Roads & Bridge Technical Memorandum

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Date:	August 21, 2020
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Subject:	Roads and Bridge Task Order No.1, Task HR2.96

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Acronyms and Abbreviations

AB	aggregate base
ADT	Average Daily Traffic
CAD	AutoCAD Civil 3D
CIP P/S	Cast-in-Place Prestressed
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	environmentally sensitive area
FDR	full-depth reclamation
HDM	Highway Design Manual
HMA	hot-mix asphalt

I-5	Interstate 5
MAF	million acre feet
MPH	miles per hour
SDC	Seismic Design Criteria
TCE	Temporary construction easements
TM	technical memorandum
WLA	William Lettis and Associates

1.0 Introduction

1.1 Purpose and Scope

The Sites Project Authority (Authority) is preparing a feasibility-level evaluation for a 1.5-million-acre-foot (MAF) reservoir as a preferred option for the Sites Reservoir Project. This reservoir would be in the same location as the reservoir studied previously by the California Department of Water Resources, Division of Engineering (DWR), and the U. S. Bureau of Reclamation (USBR).

This technical memorandum (TM) discusses the basis for selection of layout of roads around the project site, and the bridge across the reservoir. This TM will support the Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) for the Sites Reservoir Project through feasibility-level designs of project features.

1.2 Limitations

The scope of work for this TM was restricted to the development of the feasibility design for the Sites Reservoir Roads and Bridges. It did not include consideration of other Sites facilities beyond those specifically listed.

The feasibility designs presented in this TM were based on topographic contours that originated from DWR for their 2003 studies and available USGS quadrangle topographic mapping. Updated site-specific topographic maps would be prepared for use in preliminary and final phases of design.

AECOM represents that our services were conducted in a manner consistent with the standard of care ordinarily applied as the state of practice in the profession, within the limits prescribed by our client.

This TM is intended for the sole use of the Sites Project Authority. The scope of services performed may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or of the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

2.0 Roads

2.1 General

The Sites Reservoir project would involve impacts to surrounding area roadways regarding general public traffic routing, temporary construction access, and permanent Sites Reservoir facilities maintenance access. Roads that are implemented/improved for construction would likely be used for reservoir facilities maintenance following construction completion. The roads being considered through feasibility evaluation are listed in **Error! Reference source not found.**.

These roads are shown in preliminary layout drawings (Section 4). Although all the roads noted in Table 2-1 are being studied in this Feasibility Study Phase, the roads that are shaded have been conceptually defined to provide the necessary detail to inform the environmental studies that are currently being performed. The remainder of the roads can be considered in the environmental studies without conceptual definition.

Sites Lodoga Road provides access to and from the town of Maxwell, which is adjacent to Interstate 5 (I-5). Sites Lodoga Road becomes Maxwell Sites Road east of the rural community of Sites, which is in the reservoir. Sites Lodoga Road is an important east-west two-lane major collector road, and provides an emergency and evacuation route to and from the rural communities due to a limited roadway network (see Figure 2-1). The reservoir would sever Sites Lodoga Road east-west access to I-5 (east of the reservoir) from the rural communities of Stonyford and Lodoga (west of the reservoir). Because construction of the Sites Dam would impede access on the Sites Lodoga Road, this important collector would need to be relocated (realigned) prior to the construction of the reservoir. Construction access roads are shown on Figure 2-2. This Sites Lodoga Road realignment has been studied in various alternative alignments as illustrated in Figure 2-3; of these alternatives, Alternatives 1 and 4 are being studied further, as noted in Table 2-1. Alternative 1 focuses on the most efficient alignment crossing the reservoir, while Alternative 4 focuses on a southerly alignment around the reservoir.

Table 2-1 – Sites Project Roads & Purposes

Roads		Road Purposes By Agency	
		Colusa County [2]	**Glenn County** [2]
1	Sites Lodoga Road Realignment (Alt 1 Causeway)	Local	
2	Sites Lodoga Road Realignment (Alt 4 – South Road)	Local	
3	Huffmaster Road Realignment[1]	Local	
4	Road 68		Local / Construction
5	Road D		Local / Construction
6	Road 69		Local / Construction
7	North Road (Access Road – Road 69)		Construction / Maintenance
8	Delevan Road	Local / Construction	
9	McDermott Road	Local / Construction	Local / Construction
10	Saddle Dam Road – North (5 – 8)		Construction / Maintenance
11	Saddle Dam Road – South (1 – 5)	Maintenance	Maintenance
12	Access Rd A (GG Dam)	Maintenance	
13	Access Rd B (Inlet/Outlet Tower/GG Dam)	Maintenance	
14	Access Rd C (O&M/PGP/GG Dam)	Maintenance	
15	Comm Road (To Communication Towers)	Local	
16	Day-Use Boat Ramp (westside)	Local	
17	Peninsula Hills Recreation Area	Local	
18	Stone Corral Recreation Area / Sites Dam	Local	

Notes:
1) Huffmaster Road Realignment is the easterly segment of Sites Lodoga Road Realignment (Alt 4) from Huffmaster Road to Maxwell Sites Road. This is the south road to the southern residents.
2) Local access includes a local road for public use and recreational access.

Construction access for the reservoir and supporting facilities would occur on public roads from I-5 to the reservoir site on the north, and at Sites Lodoga Road on the east. There are three primary construction access routes for consideration, which would most likely be defined for use by the contractor (see Figure 2-2):

- One access route could occur on 5.5 miles of narrow (+/- 24 feet wide) paved road from I-5, west along Road 68, south on Road D, and west on Road 69 to just west of the Tehama-Colusa Canal, where the road reverts to a single-lane (+/- 12 feet wide) gravel road, referred to as the North Road (Access Road), continuing for approximately 5 miles to the northern end of the reservoir at the saddle dams. From this location, the contractor would establish their own “on-site” access roads within the limits of the reservoir.

- A second construction access route could occur on 7.2 miles of narrow (+/- 24 feet wide) paved road from I-5, west along Delevan Road, north along McDermott Road, and west on Road 69 to just west of the Tehama-Colusa Canal, as noted above. Approximately 1.5 miles of McDermott Road between Dirks Road and West Glenn Road is gravel, and may need to be paved to accommodate the volume of heavy construction traffic.

