941	47.92	-	-	0.51	4.19
December	1949	46.15	-	-	1.77	5.96
September	1956	45.67	-	-	0.49	6.45
November	1960	44.26	-	-	1.41	7.85
January	1967	43.56	-	-	0.70	8.55
October	1970	39.75	-	-	3.81	12.36
December	1981	36.72	-	-	-	12.36
November	1983	36.38	-	-	0.33	12.70
November	1987	36.11	-	-	0.27	12.97
October	1991	37.05	0.55[d]	-	-	12.42
April	1997	34.78	-	-	2.27	14.68
September	1998	34.27	-	-	0.52[e]	15.20
December	1998	36.36	2.10[f]	-	-	13.10
October	2009	36.02	-	-	0.35	13.45

Notes

a. Capacity at elevation 1,152 feet.

b. Accumulation is a combination of storm sediment and sluicing from the upstream San Gabriel Reservoir.

c. First debris season assumed to be 1933-34.

d. Estimate of amount sluiced in 1991 Pilot Sluicing Project. There is no record of pre-sluice survey that was apparently taken in 9/91.

e. No sluicing from San Gabriel Reservoir occurred between April 1997 and September 1998.

f. Calculated estimate of difference between the reservoir bottoms per the pre-and post-sluice surveys of the 1998 sluicing. Post-sluice (December 1998) reservoir capacity is back-calculated using this estimate.

Past Sluicing Projects

The first sluicing event at Morris Dam was conducted in 1991 was a pilot study to determine if sediment would sluice through Morris Dam and to evaluate the transport of sediment in the San Gabriel River. The project successfully removed approximately 550,000 CY of sediment from the reservoir. No agitation equipment was used during this event however, water hoses we used to push sediment into the low flows.

As a part of this project, fish and turtle relocations were conducted, in the reservoir and downstream of the dam, respectively. A biological assessment of the impacted areas was conducted before, during, and after the project. The conclusion was that most biological impacts from sluicing were short-term, and the expected recovery period would be approximately 500 days. At that time, it was estimated that the cost of sediment removal was approximately $1/CY.

In 1998, at the conclusion of a six-year National Environmental Policy Act (NEPA)/California Environmental Quality Act (CEQA) process for the San Gabriel Canyon Sediment Management Plan, a second sluicing event was conducted and removed approximately 2.1 MCY of sediment. Mechanical agitation equipment was used to facilitate sediment transport.

The sediment that was washed from behind Morris Dam was mainly left in place through the length of the river channel from Morris Dam to the Drop Structures. Starting at the beginning of March 1999, water was released from Morris Dam in an effort to move sediments downstream. These flows sent the water from Morris Dam, through the Drop Structures, to the reservoir behind Santa Fe Dam. The water was pooled there to allow the sediment to settle out and then the water was released from Santa Fe Dam to downstream groundwater recharge facilities.

The 1998-99 storm season following the sluicing operation was lower than average, so storm flows and water stored in the reservoirs in San Gabriel canyon were not sufficient to conduct an extended post-sluicing flush of the river below Morris Dam. In July 1999, the Flood Control District utilized for flushing imported water that was purchased by a local water entity for groundwater replenishment and released at an outlet located just downstream of Morris Dam. These imported water releases were completed in September 1999. The 1999-2000 storm season was up to that time one of the driest on record for San Gabriel Canyon. In February 2000, the Flood Control District again utilized released imported water for flushing. The imported water flowed from below Morris Dam, through the Drop Structures, and was pooled behind the Santa Fe Dam prior to being released downstream for groundwater recharge. With each of the flushes and releases of imported water, additional sediments were washed downstream. As a result of consecutive dry rainfall years, there was a persistent presence of sediment in the river channel until there was adequate water supply to flush the river with a combination of imported water and Morris releases.

The Flood Control District engaged an environmental consultant to conduct monitoring and reporting during and for 5 years after the 1998 sluicing to identify impacts to the upper San Gabriel ecosystem. The summary of the post-sluicing impacts at Morris prepared by the consultant states: "…overall, the sluicing from Morris Reservoir [in 1998] had some short term effects on the downstream aquatic habitat, but the habitat recovered in around 2 to 3 years after the sluicing."

7.4.1.6 SPECIAL CONDITIONS

The San Gabriel River Water Committee has a water right to the normal flow of the river, up to 135 cfs. The Committee takes its water from both the Azusa Conduit and an intake at the mouth of the canyon downstream of Morris Reservoir. The Azusa Conduit has intakes at San Gabriel Dam and at Morris Dam. The intake at San Gabriel Dam allows its use under most reservoir pool levels, except when the reservoir pool is extremely low or the reservoir is completely drained. The intake at Morris Dam could only be used when the pool in Morris Reservoir is extremely high. The water treatment facilities for the San Gabriel River Water Committee have regulatory restrictions that prohibit intake of water with elevated levels of turbidity.

7.4.2 PLANNING QUANTITY & APPROACH

As described in Section 5.3, the 20-year planning quantity for sediment inflow into Morris Reservoir is 1.3 MCY. It is assumed for planning purposes that some sediment from San Gabriel Reservoir would be sluiced to Morris Reservoir. For planning purposes it is estimated that approximately 2 MCY could be sluiced into Morris Reservoir in the 20 years without severely impacting the ability to manage sediment at Morris Reservoir.

The 20-year planning quantity for Morris Reservoir is 3.3.MCY.

7.4.3 POTENTIAL STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

Staging areas are needed at Morris to drain water from sediment mixtures and to transfer sediment from one mode of transportation to another. Several candidate sites were examined but only 2 were deemed feasible. This section includes a description of the 2 staging areas that are included in the plan.

7.4.3.1 SANTA FE FLOOD CONTROL BASIN

Background

Santa Fe Flood Control Basin, shown in Figure 7-39 is owned and operated by the Corps. It is located in the City of Irwindale approximately 7.5 miles downstream of Morris Dam. Santa Fe Flood Control Basin was cleaned out twice, at the Corps' request, after the 1998 Morris sluicing project. The cleanouts occurred in an area in front of the dam's outlet works. Santa Fe could be used as a staging area for sluiced sediment.

Figure 7-39 Santa Fe Flood Control Basin Aerial

Santa Fe Flood Control Basin - Environment

Environmentally sensitive areas are located in the basin and include willow-dominated riparian habitat. Both the least Bell's vireo and the coastal California gnatcatcher have been documented in or near this area. Incoming sediment could be temporarily disruptive to the existing habitats. Excavation of sluiced sediment could cause significant disruption of riparian habitat areas could occur. Implementation of appropriate mitigation measures would be needed.

Santa Fe Flood Control Basin - Social

A large portion of Santa Fe Flood Control Basin is a recreational area. The area that would be used for sediment management is located within the improved flood waterway area outside of the recreational area, as seen in Figure 7-40. However, there are several bike paths and hiking trails that adjacent to the potential area of impact. Although impacts would be temporary, consideration for these areas would need to be taken when determining traffic paths for conducting any sediment removal projects, which would include transport of the sediment to site(s) that, would be designated at the time the projects are actually planned.

Excavation of material from Santa Fe Flood Control Basin would likely increase noise and visual impacts to the users of the recreational areas as well.

Another facility potentially impacted by sediment removal operations, especially transport, at the Santa Fe facility is the City of Hope National Medical Center, located at the northwest corner of the basin. Consideration of this facility would also need to taken when planning sediment removal activities.

Figure 7-40 Santa Fe Flood Control Basin Designation

Santa Fe Flood Control Basin - Implementability

Any use of Santa Fe Flood Control Basin would require an agreement with the Corps as well as environmental regulatory permits. There is currently sediment in storage behind Santa Fe Dam that would need to be removed before the site could be used for new sediment management projects. The Corps has indicated that, if allowed, the Flood Control District would need to remove as much sediment as would be brought into the basin but could leave sediment at the level it was before a cleanout began.

Assuming the Corps allows the Flood Control District to use Santa Fe Flood Control Basin and the Flood Control District obtains all required permits, Santa Fe Flood Control Basin would be a feasible staging area.

Santa Fe Flood Control Basin - Performance

The existing willow-dominated riparian habitat within the basin limits the available space for sediment storage to approximately 580,000 CY. This limited capacity restricts the quantity of sediment that could be sluiced in any one year.

Given the following assumptions, it was determined that if Santa Fe Flood Control Basin is to be used as a stockpiling area for sediment from Morris Reservoir, the sediment would have to be removed and sent to Santa Fe Flood Control Basin every two years or so.

- The entire 3.3 MCY planning quantity for Morris Reservoir would be stockpiled at Santa Fe Flood Control Basin at some point during several removal projects
- Sediment removal operations at Morris Reservoir are able to be conducted in a way that the maximum stockpiling capacity at Santa Fe Flood Control Basin is able to be utilized during each sediment removal project

The limited capacity at Santa Fe Flood Control Basin leads to a low performance rating. While not preferred, increasing the size of the stockpile area and impacting existing habitat would need to be considered if this alternative would be feasible to implement.