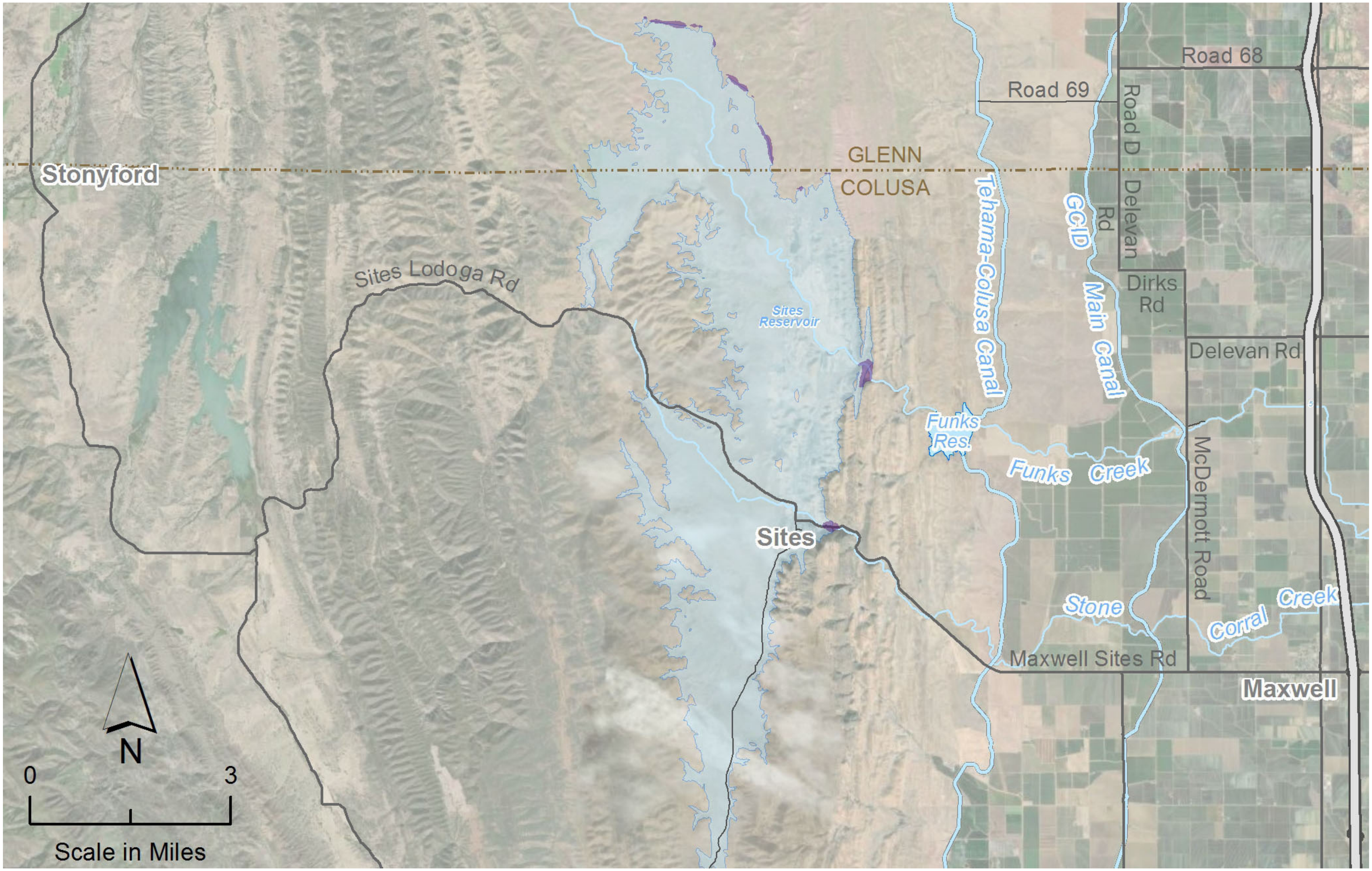

Figure 2-1 – Sites Lodoga / Maxwell Sites Road

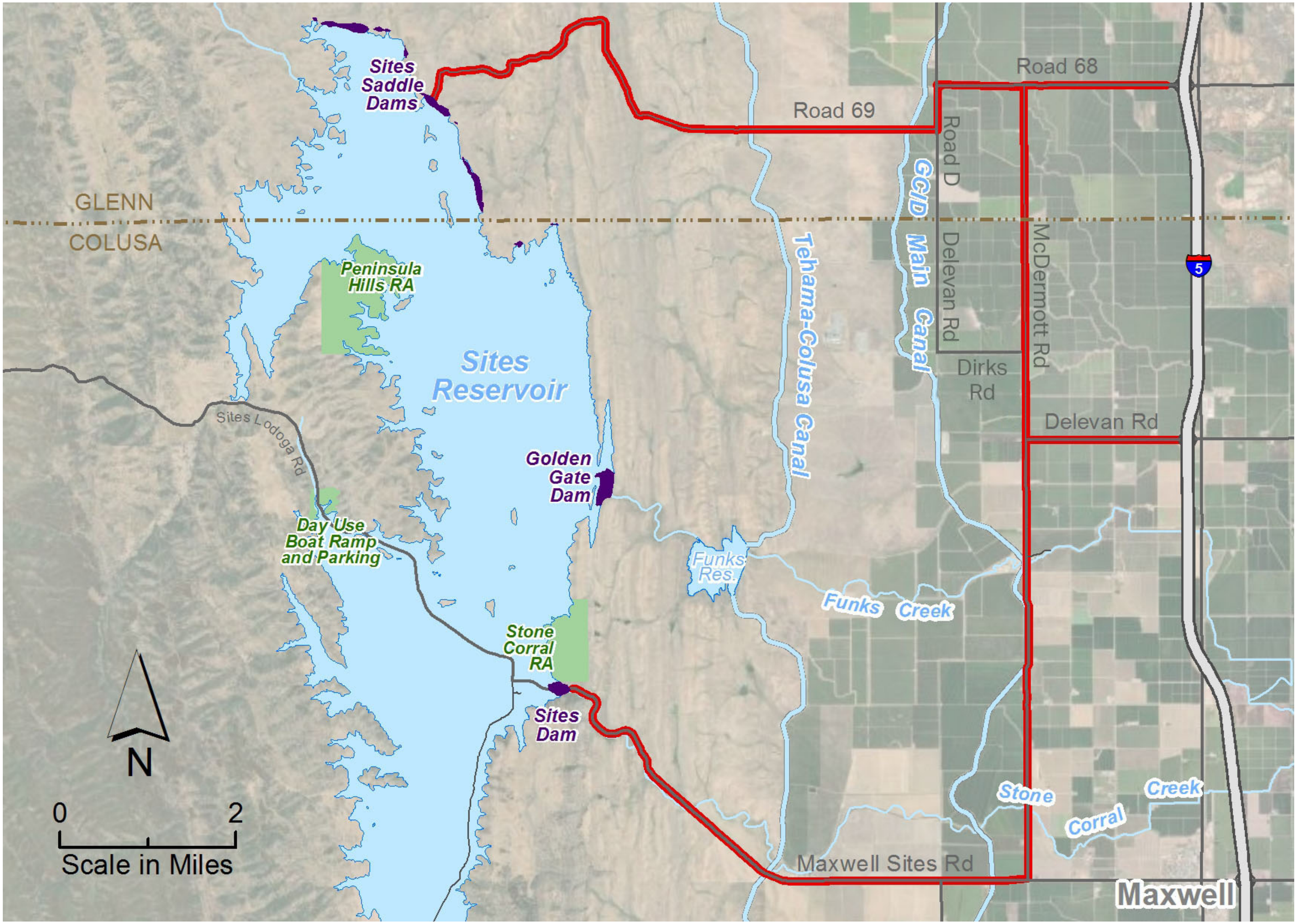

Figure 2-2 – Construction Access Roads

- A third construction route includes 12 miles of narrow (+/- 24 feet wide) paved road from I-5, along Delevan Road, south along McDermott Road to Maxwell Sites Road, and then west to the existing gravel access road to Funks Reservoir. The first mile of this gravel road is the initial segment of Alternative 1 of the realigned Sites Lodoga Road. This gravel road would also provide access to the Funks Reservoir Pumping Generation Plant and Switching Yard and beyond to the Golden Gate Dam. Sites Maxwell Road would provide access to the Sites Dam location.

Because Sites Lodoga Road / Maxwell Sites Road is an important major collector road, this road would need to maintain traffic conveyance throughout construction, with the possibility of short-term (3- to 5-day) closures to connect the realigned roadway segment to the existing roadway. To maintain traffic during construction, the realignment of Sites Lodoga Road / Maxwell Sites Road would need to be constructed as part of the first order of work.

Construction equipment/materials would not be permitted to pass through the town of Maxwell on Maxwell Sites Road; therefore, the construction access roads must be routed around Maxwell (see Figure 2-2).

2.2 Background

2.2.1 Existing Roadways and Deficiencies

Construction Access – Local Roads

The existing roads are nonstandard in geometry and likely have inadequate roadbed structural section to accommodate large-sized construction equipment/materials transport loads. These roads include Road 68, Road D, Road 69, and possibly Delevan Road and McDermott Road. These roads are narrow, and typically include two paved 11-foot or 12-foot lanes, and 1- to 3-foot earthen shoulders. Road 68, Road D, and Road 69 pavement conditions are “at risk” “poor” and “very poor,” respectively, on visual inspection during our June 18, 2020, field review. A portion of McDermott Road is gravel in Colusa County. Road 69 transitions to a narrow, single-lane gravel road west of the Tehama-Colusa Canal. The following roadway improvements may need to be implemented on these existing roadways:

- Roadbed widening
- Intersection widening
- Roadbed reconstruction
- Horizonal curve corrections
- Vertical curve corrections
- Drainage feature improvements

Portions of existing county roads would need to be widened to provide sufficient shoulder widths for safe mobility of construction traffic that would be comingled with local vehicular and agriculture equipment traffic. The roadbed structural section may need to be increased by overlaying hot-mix asphalt (HMA), or may require complete reconstruction. Complete reconstruction could be performed through conventional means of roadbed excavation and placement of new HMA on aggregate base (AB), or reconstructed with full-depth reclamation (FDR) methods, reusing in-place material through full-depth pulverizing, injection of emulsion or additive, compaction, and then HMA overlay. FDR is less impacting to traffic, and allows traffic to be restored immediately following the pulverizing process, reducing construction schedule and cost. FDR is also considered a “green” method for roadway construction, because it reduces greenhouse gas effects due to avoiding long-haul transport of providing and disposing of materials. Additionally, narrow intersections may need to be widened to accommodate large-equipment turning movements; and where horizontal and vertical curves are inadequate, reconstruction of these roadway features may need to occur. All existing roadway improvements would be designed to minimize or avoid utility and right-of-way impacts.

The noted construction access routes involve roadways with structures over irrigation canals and channels that would need to be evaluated for their ability to support construction transport loads. The following roads involve the noted number of structures to be evaluated. These structures may need to be widened, strengthened, or replaced depending on their structural condition and load rating capacity.

- Road 68 – two structures
- Road D – two structures
- Road 69 – three structures (two on the paved road crossing the Tehama-Colusa Canal and Glenn County Irrigation District Canal, and one on gravel road)
- McDermott Road – five structures

These structures would be evaluated in a future project design phase. For this study, it is assumed that these structures would be replaced for conservatism in project construction cost estimating, which would occur in a later project development phase. On further evaluation, it is possible that some or all of these structures may have adequate integrity for construction loads, and may not need to be replaced. In such cases, some of these structures would need to be widened to accommodate safer two-way passage of construction and public traffic. Should structures be deemed to lack integrity for construction loads, such structures could be additionally supported from below their decks with temporary supports to avoid costly replacement. This would be included in future project phase evaluations.

<u>Local Access – Sites Lodoga Road</u>

Sites Lodoga Road is a narrow roadway consisting of two 11-foot lanes and 1-foot paved shoulders with 1- to 3-foot earthen shoulders. The roadway alignment is linear, extending east to west from I-5 through Maxwell and across San Joaquin Valley floor farmland before meandering through a rolling hill range that has an advisory posting of "CAUTION, NARROW WINDING ROAD, NEXT 18 MILES," and advisory "35 MPH (miles per hour)." Beyond the rolling hill range, the road extends across Antelope Valley and then meanders over a small mountain range into Lodoga, where a series of curves includes posted advisory speeds of "20 MPH" and "25 MPH." Maxwell Sites Road/Sites Lodoga Road is classified by Colusa County as a Class III Bike Route. The relocated portion of Sites Lodoga Road is proposed to include 5-foot shoulders adjacent to the two 12-foot lanes to accommodate bicycles in the Sites Reservoir recreational area.

<u>Off-Site Borrow Sites</u>

Within the limits of the reservoir, some locations may be used as material borrow sites. Beyond these localized sites, other possible borrow sites have been identified for transporting material to the reservoir site for constructing the roadways and dams. These off-site borrow sites include:

- A site near Orland, about 30 miles north of Maxwell on I-5.
- Butte Sand and Gravel along State Route 20 near the town of Sutter, 23 miles east of Williams, which is 8 miles south of Maxwell.
- Saddle Dam Sandstone Quarry, which is located immediately east and adjacent to the reservoir site.

These locations are illustrated on Drawings STS-315-C-2002 to STS-315-C-2004.

2.2.2 Roadway Objectives and Maintenance Responsibilities

The three purposes of roadways as defined for this project are as noted above – Local Access, Construction Access, and Maintenance Access. Roadways that are used or constructed for project construction activities would be maintained by the contractor until the Sites Authority accepts the Sites Reservoir Project as fully completed. The roadways' general objectives and the post-construction responsibilities for their maintenance are as follows:

- Local Access – Provide a reliable roadway facility for the traveling public that is commensurate to its use, and that is consistent with current design standards and accommodates transportation needs. Generally described, this would involve two 12-foot paved lanes with paved shoulders. Maintenance of Local Access roadways would be the responsibility of the agency having jurisdiction of the roadway: Colusa County, or Glenn County.