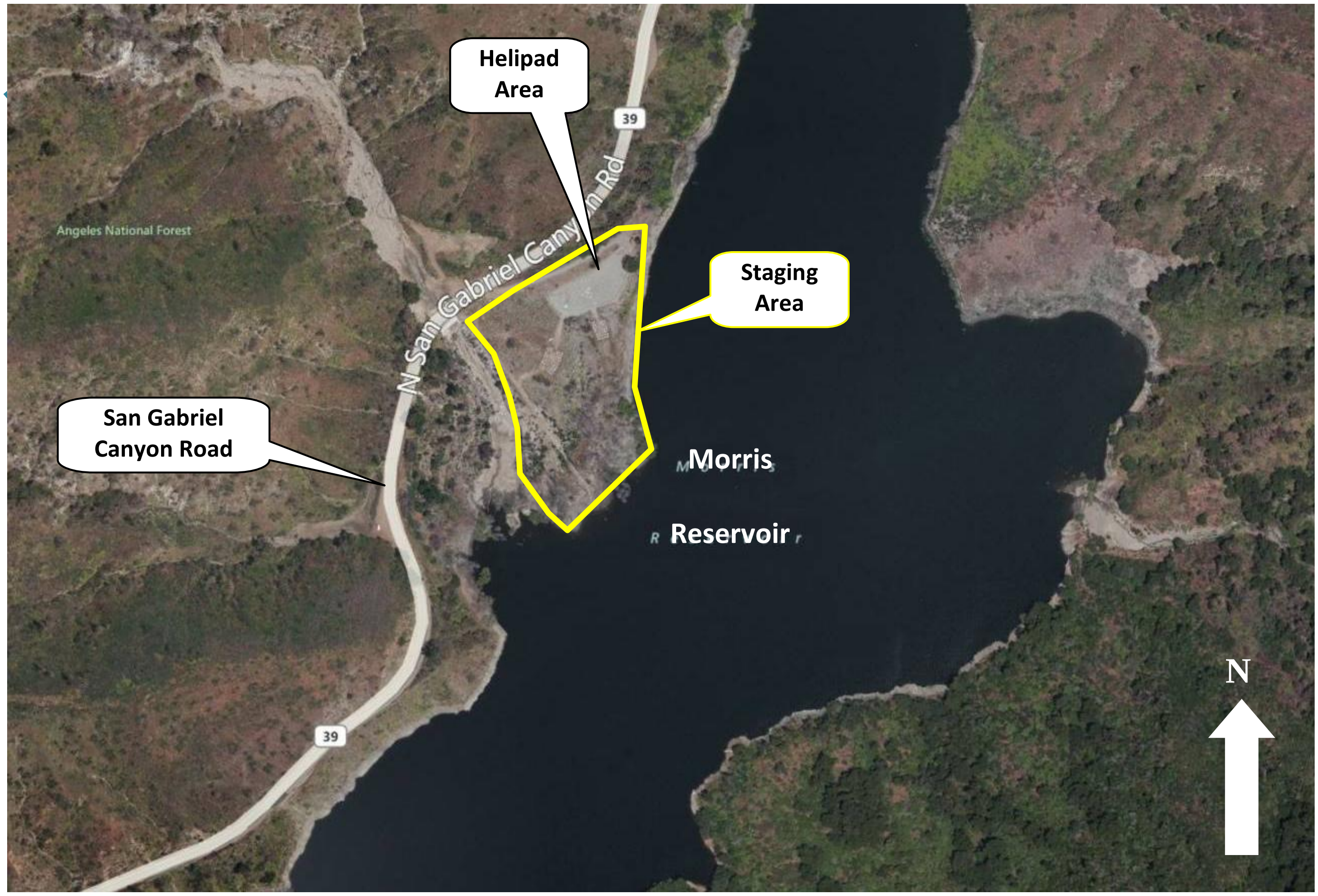
Santa Fe Flood Control Basin - Cost

The approximate cost to remove 3.3 MCY of sediment from Santa Fe Flood Control Basin is $10 million.

7.4.3.2 UPSTREAM STAGING AREA

Located approximately 1.8 miles north of Morris Dam to the east of San Gabriel Canyon Road and adjacent to the reservoir is a parcel that could serve as a possible access point and/or staging area. There is a helipad at the northern-most portion of the parcel, as shown in Figure 7-41. It is assumed that at least 4 acres of the site would be available for staging material while maintaining ample space for access through the helipad.

Figure 7-41 Helipad Area



Upstream Staging Area – Environment

Existing habitat may be impacted if this location is utilized as a staging area. Further study will be needed to determine what habitat exists.

Upstream Staging Area - Social

The upstream access area is located on Flood Control District property and is not available for public use. San Gabriel Canyon Road is travelled frequently by the public to access recreational facilities upstream so there would be a minor visual impact when the site is being used. There would also be noise from equipment at the site.

Upstream Staging Area - Implementability

The upstream access area is owned and maintained by the Flood Control District and therefore no acquisition or leasing would be needed. The Flood Control District is however currently leasing a portion of this parcel for the use of beekeeping. If this site is selected for future use it would not be an issue to discontinue the lease. There would be little work to prepare the site to be used for staging and/or transferring the sediment.

Upstream Staging Area - Feasibility

For this plan, it is assumed that the 4 acres would be adequate for staging and/or transferring the sediment.

7.4.4 REMOVAL

The following section discusses the impacts and costs of sediment removal at Morris Reservoir by means of dry excavation, dredging, and sluicing. Discussion of the transportation and placement alternatives is presented in Sections 7.4.5 and7.4.6, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 7.4.7.

7.4.4.1 DRY EXCAVATION

While dry excavation as described in Section 6.3.1 has not been used at Morris Reservoir, it has been successfully used by the Flood Control District at several other reservoirs.

Access for Dry Excavation Equipment & Operation

The upstream access point described earlier is the assumed access point for dry excavation.

Dry Excavation - Environmental Impacts

A major environmental concern with dry excavation is the impact on the aquatic habitat within Morris Reservoir. As previously described, past projects have taken measures to conduct fish removals (since the fish species in the reservoir were non-native invasive species) and relocate sensitive species of turtles and garter snakes prior to final drawdown of the reservoir pool. The downstream habitat is not expected to be impacted by dry excavation.

For dry excavation, it is assumed that the upstream access point, 0.5 miles upstream of the dam, would be utilized. Depending on the vegetation present at the chosen access point, there could also be some environmental impacts. The environment along the reservoir would be taken into consideration when choosing the precise access point.

Another concern is the impact to water conservation. To address concerns, water drained from the reservoir would be captured by downstream groundwater recharge facilities such as the soft-bottomed San Gabriel River, the San Gabriel Canyon Spreading Grounds, and Santa Fe Spreading Grounds. The Azusa Conduit intake at San Gabriel Dam would be used to deliver flows to the San Gabriel River Committee per its diversion rights.

Water quality impacts to water users would likely not occur, due to the way water would be delivered and recharged. Based on the findings of the 1998 sluicing monitoring reports, water quality impacts to habitat in the river from the much less turbid flows from dry excavation would be minimal.

As discussed earlier there would also be an impact to air quality as a result of the equipment necessary for excavation.

Dry Excavation - Social Impacts

Dry excavation would occur within the reservoir itself. For the excavation portion alone, there would be no increase in traffic in the surrounding area. Impacts to traffic from transportation methods will be evaluated in Section 7.4.5.

The nearest residential area to Morris is 1.5 miles downstream, as shown in Figure 7-42. Morris Reservoir is not in the viewshed of any houses or buildings. Therefore the scenic and visual impacts of dry excavation would be minimal and the operation would be temporary.

There are no recreational areas within the immediate vicinity of Morris Reservoir. San Gabriel Canyon Road is frequented by members of the public travelling to recreational areas further upstream. Though unlikely, the noise from traditional excavation equipment could impact the downstream residential area.

Figure 7-42 Location of Residential Area to Morris Reservoir

Dry Excavation - Implementability

The Flood Control District has conducted many dry excavation projects. Despite not having used this method at Morris, the technology is proven and there is technical certainty that dry excavation could be successfully implemented.

Environmental regulatory permits would need to be obtained prior to any excavation.

Dry Excavation - Performance

In order to dry excavate Morris Reservoir the reservoir must first be dewatered. As discussed previously, dry excavation could only be conducted over the summer months. Therefore dewatering would begin no earlier than mid-April, after the conclusion of the storm season. This would leave approximately six months to excavate. The performance effectiveness of dry excavation would be determined by the transportation mode removing the sediment from the reservoir. It is expected that the excavation equipment would be able to match the rate of removal by any mode of transportation being considered.

Dry Excavation - Cost

The removal of 3.3 MCY from Morris Reservoir by means of dry excavation is $10 million. This only includes the cost of excavating material.

7.4.4.2 DREDGING

As discussed in Section 6, dredging has not been used to remove sediment from the reservoirs under the Flood Control District's jurisdiction. In order to accurately determine the technical feasibility of a dredging operation at Cogswell Reservoir, detailed analysis would need to be conducted.

The following analysis is based on the assumptions detailed in Section 6 and the assumption that the entire 3.3 MCY of Morris Reservoir's planning quantity has the appropriate gradation to be dredged. Furthermore, it was assumed that the dredge could be connected to a slurry pipeline downstream of the dam.

Dredging - Environmental Impacts

It is expected that there would be an impact to water quality by increasing turbidity within the reservoir during dredging. Further study is necessary to determine the level of impact to other areas of concern.

Black crappie, bluegill, channel catfish, largemouth bass, rainbow trout, redear sunfish, and smallmouth bass have been previously found in Morris Reservoir. Black crappie and smallmouth bass are non-native game fish. Southwestern pond turtles and two striped garter snakes have been previously located in the Morris Reservoir vicinity.

There could be other species present within Morris Reservoir. Additional studies would be needed in order to identify the potential impacts dredging would have on vegetation and fauna. Furthermore, area(s) considered for discharge and drying of dredge material would also need to be determined.

As discussed in Section 6, dredging sediment (and transporting it via a slurry pipeline) could affect water conservation.

Dredging - Social Impacts

The nearest residential area to Morris Reservoir is 1.5 miles downstream. There are no recreational areas within the immediate vicinity of Morris Reservoir. San Gabriel Canyon Road is frequented by members of the public travelling to recreational areas further upstream. The noise of the dredge is not expected to be a disturbance to the downstream residents or recreational users.

Dredging of Morris Reservoir is not expected to have a long-lasting impact on traffic. Conducting dredging operations within the reservoir would not impact any recreational resources because Morris Reservoir is not a resource for active recreation.

Morris Reservoir is not in the viewshed of any houses or buildings. Therefore the scenic and visual impacts of dredging would be minimal and the operations would be temporary.

Dredging - Implementability

As discussed previously, dredging is not considered to be a proven method to remove sediment from the reservoirs under the Flood Control District's jurisdiction as it has not been previously used.
From past studies completed for the Flood Control District including consultation with dredging professionals, it has been determined that portable cutterhead suction dredges are available in a size suitable for use at the Flood Control District's reservoirs. As the dredge could reach a maximum depth of 50 feet, the reservoir water level would need to be lowered. From there, the material could be dredged to a slurry pipeline through the dam to a downstream area to dewater.

As with any other operation within Morris Reservoir, dredging would require environmental regulatory permits.

Maintenance of a dredging operation at Morris Reservoir is not expected to be different from the maintenance that would be required for a dredging operation that has been discussed in the document for any of the other reservoirs under the jurisdiction of the Flood Control District.

Dredging - Performance

Considering the capabilities of the dredging equipment and slurry pipeline discussed in Section 6, it would take approximately nine (9) 6-month removals operations to dredge the entire 3.3 MCY 20-year planning quantity for Morris Reservoir.

Due to the volume of water needed to dredge, a dewatering area is necessary. Assuming the total volume would double with the water and also that a 3 foot high stockpile could be accommodated, the area needed for 400,000 CY is 165 acres. There is not an area of 165 acres available for dewatering within the reservoir.

If an area is available downstream to dewater, a slurry pipeline could be used to convey the slurry downstream. Depending on the location of the staging area for dewatering, the clear water remaining once the sediment is removed, could continue to be used for groundwater recharge.

Fine sediments that remain in the water could cause clogging of spreading basins. Once fines are introduced they cannot be removed from some of these basins, especially those at Santa Fe Spreading Grounds. It could be possible to relocate the dredge to clean out the much deeper basins at San Gabriel Canyon Spreading Grounds, but further investigation would be needed to determine feasibility.

Dredging - Cost

The estimated cost of dredging 3.3 MCY of material is $35 million. If it is determined that the material must be mechanically dewatered the estimated cost of dredging would be $114 million bringing the total to $149 million just for removal via dredge.

7.4.4.3 SLUICING

This section describes the impact of sluicing to Cogswell Reservoir itself. The impacts of sluicing on the downstream area of the San Gabriel River will be evaluated in Sluicing (Transportation) in Section 7.4.5. Given the quantity of sediment in storage at Morris Reservoir and that some material has been sluiced from San Gabriel Reservoir, it is assumed that 3.3 MCY of sediment would be sluiceable.

Sluicing (Removal) - Environmental Impacts

Within Morris Reservoir itself, the impacts on vegetation and animal species would be expected to be similar to the impacts associated with excavating sediment from the reservoir since in both cases the reservoir would need to be drained.
During a sluicing operation, water quality within the reservoir would be expected to be poor due to the higher-than-normal sediment concentration. Sediment traveling downstream could clog the river and its ability to percolate water. Subsequent storms and releases are expected to move more of this sediment further downstream.

As discussed in Section 6, removing sediment from a reservoir by sluicing could affect water conservation. However, at Morris Reservoir the Azusa Conduit could also be used to hold some of the water during sluicing to assist with groundwater recharge after.

Sluicing operations within Morris Reservoir would result in increased emissions within the reservoir. However, the amount of equipment that would be employed is a sluicing operation would not be expected to be high, given the Flood Control District's previous sluicing projects, so impacts are not expected to be significant.

Sluicing (Removal) - Social Impacts

The only expected traffic and noise impacts for the residents within the vicinity of Morris Reservoir would be during the mobilization and demobilization of the sluicing operation along San Gabriel Canyon Road. However, as stated previously, a large number of equipment would not be expected to be needed for the sluicing operation.

Morris Reservoir is not in the viewshed of any houses or buildings. Therefore, the scenic and visual impacts of dredging would be minimal and the operations would be temporary.

Since Morris Reservoir does not serve a recreational purpose, within the reservoir sluicing would not have any impacts to non-passive recreational resources.

Sluicing (Removal) - Implementability

Sluicing at Morris Reservoir is a proven method of sediment removal. Though proven, the alternative still necessitates water availability. For planning purposes a water-to-sediment ratio of 9-to-1 is being used. Being downstream of two reservoirs, water supply for Morris is not expected to be a problem. However, it could still be necessary to time the sluicing events after larger storm years.

As any other operation within Morris Reservoir, sluicing would require environmental permits. It is possibly that certain permits could contain stipulations to quantify and limit the amount of sediment released, which would affect the implementability of this method. In the past, extensive water quality and biological monitoring was required as a condition to certain permits.

Sluicing (Removal) – Performance

In order to sluice Morris Reservoir the reservoir must first be dewatered. From the past two sluicing events it was determined that the water released during this time, though turbid, was still suitable for recharge in the riverbed.

For more efficient sluicing, it is recommended to use mechanical agitation equipment to facilitate sediment transport. Using such equipment would increase the sediment able to be sluiced.

Sluicing (Removal) - Cost

Based on the estimated unit cost for sluicing, the cost of sluicing 3.3 MCY is approximately $8 million.

7.4.5 TRANSPORTATION

The following section discusses the impacts and costs of transporting sediment removed from Morris Reservoir by means of sluicing, trucking, conveyor belt, and slurry pipeline. Discussion of the removal alternatives was presented in Section 7.4.4. The placement alternatives are presented in 7.4.6. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 7.4.7.

7.4.5.1 SLUICING

The following subsection explains the impacts of sluicing after sediment has passed through the dam.

Sluicing (Transportation) - Environmental Impacts

In general, sluicing activities could cause scour/erosion in certain areas and create deposits along the channel banks in other areas. Temporary disturbance of riparian habitats and associated wildlife could occur, but the level of disturbance would likely be similar to that occurring under natural flood conditions.

Prior to the 1998 sluicing, a baseline survey was conducted to characterize the condition of the San Gabriel River ecosystem in areas that would potentially be impacted by sluicing operations planned for both Morris Reservoir and the San Gabriel Reservoir located upstream. Riparian habitat, aquatic habitat, and water and sediment quality were evaluated. These areas were surveyed from 1999 through 2003, 5 years after the 1998 sluicing event, to determine the ecological impact of sluicing and recovery of the riparian and aquatic systems following sluicing. Similar surveys continued from 2004 through 2008 in anticipation of planned sluicing from San Gabriel Reservoir, which did not occur.

The San Gabriel River north of the Santa Fe Dam is located within a Significant Ecological Area (SEA) No. 22 as identified in the Los Angeles County General Plan and includes species listed as threatened or endangered by State and Federal agencies.

The results of this ecological evaluation show that the 1998 sluicing of sediments from Morris Reservoir had only short-term effects on riparian and aquatic habitat quality. The sluicing could have had a slight positive impact on riparian habitat by increasing substrate for the recruitment of riparian plant seedlings. Although the quality of downstream aquatic habitat was less than pre-sluicing conditions over the short term, aquatic habitat quality recovered to pre-sluicing baseline conditions within 2 to 3 years. It should also be noted that the years immediately after the 1998 sluicing had below average rainfall, which also impacted aquatic habitat. The results indicate that future removal of Morris Reservoir sediments by sluicing would result in only short-term impacts on downstream riparian and aquatic habitats. Although past monitoring indicated short-term and non-significant impacts, it is likely that regulatory permits continue to require extensive water quality and biological monitoring during and after sluicing operations.

As discussed in Section 6, transporting sediment via sluicing could affect water conservation.

Also discussed previously, Santa Fe Flood Control Basin would be the staging area for sluiced material.