- Construction Access – Provide the necessary roadway improvements that are specific to construction equipment/material transport. Design standards for construction routes are typically less stringent than Local Access design. Where construction access is comingled with local access, the objectives for both uses are combined, with priority given to local traffic use and safety. Generally described for construction access only, this would involve two 12-foot gravel lanes with up to 2-foot shoulders (locally, there would be not shoulders). Maintenance of Construction Access roadways would be the responsibility of the contractor. Where Construction Access and Local Access are commingled, maintenance of Local Access roadways would be the responsibility of the agency having jurisdiction of the roadway: Colusa County, or Glen County.

- Maintenance Access – Provide the necessary roadway improvements that are specific to the maintenance equipment for the facility that access is being provided for. Design standards for maintenance access roads are typically less stringent than Local Access design, but possibly more stringent than for Construction Access. Generally described, this would involve one 15-foot minimum gravel lane with no shoulders. Maintenance of Maintenance Access roadways would be the responsibility of the Sites Authority, unless used by the contractor; then maintenance responsibility would be that of the contractor until the Authority takes ownership.

2.3 Traffic Engineering Performance Assessment

During subsequent project development phases, consideration would be given to existing performance deficiencies on existing roadways that would be improved. Any identified locations that indicate a history of traffic incidents or pose a concern to comingling local vehicular/farming equipment and construction traffic would be evaluated for association with existing roadway features that may offer safety enhancements through improvement of the roadway or roadside features. Any identified locations and beneficial improvements would be incorporated into subsequent design phases.

Because Sites Lodoga Road would be realigned, the two remaining alternatives would be evaluated for expected traffic performance benefits and impacts. The results of this evaluation would be considered with the selection of the final alternative for this realignment.

2.4 Corridor and System Coordination

Corridor system management planning would be considered with the completed project. Sites Lodoga Road is classified as a Class III Bike Route. The completion of Sites Reservoir project with recreational areas and boating facilities would attract greater use of alternative modes of travel such as walking or biking. This would be considered with this feasibility study to define needed facilities and roadway features to accommodate expected use of this roadway facility. The relocated section of Sites Lodoga Road could be designed as a Class II facility to emphasize awareness of a higher use of this segment of roadway for alternative transportation uses.

2.5 Roadway Alternatives

This project involves improving existing local rural roads, realigning and constructing new local rural roads. The general design standards that would govern roadway design would be based on the following:

- American Association of State Highway and Transportation Officials "A Policy on Geometric Design of Highways and Streets" 2018, 7th Edition.
- Caltrans Highway Design Manual (HDM), 6th Edition.
- Colusa and Glenn County Standards.
- A Design Criteria Technical Memorandum was developed to document the specific design standards to be implemented (AECOM, 2020a). These design criteria were discussed at a meeting with Colusa and Glenn Counties and the Sites Authority on June 10, 2020 (AECOM, 2020b). This meeting's discussion and the specific design criteria were documented in meeting minutes, and are the basis for the Technical Memorandum, with supporting roadway plans.

The design of the roadways would require determining future Average Daily Traffic (ADT) based on full functioning reservoir and associated facilities. The future ADT would establish the Traffic Index for appropriate geometric and structural section design, and to provide for a 40-year minimum design service life of the roadways.

Where non-standard features are necessary and agreed to or not to be improved, a Design Exception would be issued to document the need, justification, and concurrence on any non-standard features.

The design of these roadways would consider large construction transports based on loads and size of equipment and materials that could be involved with the construction of this project. One example is the possibility of precast-concrete segmental bridge superstructure segments, should this be below the bridge type constructed. More information regarding this type of bridge construction is provided in Section 3.

Due to the lack of design-level surveys at this time, which would be obtained in a later project development phase, this Feasibility Study would establish roadway alignments based on service needs, and that are flexible in both horizontal and vertical geometry using existing planning-level–based mapping. This flexibility would require establishing a corridor width along roadways for various Service Area studies, such as environmental, geotechnical, and right-of-way. Corridor widths vary depending on the level of topographical relief; greater relief would require greater flexibility, and therefore a wider study corridor. This flexible approach would allow for final alignment adjustments during final design, based on project-specific design-level topographic mapping. Additionally, this flexible approach considers any constraints within the defined corridor that could influence the final roadway alignment, and avoid/minimize impacts. Corridor widths are discussed in Section 2.8, Environmental Compliance.

2.5.1 Construction Access Roads

The construction access options are as previously described in Section 2.1. These options may involve roadway rehabilitation prior to construction to accommodate the size and loads of transported construction equipment and materials. The existing roadbeds would be widened to accommodate 2-foot paved shoulders that currently are nonexistent. To avoid impacts to roadside ditches, and to avoid potential right-of-way impacts, the paved shoulders would be limited to 2 feet on each side. Incorporating 2-foot shoulders would improve safety for the passing of oncoming construction traffic with local vehicular and agriculture equipment traffic. Additionally, the narrow road intersections would need to be modeled for truck turning to define the need to widen the intersections to safely accommodate conflicting traffic movements in the intersections.

2.5.2 Sites Lodoga Road Realignment

Because the reservoir would inundate the existing route for Sites Lodoga Road through the Antelope Valley, this portion of the roadway would need to be relocated (realigned). Five alternative alignments have been identified: four involving reservoir crossings (causeways), and the fifth involving traversing around the southerly tip of the reservoir. Alternative 1A involves a full-length bridge at approximately 7,800 feet across the reservoir, while the other three causeways involve placing fill in the reservoir, with shorter bridge segments. A brief summary of these alternatives is provided in Table 2-2, and illustrated on Figure 2-3 (Sites Project Authority, 2020).

Table 2-2 – Sites Lodoga Road Realignment Alternatives Summary

Alternatives	1A	1B	2	3	4
Alignment Length (mile)	5.1	5.1	10.2	15.4	19.3
Time of Travel (minute)	14	14	22	31	33
Relative Est. Construction Cost	High $ (2.3 x Low $)	Low $	Mid-Low $ (1.2 x Low $)	Mid-Low $ (1.3x Low $)	Mid-High $ (1.6 x Low $)

Alternatives 1A, 1B, 2, and 3 are similar, and involve causeways in the reservoir. Alternatives 1A and 1B are more favorable due to their benefits of reduced length and reduced time of travel. However, Alternative 1A has a cost of nearly 2.3 times the cost of Alternative 1B, which makes Alternative 1B the most favorable from the added benefit of least cost. Therefore, Alternatives 1A and 1B would be carried forward for further analysis due to their benefits over Alternatives 2 and 3. Alternative 4 is the only alternative that does not cross the reservoir; therefore, it would be carried forward for further analysis. Alternatives 1A, 1B, and 4 would be relatively evaluated to determine the preferred alternative. The full-length bridge would offer navigational passage along the entire width of the reservoir. A causeway with partial fill would limit the navigational passage within the reaches of the shorter bridges. The approach to implementing fill prism in the reservoir would significantly reduce construction cost, and is a desired feature for further consideration of any reservoir crossing. These Alternatives with Options A and B for Alternative 1, are shown in the drawings (Section 4).