Sluicing (Transportation) - Social Impacts

Residential development adjacent to the San Gabriel River downstream of Morris Dam has increased since the previous sluicing events. As a result recreational uses such as bicycling, hiking, and horse riding have also increased in those areas. There would be visual impacts to the recreational users along San Gabriel River.

The Santa Fe Dam Basin is a Corps facility. With permission from the Corps, portions of the basin could serve as staging areas for dewatering, drying, and processing sediment sluiced or otherwise removed from Morris Reservoir. Truck traffic would need to be managed to minimize noise in and travel through adjacent residential areas and the vicinity of the City of Hope.

Additional social impacts include potential odor from sluiced material both in the San Gabriel River and in Santa Fe Flood Control Basin. The appearance of the water would be dirty and unappealing. There could also be an increase in black flies and/or mosquitoes.

Sluicing (Transportation) – Implementability

In order to sluice, the Flood Control District would need to utilize Santa Fe Flood Control Basin as a staging area. As discussed in Section 6, this would require an agreement with the Corps. There is currently sediment in storage behind Santa Fe Dam that would need to be removed before the site could be used for new sediment management projects. Due to limited available storage capacity at the basin, the Corps would require the Flood Control District to pre-excavate the expected amount of sediment to be sluiced to their facility.

Following the sluicing events, San Gabriel River would need to be flushed to remove sediment caught in the channel. For planning purposes it is assumed that 2/3 of the sluiced sediment volume would make it to Santa Fe Flood Control Basin during that initial winter. Over the following 2-3 years the remainder sediment caught in the channel would continue downstream. It is thus possible that sediment removal from Santa Fe would have to occur in consecutive years. Recharge within the San Gabriel River and Santa Fe Flood Control Basin would also be reduced. It should be noted that the Flood Control District was able to avoid waste to the ocean and fulfilled all of the water entities' groundwater replenishment requests during and after the 1991 and 1998 sluicing operations.

Sluicing (Transportation) - Performance

Although sluicing could remove over 2 MCY of sediment per year, the constraints of removal from Santa Fe Reservoir are limited by Santa Fe Flood Control Basin. For planning purposed, it was determined that if sluicing was to be conducted from Morris Reservoir o Santa Fe Flood Control Basin approximately 773,000 CY could be removed per sluicing event. It is assumed that adequate water supply is available to sluice and that material within Morris Reservoir would be mechanically agitated to move sediment downstream. It is also assumed that sediment in Santa Fe could be adequately removed before the next cleanout.

At this rate it would take approximately five (5) 6-month sluicing projects to remove the 20-year quantity of 3.3 MCY.

Sluicing (Transportation) – Cost

As discussed previously, sluicing 3.3 MCY would cost approximately $8 million.

7.4.5.2 TRUCKING

Trucking from Morris Reservoir would be conducted in conjunction with dry excavation. The material would be loaded directly on to the truck and driven to its final placement location. For this analysis the assumed final location is a pit in Irwindale approximately 8 miles downstream.

Access and Route for Trucking

Access for trucks into Morris Reservoir would be made from a point approximately 0.5 miles upstream of the dam as described in previously. From this access point, trucks would drive in and out of the reservoir. Trucks would then travel south along San Gabriel Canyon Road. In an effort to avoid the impact to the communities downstream, it is proposed to use the route described previously for trucks going from San Gabriel Reservoir to Irwindale. Utilize the access road for the San Gabriel Canyon Spreading Ground to travel down to Foothill Boulevard, away from the residential areas. As mentioned previously, this route is adjacent to an existing bike path.

Trucking - Environmental Impacts

The trucks used for sediment removal would utilize San Gabriel Canyon Road and existing access roads. There would be no environmental impact to habitat from the trucking aspect of the removal.

As discussed previously, there would be an impact to air quality. The use of low emission trucks would result in lower air quality impacts than if standard trucks were used.

Trucking - Social Impacts

In using the access road described in previously, trucks would avoid driving through downtown Azusa. As discussed, two neighborhoods along San Gabriel Canyon Road, recreational users of the bike path, and potentially the users of the proposed Geology Area & Park would be affected by the truck traffic, increased noise, and scenic impact during sediment removal. See the trucking subsection in Section 6 for more details on general trucking impacts

Trucking - Implementability

At Morris reservoir access allows for double-dump trucks with a capacity of 16 CY to be utilized. As discussed previously, these trucks are standard for construction projects and should be readily available. Further investigation is needed to determine if there are any limitations with the use of this proposed route near the bike path. There

The use and availability of low emission vehicles would need to be explored further as specific cleanout plans are formed.

Trucking - Performance

Given the following assumptions, it was determined that if dry excavation was to be implemented for Morris Reservoir approximately 800,000 CY could be removed per cleanout. Sediment would be brought to the Irwindale area, a 15 miles roundtrip from the access area 0.5 miles upstream of the dam.

At this rate it would take approximately five (5) 6-month cleanout projects to remove the 3.3 MCY 20-year planning quantity.

Trucking - Cost

Given the distance from Morris Reservoir to Irwindale and assuming the use of double-dump trucks, the estimated trucking cost is approximately $15 million for 3.3 MCY.

7.4.5.3 CONVEYOR BELTS

The use of a conveyor belts would be in conjunction with dry excavation. Downstream of Morris there is an existing conveyor belt owned by Vulcan Materials Company (Vulcan). That conveyor belt terminates at a Vulcan pit just north of the 210 Freeway. Cooperative use of the existing Vulcan conveyor belt would need to be established in order to implement this alternative otherwise a separate system for this length would need to be constructed.

Figure 7-43 Existing Conveyor Belt Alignment

Access and Route for Conveyor Belt

A conveyor belt could begin inside the reservoir and travel through a valve in the dam to the downstream face of the dam. From here, the conveyor belt could be constructed along Old San Gabriel Canyon Road. As mentioned in previously, a portion of Old San Gabriel Road has been washed out and would need repair if it is to be used, even just for access to the conveyor belts.

Old San Gabriel Canyon Road ends at San Gabriel Canyon Road approximately 2 miles downstream of Morris dam. The conveyor would then have to be routed across to the West side of San Gabriel Canyon Road. From here, the conveyor belt could be aligned with the bike trail and continue downstream to the point where it eventually meets with the existing Vulcan conveyor belt. There are multiple places where the conveyor belt would need to be configured to accommodate regular traffic or access on the bike trail. This could involve trenching the conveyor belts underground or bridging the conveyor over certain points.

See the alignment of the existing Vulcan conveyor belt in Figure 7-43 and the whole alignment in Figure 7-44.

Figure 7-44 Morris Conveyor Belt Alignment

Conveyor Belts - Environmental Impacts

Some habitat along Old San Gabriel Canyon Road would be impacted by repairing the road. Additional use of the area outside of the established road would also need to be considered. Additional habitat along the bike path adjacent area would also likely be impacted.

Conveyor Belts - Social Impacts

Along Old San Gabriel Canyon Road there is a religious facility, an equestrian facility, and also the headquarters building of the San Gabriel River Mountains Conservancy. Access to these facilities would not be inhibited by the proposed conveyor belt. However, there would likely be noise and visual impacts associated with the conveyor running along that road. It could be possible to trench the conveyor belt underground to minimize impacts.

Similar to trucking, the two neighborhoods as seen in Figure 7-24 on page 7-47, along San Gabriel Canyon Road would also be affected by the conveyor belt. It would likely be necessary to trench the conveyor belt so as not to block access to the neighborhoods from San Gabriel Canyon Road as the conveyor alignment crosses these roads.

Based on the use in other projects, the noise from conveyor belts has proven to be minimal. It is not expected to impact the nearby neighborhoods. However, a conveyor belt could cause temporary noise and scenic impacts to recreational users of the bike trail though there is already an existing conveyor belt near a portion of the bike path.

Conveyor Belts - Implementability

Once sediment is excavated, it could then be loaded into a hopper inside the body of the reservoir. Sediment would then need to be conveyed either over the dam using a vertical bucket conveyor or through one of the valve tunnels on the dam using a more traditional conveyor belt system. The valve would have to be removed to accommodate the conveyor.

Approximately 2 miles of conveyor belt would need to be constructed along Old San Gabriel Canyon Road which travels south from Morris Dam to San Gabriel Canyon Road. Old San Gabriel Canyon road has several curves and depending on the specific alignment, possibly elevation changes; both which could present complications with conveyor construction.

As discussed, the conveyor would need to be routed to the west side of San Gabriel Canyon Road. From here, the conveyor belt could be constructed along the area adjacent to the bike path. About 0.5 miles downstream are two access roads to a development on the west side of the San Gabriel River. Further downstream there are several access points to the bike path. The conveyor belt could need to be trenched or elevated to maintain access in some of these locations.

Approximately 1.5 miles downstream, adjacent to the San Gabriel Canyon Spreading Grounds, there is an existing conveyor belt. The existing conveyor system is approximately 1.8 miles long and terminates at an existing Vulcan pit between Interstate 210 and West Foothill Boulevard just west of North Irwindale Avenue. If the Flood Control District is able to use the existing conveyor belt, material could be transferred from the new conveyor belt to the existing conveyor belt to be brought to the pit.

If the Flood Control District is not able to use the existing conveyor belt, the new conveyor belt could be extended the additional 1.8 miles, adjacent to the existing conveyor belt to carry the material to the existing Vulcan pit.

Environmental regulatory permits would be needed to place a conveyor belt in the proposed alignments.

Conveyor Belts - Performance

Conveyor systems have the ability to handle relatively circuitous alignments as long as the turning radii are no less than approximately 300 feet. From examination of aerial imagery, the existing access roads for Morris Dam appear to meet these criteria.

Given the following assumptions, it was determined that if conveyor belts were to be used at Morris Reservoir approximately 560,000 CY could be removed per cleanout. The conveyor belt would have a capacity of 800 CY/hour. Sediment would be brought to the Vulcan Pit, approximately 5.4 miles from Morris Dam. Material would be brought to the Vulcan Pit, just north of the 210 Freeway.

At this rate it would take approximately seven (7) 6-month cleanout projects to remove the entire 3.3 MCY 20-year quantity.

Conveyor Belts - Cost

The estimated cost for constructing and operating a conveyor belt from Morris Dam to the Vulcan Pit is approximately $23 million. If the existing conveyor belt is utilized, the cost is estimated at $34 million.

7.4.5.4 <u>SLURRY PIPELINE</u>

As discussed in Section 7.4.4.2, slurry pipelines would be used in conjunction with dredging. A slurry pipeline could be constructed to transport slurry material to Santa Fe Flood Control Basin to dewater. As discussed, it is assumed that the entire 3.3 MCY would be dredgeable.

Route for Slurry Pipeline

A slurry pipeline would begin at the end of the dredge line on the downstream face of Morris dam. From here, the slurry pipeline could be constructed along Old San Gabriel Canyon Road. As mentioned in previously, a portion of Old San Gabriel Road has been washed out and would need repair if it is to be used, even just for access to the slurry pipeline.

Old San Gabriel Canyon Road ends at San Gabriel Canyon Road approximately 2 miles downstream of Morris dam. The slurry pipeline would then have to be routed across San Gabriel Canyon Road to the side that Gabriel Bike Trail is located. From here, the slurry pipeline could be aligned with the bike trail and continue downstream to Santa Fe Flood Control Basin. There are multiple places where the slurry pipeline could need to be configured to accommodate regular traffic or access on the bike trail. This could involve trenching the slurry pipeline underground or bridging the slurry pipeline over certain points. See the alignment of the pipeline in Figure 7-45.

Figure 7-45 Morris Slurry Pipeline Alignment

Slurry Pipelines - Environmental Impacts

In order to identify and minimize the potential environmental impacts of placing and operating a slurry pipeline from Morris Dam to Santa Fe Flood Control Basin or a pit further downstream, the habitat along the potential alignments would have to be studied. Water quality, groundwater recharge, and air quality would not be expected to be impacted, provided the capacity of the electric power grid in the area could accommodate the pipeline's booster stations.

Slurry Pipelines - Social Impacts

Along Old San Gabriel Canyon Road there is a religious facility, an equestrian facility, and also the headquarters building of the San Gabriel River Mountains Conservancy. Access to these facilities would not be inhibited by the proposed slurry pipeline. There would likely be a visual impacts associated with the pipeline running long that road. It could be possible to trench the pipeline underground to minimize visual impacts.

Access to the two neighborhoods previously mentioned and the bike path would also need to be accommodated in design of the slurry pipeline.

Noise from a slurry pipeline is not expected to impact the nearby neighborhoods, recreational users of the bike path, or potentially users of the Geology Area & Park, though there would likely be a visual impact.

Slurry Pipelines - Implementability

As with dredging, the Flood Control District has never used slurry pipelines to transport sediment. The ability to use a slurry pipeline relies on dredged material and with neither having ever been used; further study is recommended to determine the technical certainty of this alternative.

Assuming that dredging is determined to be efficient, the dredged material would be routed in the dredge's line to the downstream face of the dam to connect to the slurry pipeline. Pumps could be needed to be used to move the slurry mix either over the dam or through a valve tunnel in the dam.

As discussed in Section 6, the slurry pipeline is flexible and would be able to handle the turning radii necessary to reach the Santa Fe Flood Control Basin or a pit located further downstream. This type of pipe is expected to perform well past the 20-year planning timeline resulting in minimal maintenance effort.

Approximately 7 miles of slurry pipeline would be constructed along Old San Gabriel Road and the Gabriel Bike Path to Santa Fe Flood Control Basin. For planning purposes it is assumed booster stations would be needed every mile to keep the slurry moving down the pipeline. Further evaluation would be needed to determine whether the existing electric power grid in the area and whether there is adequate land space to accommodate the pipeline's booster stations. Placement of a slurry pipeline and booster stations along the proposed route would present right-of-way and permitting issues.

It is assumed that there would be adequate capacity and location at either Santa Fe Flood Control Basin or an acquired pit to dewater the slurry mixture.

Slurry Pipelines - Performance

As mentioned previously, a slurry pipeline would be used in conjunction with the dredging alternative. Therefore, if 9 dredging operations were to be conducted during the 20-year planning period to remove the entire 3.3 MCY of planning quantity, then the slurry pipeline would be used a total of nine times during the 20-year planning period. As discussed in Section 6, the slurry pipeline would need to transport approximately 2,000 CY of the water-sediment slurry per hour or approximately 15 cubic feet of the slurry per second. In total, during a 6-month dredging operation, the slurry pipeline would need to handle a total of 4 MCY or 2,500 acre-feet of slurry. It is expected that the type of slurry pipeline that would be used would be able to perform during the 20-year planning timeline.

For planning purposes, it was assumed that a total of nine lift stations would be required for the 6.4-mile long slurry pipeline between Morris Dam and Santa Fe Flood Control Basin.

Slurry Pipelines – Cost

The estimated cost for a slurry pipeline, including the cost of booster station, from Morris Reservoir to Santa Fe Flood Control Basin is approximately $36 million. The cost from Morris Reservoir to an acquired pit is estimated at approximately $46 million. Both costs include the cost of booster station approximately every mile for 7 miles.

7.4.6 PLACEMENT

Although Section 6 identified landfills as a feasible placement alternative for reservoirs, the long distance and limited available capacity prohibit their use for sediment removed from Morris Reservoir.

7.4.6.1 LANDFILLS

Although Section 6 identified landfills as a feasible placement alternative for reservoirs, the long distance and limits capacity prohibit the use for Morris Reservoir.

7.4.6.2 PITS

The general impacts of employing pits for sediment placement were discussed in Section 6. There are multiple pits in Irwindale. Figure 7-9 shows the location of the pits in relation of San Gabriel Reservoir. For San Gabriel Reservoir to the pits, the distance is approximately 14 miles, depending on the route, which can vary accordingly, and the mode of transportation used.

7-18 Irwindale Pits Location

The general impacts of employing pits for sediment placement were discussed in Section 6. There are multiple pits in Irwindale. From the upstream access point of Morris Reservoir to the pits, the distance is approximately 15 miles, depending on the specific pit identified for use, the mode of transportation used, and the route. From Santa Fe Flood Control Basin the distance is approximately 2 miles and can also vary depending on the specific pit identified for use, the mode of transportation used, and the route.

It is assumed that the entire 3.3 MCY of material from Morris Reservoir that is proposed for transport out of the canyon would be marketable. Given that assumption and other assumptions discussed in Section 6, it was assumed that pits operated by the gravel industry would accept the entire 3.3 MCY of sediment from Morris Reservoir free of charge.

As discussed in Section 6, the acquisition of pits for the placement of sediment from facilities under the jurisdiction of the Flood Control District should be pursued. Acquisition of a quarry in Irwindale would be most desirable for sediment management operations related to Morris Reservoir. It would cost a total of $3 per cubic yard to acquire and place the 3.3 MCY of sediment at the Flood Control District-owned pit.

7.4.6.3 Sediment Placement Sites

Burro Canyon SPS is located approximately 8.5 miles upstream from Morris Dam. Due to the extensive need for sediment placement locations for both San Gabriel Reservoir and Cogswell Reservoir, Burro Canyon was not included in the placement alternatives for Morris. Burro Canyon SPS could be considered in the future if all of the placement alternatives from this plan are exhausted. More information about the impacts of Burro Canyon SPS can be found in Section 7.3.

No other previously-used SPS or new canyon-SPS was considered for disposal of sediment from Morris Reservoir.

7.4.7 COMBINED SEDIMENT MANAGEMENT ALTERNATIVES

Combining the removal and transportation alternatives for Morris Reservoir there are five sets of feasible options. A description of each of these combined sediment management alternatives is given below. More specific details regarding the environmental impacts, social impacts, feasibility, implementability, and cost for individual alternatives are given in the previous subsection. Combined impacts and costs are described below.

7.4.7.1 Combined Alternative 1: Dry Excavation → Trucks → Irwindale Pits

Combined Alternative 1 would involve dry excavating then trucking the sediment partially along San Gabriel Canyon Road and partially on a private access road near the Gabriel Bike Path. By routing the trucks along the access road no truck traffic would pass through downtown Azusa. There would be some social impacts to a few neighboring communities and likely to the bike path users.