The causeway profile is designed to elevate the roadway and bridge profile at 2 feet above the maximum flood plus wave height. The maximum flood plus wave height is set at 10 feet above the normal water surface elevation (elevation 498 feet for the 1.5-million-acre-foot (MAF) reservoir). The profile across the bridge includes one location where 12-foot vertical clearance is provided for the Sheriff’s boat passage, with normal water surface elevation.

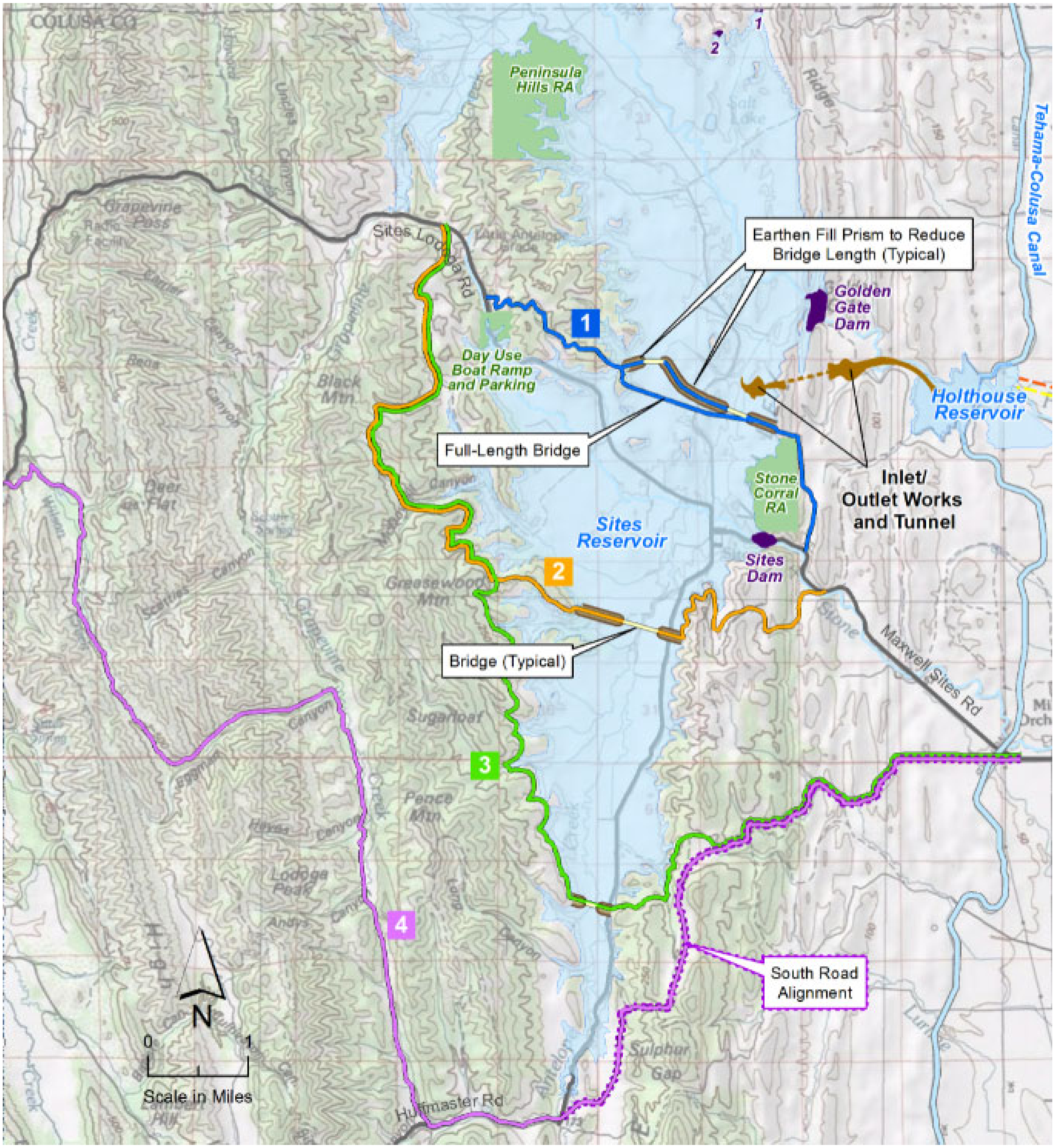

Figure 2-3 – Sites Lodoga Rd Realignment Alternatives

Fill prism in the reservoir would need to account for settlement due to saturation of the fill, as well as the natural soils that would support the fill. Geotechnical investigations of the project site are needed to identify borrow sites where suitable fill prism material can be obtained. Such borrow sites would likely be identified within the limits of the reservoir to avoid unnecessary ground disturbance and environmental impacts. Geotechnical analysis would be needed to estimate the total amount of settlement and its duration. This would be the basis for determining a settlement period, and method(s) to account for the settlement. Depending on the determined anticipated amount of settlement, methods to account for settlement could include: 1) additional placement of fill height equal to the anticipated settlement amount (overbuild); 2) place additional fill and establish final grade after settlement; or 3) accept the settlement and rely on bridge approach slabs to account for differential settlement at the abutments. Further discussion regarding the bridges is provided in Section 3.

Because the fill prism is needed to establish the causeway could be as high as 150 feet, seismic stability would be important in designing the fill prism as stability for draw down of the reservoir, which would potentially expose saturated fill in the prism. Also, settlement of the fill prism could limit its height, which in turn would reduce the prism length, while correspondingly increasing the bridge length.

The existing Sites Lodoga Road roadbed material could be pulverized, excavated, and used as aggregate base for the realigned Sites Lodoga Road to save on materials costs and need for disposal. This approach is considered a “green” method for roadway construction, because it reduces greenhouse gas effects due to avoiding long-haul transport of providing and disposing of materials.

Because the realigned Sites Lodoga Road could be placed across the reservoir and exposed to high winds, consideration would be given to the high wind advisory facilities, such as static roadside signs or extinguishable message signs that are illuminated when instruments measure high winds.

2.5.3 Other Roads

The remainder of the roads listed in **Error! Reference source not found.** do not involve alternatives, because each of these roads is a required feature to the various facilities that they serve, such as the saddle dams, O&M Yard, Golden Gate Dam, Inlet/Outlet Tower, Funks Reservoir Pumping Generation Plant and Switchyard, and localized recreational areas. These other roads are also shown in the drawings (Section 4).