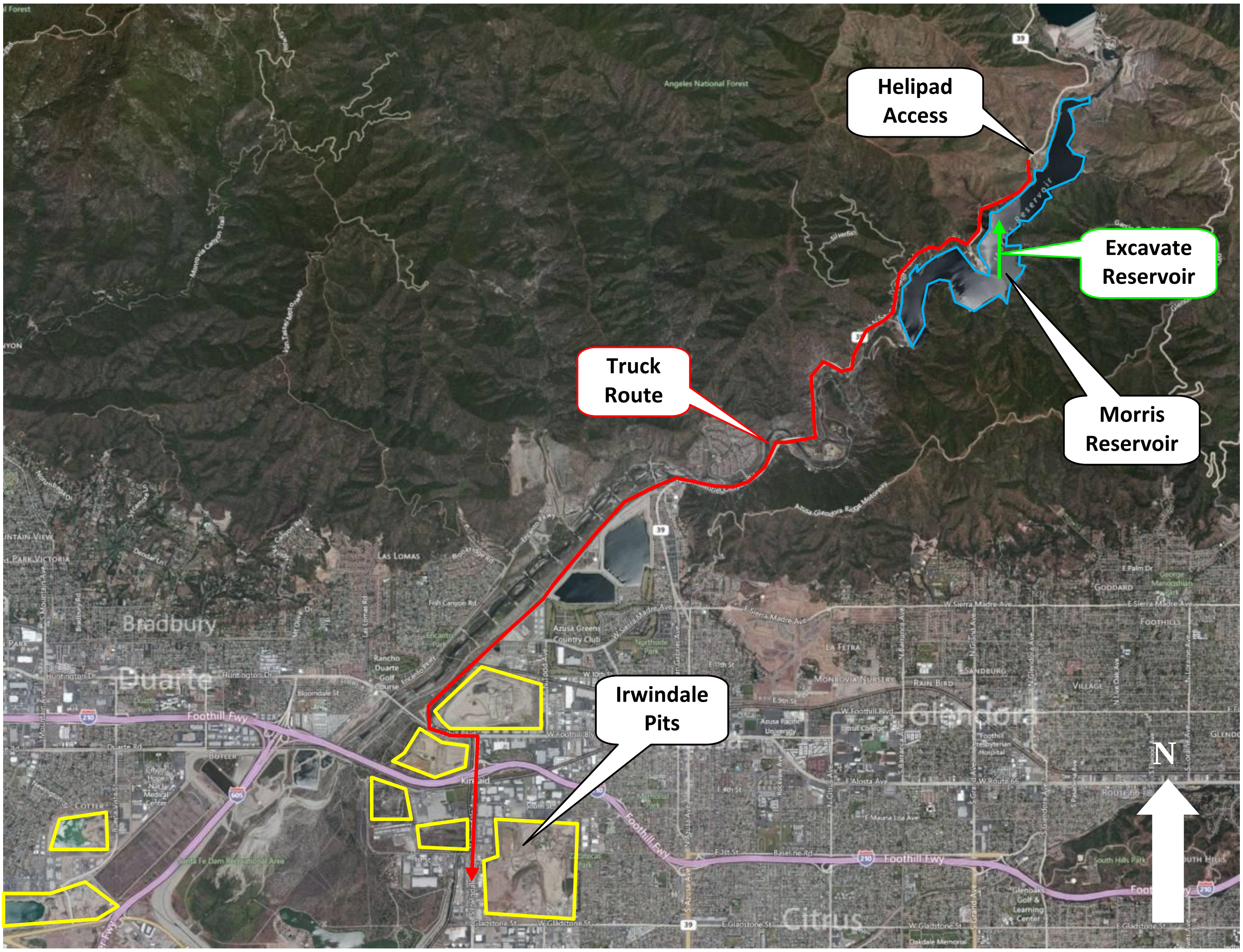
Utilizing existing roads and access roads minimizes new impact to habitat. There would be some impacts to air quality. From this access route the sediment could ultimately be brought to a placement site in Irwindale. There are several potential pit options in the Irwindale area. The Flood Control District intends to pursue the purchase of a new pit as well as the use of those existing.

Given the assumption regarding dry excavation and trucking it would take approximately five (5) 6-month cleanout projects to remove the total 3.3 MCY 20-years in conjunction with trucking. Implementation of this alternative could cost from an estimated $35 Million to $50 Million depending on the destination of the sediment. The breakdown of estimated costs is provided in the following table.

Table 7-19 Estimated Costs for Combined Alternative 1

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Excavate Material at Morris Reservoir	3.3	$10
Truck from Morris to Irwindale Pits		$15
Place sediment at an Irwindale Pit		$10-$23
Total	**3.3**	**$35-$50**

Figure 7-46 Morris Reservoir Combined Alternative 1



7.4.7.2 COMBINE ALTERNATIVE 2: DRY EXCAVATION → CONVEYOR BELT → VULCAN CONVEYOR BELT → SELECT IRWINDALE PIT

Combined Alternative 2 would involve dry excavating and transporting it on a conveyor belts downstream. It is assumed that the conveyor system could either be directed through a low valve on the dam or over the top of the dam. More study would be needed to determine the most efficient way to transport the sediment from the reservoir to the downstream face of the dam.

The conveyor system would be approximately 4 feet wide would start either from inside the basin or at the downstream face of the dam, depending on removal technique, and continue along Old San Gabriel Road as seen in Figure 7-47. At the end of Old San Gabriel Canyon Road the conveyor belt would need to cross San Gabriel Canyon Road to reach the west side of the road. From there, the conveyor belt would run adjacent to the bike path for almost 2 miles. At this location there is an existing conveyor belt owned by Vulcan Materials Company (Vulcan). If the Flood Control District is able to rent the existing conveyor system from Vulcan temporarily during these cleanouts the new conveyor could connect to an existing conveyor system that bring the sediment to a pit owned by Vulcan located just north of the 210 Freeway. If the existing conveyor belt is not available for use, it could be possible to construct a new conveyor belt adjacent to the existing one. This conveyor belt could possibly end at the Vulcan Pit just north of the 210 Freeway as well.

There are residents on the lower portion of Old San Gabriel Road. If the conveyor system is located above ground there could be some visual impact. It could be necessary to trench the conveyor system in some areas to maintain access.

Habitat along Old San Gabriel Canyon Road as well as along the bike path would be impacted by the construction of a conveyor system. If portions of the conveyor system are trenched there could be more opportunity for habitat to recover along that portion of the alignment.

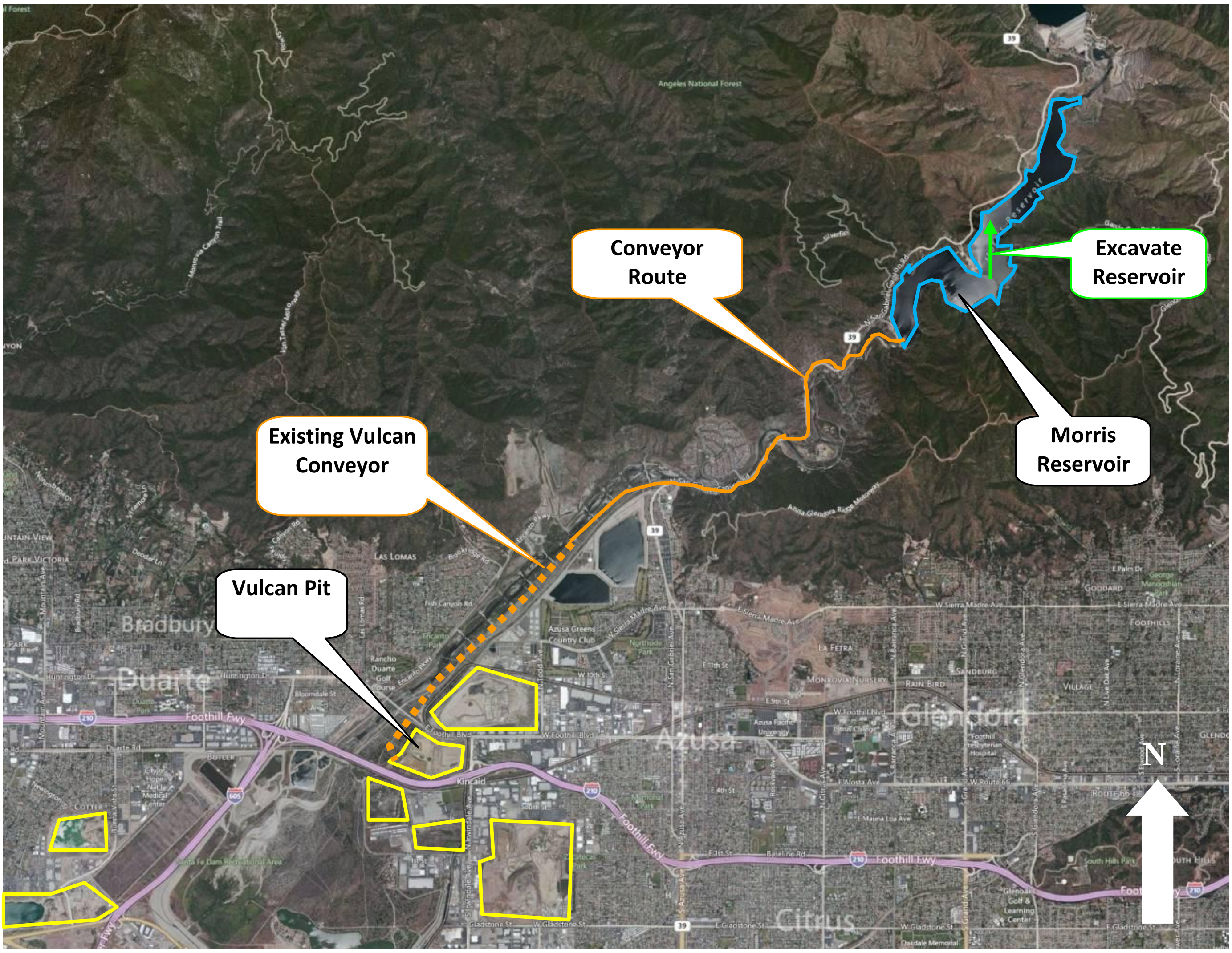
For the total 3.3 MCY of sediment to be removed in the next 20-years using conveyor belts there would take approximately seven (7) 6-month removal projects.

As discussed in previously, it is assumed that the all of the material would be left with Vulcan. The total cost would between approximately $55 million and $70 million. The breakdown of estimated costs is provided in the following table.

Table 7-20 Estimated Costs for Combined Alternative 2

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Excavate Material at Morris	3.3	$10
Transport via New Conveyor Belt		$23-$34
Transport on Existing Conveyor Belt		$0.5
Place at an Existing Pit		$23
Total	**3.3**	**$55-$70**

Figure 7-47 Morris Reservoir Combined Alternative 2



7.4.7.3 COMBINED ALTERNATIVE 3: DREDGE → SLURRY PIPELINE → SANTA FE → TRUCKS→ IRWINDALE PITS

Combined alternative 3 would involve dredging material to a slurry pipeline to downstream San Fe Basin. As discussed in previously, dredging could occur once the reservoir has been lowered to such a level that the maximum depth to the sediment to be dredged is 50 feet. It is assumed that the slurry line could either be directed through a valve tunnel in the dam or over the top of the dam. Further study would be needed to determine if there is adequate water to dredge material while keeping a lower reservoir elevation.

From the downstream face of the dam the slurry pipeline would be constructed along Old San Gabriel Road. At the end of Old San Gabriel Canyon Road the slurry pipeline would need to cross San Gabriel Canyon Road to the west side of San Gabriel Canyon Road. From there, the slurry pipeline would run adjacent to the bike path for approximately 7 miles to Santa Fe Flood Control Basin. In some areas it could be necessary to trench the slurry line. Booster stations would be needed for every mile of slurry line to keep the mixture moving. It is assumed that there would be an adequate area to dewater the slurried material. Further study would be necessary to verify this assumption.

Sediment that is trucked from the reservoir could be brought to either a privately owned pit or a pit that the Flood Control District could purchase in the future. The Flood Control District intends to pursue the purchase of a new pit as well as the use of those existing.

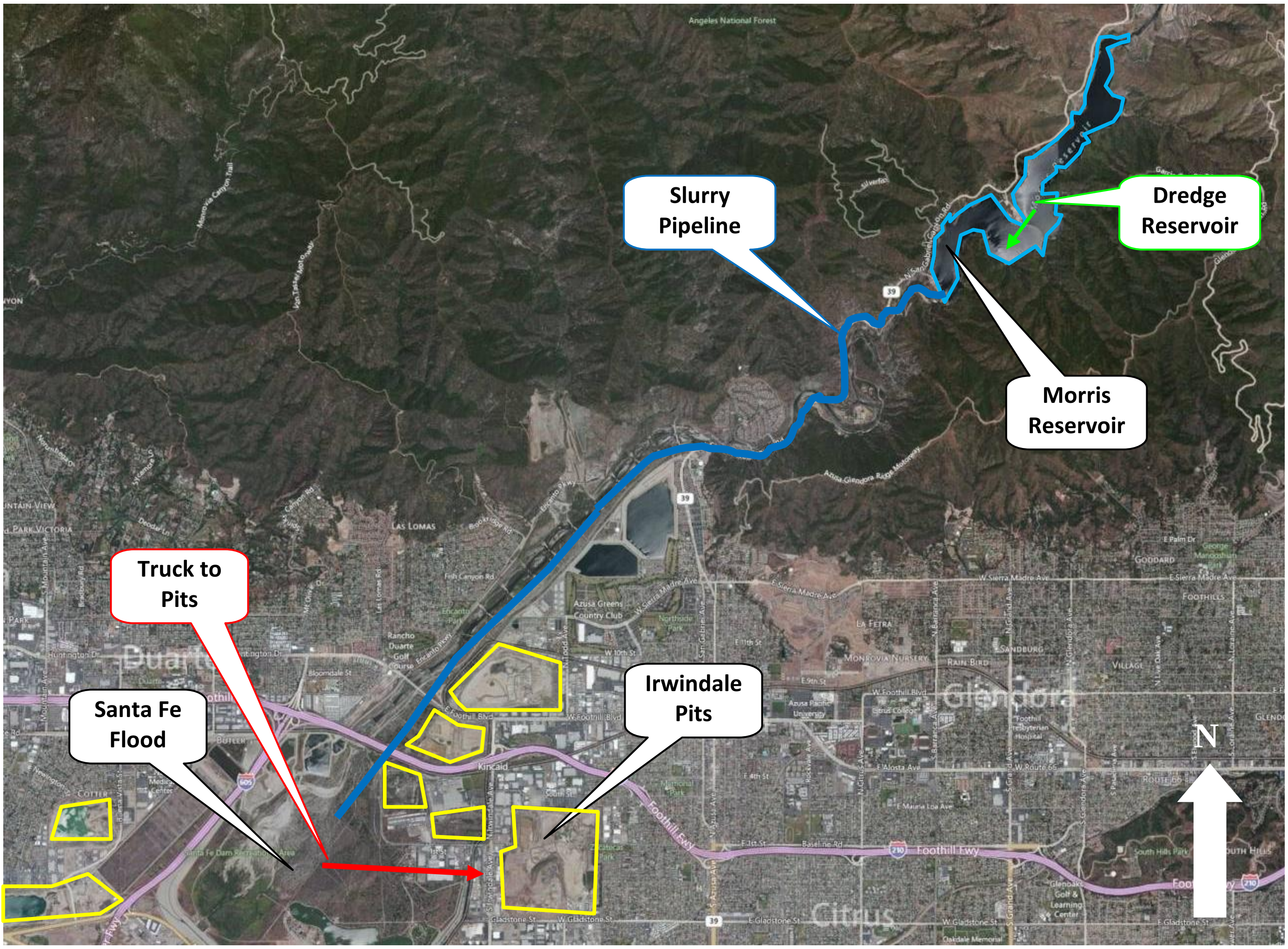
For the total 3.3 MCY of sediment to be removed in the next 20-years via dredging to a slurry pipeline, there would need to be approximately nine (9) six-month cleanouts. Implementation of this alternative could cost from an estimated $90 Million to $110 million depending on the destination of the sediment. The breakdown of estimated costs is provided in the following table.

Table 7-21 Estimated Costs for Combined Alternative 3

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Dredge Material at Morris	3.3	$36
Slurry Material from Morris to Acquired Pit		$46[a]
Slurry Material from Morris to Santa Fe Flood Control Basin		$36
Excavate Material from Santa Fe Flood Control Basin		$10
Truck Material from Santa Fe to an Irwindale Pit		$2
Place sediment at either and Acquired or Existing Pit		$16-$36
Total	**3.3**	**$90-$105**

a. Material slurried directly to an acquired pit would be at its final placement location.

Figure 7-48 Morris Reservoir Combined Alternative 3



7.4.7.4 COMBINED ALTERNATIVE 4: SLUICING → SANTA FE FLOOD CONTROL BASIN → TRUCKS → IRWINDALE PITS

Combined Alternative 4 involves sluicing the material from Morris Reservoir approximately 8 miles down the San Gabriel River to Santa Fe Flood Control Basin. Trucks performing the removal from Santa Fe Flood Control Basin would then travel along various existing roads in the Irwindale area depending on the exact location of placement. Figure 7-49 shows the alignment of these combined alternatives. Irwindale is a highly industrial city and it is expected that there would be minimal social impact as a result of trucking sediment. The area surrounding specific truck routes would be taken into consideration as specific projects are implemented. There could be some disruption to bike path use within Santa Fe Flood Control Basin.

Material being sluiced down the San Gabriel River would have temporary and likely minimal impacts on river habitat. Impacts on habitat, in the Santa Fe Flood Control Basin though sediment removal in the existing willow area would be avoided, would need to be studied. Utilizing existing roads when trucking sediment out of Santa Fe Flood Control Basin would minimize additional impact to habitat, though there would be impacts to air quality, due to using trucks for transport.