Maintenance access roads to the dams would involve access from outside the reservoir limits, and could involve access from within the reservoir limits to provide access to each side of the dams.

2.6 Right-of-Way

The roadway identified for construction access would involve improvements that are anticipated to be within existing right-of -way. New or realigned roadways would require new right-of-way that would be based on County standards. Right-of-way acquired would be based on the minimal need to accommodate the roadbed and any adjacent roadside ditches. Where fill or cut slopes are required, the right-of-way would be widened in such areas to accommodate these features, and to preserve the area for future maintenance of slopes. Fences would be placed along all new right-of-way as necessary for keeping livestock and/or wildlife from entering into the roadway right-of-way.

Existing parcel boundaries would influence roadway alignments to minimize the size of parcel acquisition, and the size of any remnant parcel. Remnant parcel sizes would be kept to a minimum and limited to 40 acres maximum, per Colusa County at the June 10, 2020 Roadway and Bridge Meeting, and as documented in the meeting minutes (AECOM, 2020b). Bifurcation of parcels would be avoided.

The area planned to be inundated by the reservoir would be used as a materials and construction equipment staging area for the Sites Lodoga Road/Maxwell Sites Road. Temporary construction easements (TCE) would likely be needed to the construction access roads that are described above. Some TCEs may be needed for constructing the Sites Lodoga Road/Maxwell Sites Road, and would be explored with further project development.

2.7 Stakeholder Involvement

The design of these roadways is being coordinated with the following key project stakeholders:

- Colusa County
- Glenn County
- Sites Project Authority

These key stakeholders are responsible for coordinating with the public and specific property owners that are impacted by this project.

2.8 Environmental Compliance

The corridor width has been established to be 100 feet to 150 feet wide on flat terrain; 150 feet to 300 feet wide on rolling terrain east of the reservoir; and 400 feet to 500 feet wide in mountainous terrain west of the reservoir. These corridors define the limits for technical studies and the topographical design-level surveys to support final design. Services Areas to coordinate with for a comprehensive roadway design include:

- Environmental – for resource constraints, because some resources could influence roadway alignments.
- Geotechnical – for materials considerations for ultimate roadway structural section design and geohazard constraints. because geohazards influence roadway alignments and design.
- Bridge configuration and layout – for optimized bridge design.
- Right-of-way – for landowner coordination, because access requirements may exist, and some properties may need to be avoided, and others may require minimal impacts; all can influence alignment geometry.

Conceptual design plans depicting the roadway alignments and study limits were prepared and reviewed by the environmental team. Aerial surveys were conducted within the study limits, with noticeable potential environmentally sensitive areas (ESAs) identified. These ESAs were discussed between the roadway design and environmental team members to identify locations where it may be possible for roadway alignments to be adjusted to minimize possible environmental impacts. The results of this coordination resulted in identification of several locations where roadway alignments could be adjusted to avoid or minimize potential ESA impacts. A summary of these locations (see also Figure 2-4) is: Sites Lodoga Road Realignment (Alternative 4) four locations—three on the eastern side of the reservoir, and one on the western side; Access Road C1 to Funks Reservoir—one location; Access Road C2 to Golden Gate Dam—two locations; and Saddle Dam Road (South)—one location between Saddle Dams 3 and 5.

The ESAs would be further studied to refine the location and size of ESAs in future project phases, as would the roadway alignments on attaining design-level surveys. At such time, to minimize or avoid ESAs, consideration would be given to adjusting the roadway alignments in the environmental study area, widen the roadway away from ESAs, and possibly placing retaining walls in cut or fill areas to lessen the project footprint impact.

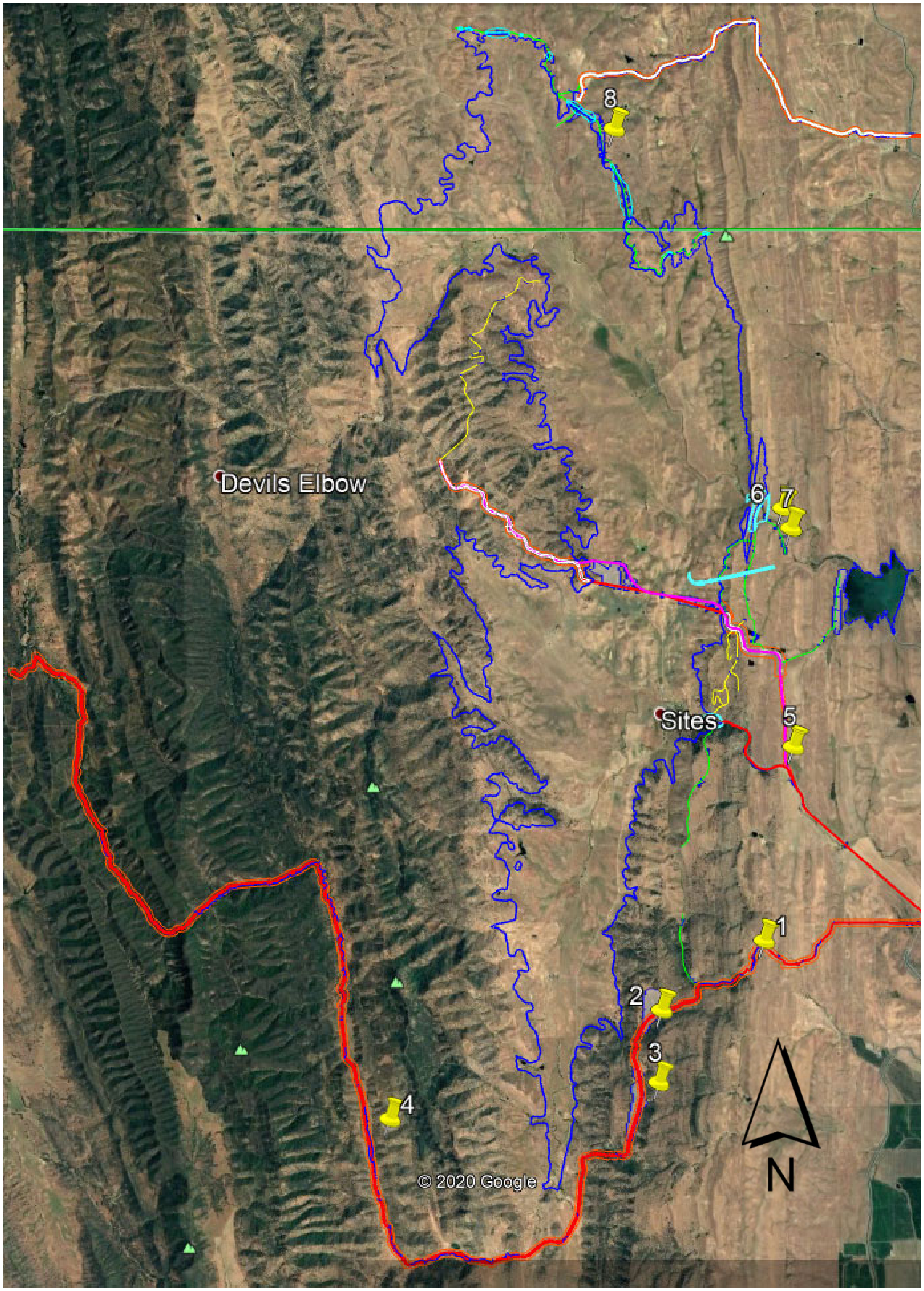

Figure 2-4 – Environmentally Sensitive Areas Along Proposed Roadways

2.9 Further Design Considerations

The following are further design considerations to be managed throughout design development:

- Future discovery of unsuitable material in drainage/waterway areas requiring over-excavation for roadway construction, or possibly realignment of a roadway, which could increase project costs.

- Discovery of slide zones in mountainous areas that could result in costly retaining walls or other stabilization treatments, or possibly even realignment of roadway that could lead to long-term roadway maintenance costs, and possible roadway closures and increased project costs.

2.10 Estimated Quantities and Disturbance Areas – Roads

The estimated road construction quantities and disturbance areas due to construction are summarized in Appendix A. These quantities are likely to change as the work is advanced.

The primary roadway construction elements that define the project footprint and inform environmental studies are the focus of estimating quantities in the Feasibility Study Phase. The following are the primary elements and methodology for estimating the quantities. Assumptions that were applied in establishing quantities are noted on the quantity calculation cover sheet.

All quantities utilized computer aided design software for measurements. Quantities that were wholly developed from computer aided design software were visually checked for correct graphic representation of the item involved. Area or volumetric calculations were spot checked by hand to verify correctness. Computations involving manual efforts were independently mathematically checked and where deviations greater than 20 percent resulted, both parties revisited their calculations for necessary adjustments for improved correlation (results less than 20 percent deviation). The larger of two values is the utilized quantity.

2.10.1 Earthwork

As noted above, due to the lack of design-level surveys at this time, which would be obtained in a later project development phase, this Feasibility Study establishes earthwork quantities based on low-level resolution topographic base mapping that would yield quantities with approximate estimates to appropriately inform environmental studies (the primary purpose of this TM), and on which to base preliminary engineering decisions.

Various roads in various terrain conditions are being quantified. After observing the terrain at each site, a grading system was developed as a basis of applying a magnitude approach for the earthwork likely to be involved. Terrain was classified as level, rolling, and mountainous. The magnitude of earthwork applied is an estimated average of the overall effort assumed for each roadway. This earthwork is assumed to include cut-slope excavation, ditch excavation, benching, and embankment construction.

The relocation of Sites Lodoga Road and North Road (Road 69 Access Road) were modeled in AutoCAD Civil 3D (CAD) to estimate approximate cut-and-fill volumes. The volumes were broken down into segments for level, rolling, and mountainous terrain. These differing terrain volumes were then broken down into volume per mile of roadway. Once these unit volumes were established, they were applied to other roadway terrain types to estimate each roadway volume.

2.10.2 Structural Section

Structural section quantities were based on each roadway’s typical section, and applied to the length to estimate the in-place volume of HMA, aggregate base, and subbase materials.

2.10.3 Clearing and Grubbing

The area for clearing and grubbing was estimated from area calculations in CAD for Sites Lodoga Road, North Road and the various county roads. Area-per-mile estimates were made based on terrain type, and applied to other roadway in similar terrain for other roadway quantity calculations.

2.10.4 Drainage

Drainage culverts, energy dissipators, and temporary inlet/outlet protection were measured in CAD based on location and linear projections of culvert layouts for Sites Lodoga Road and North Road. Other roadways for which drainage courses were defined were quantified, which was the case for all roadways except Huffmaster Road Realignment and Sites Lodoga Road Realignment (Alternative 4), maintenance access roads, and recreational area roads. Prorating was applied to these roads from the Sites Lodoga Road or North Road calculations.

2.10.5 Erosion Control

The area calculation for blanket erosion control was estimated in CAD for Sites Lodoga Road and North Road. Area-per-mile estimates were made based on terrain type, and applied to other roadways in similar terrain for other roadway quantity calculations.

Fiber roll was estimated based on level terrain type for County roads, and prorated across the other roadways.

2.10.6 Existing Facilities

Where existing roadways are planned for improvements and construction equipment access, improvements quantified include replacement of concrete box culverts and metal culverts, as identified by field visits and aerial imagery.

2.10.7 Minor Items

Other items would be involved with the completion of the project, and would be quantified during later design phases. However, for this feasibility phase, these minor items are accounted for by a percentage relationship to other primary items of work. For this Feasibility Study, such items are not necessary to consider, because they would not inform environmental study considerations or preliminary design decisions. Minor items typically include: roadside signs, headwalls, striping, barrier railing, metal beam guardrail, shoulder backing, etc.

3.0 Bridge

3.1 General

The new network of roads planned around and within the limits of the project involves Sites Lodoga Road and other likely specified construction access roads as described in Section 2. The Sites Lodoga Road/Maxwell Sites Road realignment being studied would likely necessitate two bridges as part of the reservoir crossing (see Figure 3-1).