There are several options in the Irwindale area. Sediment that is trucked from the reservoir could be brought to either a privately owned pit or a pit that the Flood Control District could purchase in the future. The Flood Control District intends to pursue the purchase of a new pit as well as the use of those existing.

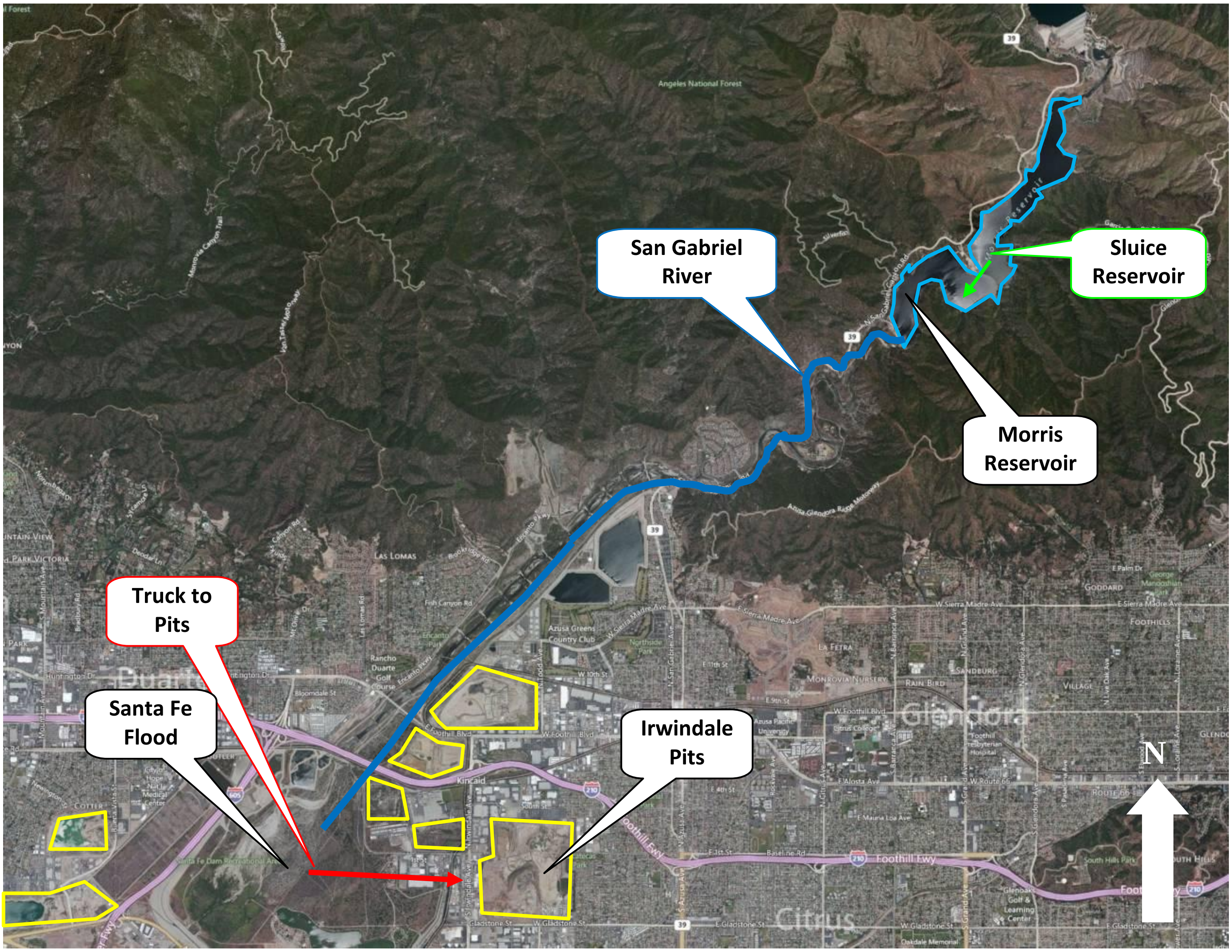
It would take five (5) 6-month sluicing cleanouts to remove the total 3.3 MCY 20-year planning quantity using this combined alternative.

Implementation of this alternative could cost from an estimated $30 Million to $43 Million depending on the destination of the sediment. The breakdown of estimated costs is provided in the following table.

Table 7-22 Estimated Costs for Combined Alternative 4

Activity	Quantity Removed (MCY)	Estimated Costs (in Millions)
Sluice Material from Morris To Santa Fe	3.3	$8
Excavate Material from Santa Fe		$10
Truck Material from Santa Fe Flood Control Basin to Irwindale Pits		$2
Place sediment at either an Acquired or Existing Pit		$10-$23
Total	**3.3**	**$30-$43**

Figure 7-49 Morris Reservoir Combined Alternative 4



7.4.8 MORRIS RESERVOIR SUMMARY AND RECOMMENDATIONS

7.4.8.1 SUMMARY

Over the next 20 years, 3.3 MCY of sediment are planned to be removed from Morris Reservoir, including the estimated 2 MCY that could potentially be sluiced or delivered by slurry pipeline from San Gabriel Reservoir. The quantity sluiced from San Gabriel Reservoir to Morris Reservoir is limited by the ability to remove the sediment from Morris Dam. The different alternatives for managing the sediment accumulated in Morris Reservoir are briefly explained below and the impacts are shown in Table 11-3.

Sediment Management Alternatives

1 Dry Excavate → Trucks → Irwindale Pits
Alternative 1 proposes to dry excavate 3.3 MCY of sediment from Morris Reservoir and truck it to the Irwindale pits. Given the location of Morris Reservoir, there would be some noise and visual impacts associated with excavation within the reservoir. There would also be some traffic, noise, and visual impacts from the trucks driving to the Irwindale pits.

2 Dry Excavate → Conveyor → Vulcan Conveyor Belt → Irwindale Pits
This Alternative is similar to Alternative 1 except that the material would be transported by conveyor belt from Morris Reservoir to the Irwindale pits. There would be some habitat impacts along Old San Gabriel Canyon Road and San Gabriel Canyon Road where the conveyor alignment is proposed.

3 Dredge → Slurry Pipeline → Santa Fe Flood Control Basin → Dry Excavate → Trucks→ Irwindale Pits
Alternative 3 proposes to dredge the 3.3 MCY of sediment from Morris Reservoir and transport the material via slurry pipeline to Santa Fe Flood Control Basin (FCB). From Santa Fe FCB, the sediment would be excavated and trucked to a pit in Irwindale. There would be some water quality impacts within Morris Reservoir and some visual and noise impacts from the dredge. There would also be some habitat impacts along Old San Gabriel Canyon Road and San Gabriel Canyon Road where the slurry pipeline alignment is proposed.

4 Sluice → Santa Fe Flood Control Basin → Dry Excavate → Trucks → Irwindale Pits
Alternative 4 proposes to sluice the entire 3.3 MCY to Santa Fe FCB. Similar to Alternative 3, the material in Santa Fe FCB would be excavated and trucked to a pit in Irwindale. There would be habitat impacts and some water quality impacts to the San Gabriel River and in Santa Fe FCB as a result of sluicing. There would also be some increased in traffic, noise, and visual impacts due to excavation in Santa Fe FCB and trucking.

Recommendations

It is recommended that Alternatives 1, 2, and 4 be considered for future sediment removal projects at Morris Reservoir. Due to the high cost, Alternative 3, which involves dredging, should be considered only after all previous recommendations are deemed infeasible.

Table 7-23 Summary of Sediment Management Alternatives for Morris Reservoir

Alternative		Quantity Removed (MCY)	Environmental				Social			Implementability	Performance		Cost
			Habitat	Water Quality	Groundwater Recharge	Air Quality[a]	Traffic	Visual	Noise	Special Permit/ Agreement Required[b]	Previous Experience	# of operations required in next 20 years	$ Millions
1	Dry Excavation	3.3	◑		○	◑		◑	◑		Yes	5	35-50
	Trucks					●	●	◑	◑				
	Irwindale Pits									Yes			
2	Dry Excavation	3.3	◑		○	◑		◑	◑		Yes	7	55-60
	Conveyor Belts		◑					◑	○				
	Irwindale Pits									Yes			
3	Dredge	3.3	○	◑	○			○	○		No	9	90-105
	Slurry Pipeline to Santa Fe Basin		◑					◑					
	Santa Fe Basin		◑	●	○	◑		◑	◑	Yes	Yes		
	Trucks					●	●	◑	◑				
	Irwindale Pits									Yes			
4	Sluice	3.3	●	●	◑			◑			Yes	5	30-45
	Santa Fe Basin		◑	●	○	◑		◑	◑	Yes			
	Trucks					●	●	◑	◑				
	Irwindale Pits									Yes			

Legend:

●	significant impact
◑	some impact
○	possible impact
	no impact

Notes: (a) Use of low-emission trucks would reduce air quality impacts from significant impact (●) to some impact (◑).
(b) All options require environmental regulatory permits.