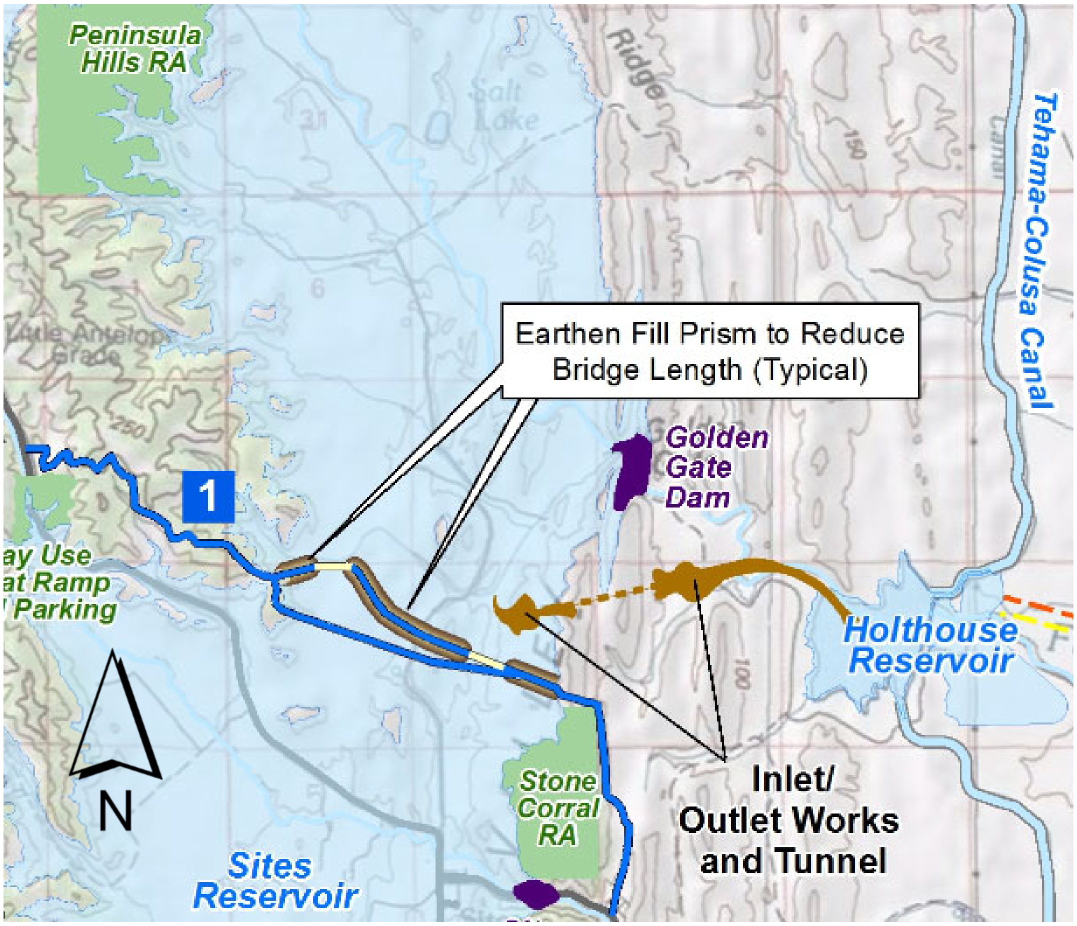

Figure 3-1 – Reservoir Crossing & Possible Bridge Locations

3.2 Proposed Bridge Structure Description

Following are the two bridge options that are currently being considered for the reservoir crossing (Section 2.5.2 provides additional information):

- Option 1A – Full-Length Bridge
  - East-side bridge – approximately 3,450 feet long and 35.5 feet wide. The proposed profile grade of this bridge results in columns that would be up to 200 feet high.
  - West-side bridge – approximately 4,050 feet long and 35.5 feet wide. The proposed profile grade of this bridge results in columns that would be up to 150 feet high.
- Option 1B – Shorter Bridges with Fill Prisms

- East-side bridge – approximately 1,600 feet long and 35.5 feet wide. The proposed profile grade of this bridge results in columns that would be up to 200 feet high.

- South bridge on the western side – approximately 1,400 feet long and 35.5 feet wide. The proposed profile grade of this bridge results in columns that could be up to 120 feet high.

The two options have slightly different alignments, and would likely result in different bridge span lengths and overall bridge deck areas. Therefore, the bridge type for Option 1A could differ from that for Option 1B. The bridge type would be selected after the roadway option is selected, and after subsurface investigations are performed.

The profile of the reservoir crossing is controlled by the normal water surface elevation of the reservoir. The bridge lengths mentioned above are preliminary, and would likely change as the project becomes more defined through various Service Area supporting studies in the next phase, and with design-level topographic mapping. This project also includes evaluations of seven to eleven existing structures along the defined construction routes, as noted in Section 2.2 for their adequacy to carry material hauling and other construction-related loads during construction of the reservoir facilities.

3.3 Bridge Superstructure Alternatives

The following bridge types are being considered, as discussed below.

3.3.1 Precast Prestressed Segmental Box Girder using Balanced Cantilever Construction

This is a popular bridge type that has been used in the United States since the early 1970s. It is an appropriate bridge type for locations that require long and tall structures, such as this location. This is also a commonly used bridge for locations in waterways, or valleys and canyons, where it is not feasible to support the structure from the ground level during its construction. This bridge type provides a cost-effective solution to site conditions like the ones on this project site, primarily due to the tall height of the bridge, which makes the use of temporary supports difficult, and the need for repetitive operations.

The bridge type involves fabrication of the transverse segments generally away from the project site, but on-site fabrication is a possible cost-effective means for some situations that would otherwise involve costly long hauling for each bridge segment. Whether off-site fabrication or on-site fabrication, the precast segments are erected (see Figure 3-3-2) on substructure elements (foundation, column, abutments, etc.). The use of precast concrete segments has the advantage that the superstructure can be erected at a faster rate compared to cast-in-place construction. The precast concrete segments are made while the substructure is being built, and then stored until needed for erection. The precast segments are built using either the short-line or long-line method. In the short-line method, each segment is cast next to the previous segment in a special adjustable casting machine. This ensures that the interface between the two segments matches exactly when erected. Each successive segment is then cast next to the previous one. In the long-line method, formwork matching the shape of the soffit is erected on the ground. A traveling form for the webs and deck is then moved along the soffit form for the casting of each segment. This is a cost-effective bridge type for spans up to 400 feet, when the total bridge deck surface area exceeds 200,000 square feet. The unit cost (cost per square foot) is higher for projects that require less deck surface area, thereby making this option less feasible. This is due to the initial cost of the specialized fabrication forms, and the overhead gantry used in erecting the precast segments.

Figure 3-2 – Typical Erection of Precast Elements

3.3.2 Cast-in-Place Prestressed (CIP P/S) Concrete Box Girder

This is the most common bridge type in California, and most local bridge contractors are familiar with this type of construction and are equipped with the needed falsework. See Figure 3-33-3 for an example of this bridge type, which was constructed using falsework. There are various engineered and tested details associated with this bridge type that have been in use in California since the early 1970s. This bridge type, however, requires the use of falsework during its construction. Low initial construction and maintenance cost, high torsional rigidity, and good resistance to seismic loads are among the many advantages of this structure type. The recommended depth-to-span ratio is 0.045 for simply supported structures, and 0.040 for multiple-span continuous structures. This structure type is a feasible option for span lengths up to several hundred feet. For typical construction methods in California, span lengths can be as long as 100 to 250 feet. The cast-in-place construction is more adaptable to aesthetic details, if needed. The structure type also provides more deflection control than other available types. Due to the high-water surface elevation of the reservoir, a very tall bridge is required to elevate the bridge deck above the water with column heights ranging up to 200 feet, which can make typical falsework for this type of construction infeasible. For falsework to be feasible, consideration would be given to temporary fill placed beneath the bridge to reduce the height of the falsework towers. The fill would subsequently be removed after construction of the bridge superstructure, and the original groundline would be restored. This approach would provide a more cost-effective bridge type. Other construction methods such as incremental launching or movable scaffolding system can also be competitive for specialized contractors.

Figure 3-3 – CIP P/S Box Girder Bridge, West Imola Avenue (SR 121) Over Napa River

3.3.3 Precast Post-tensioned California Wide-Flange Spliced Girder

This bridge type is composed of precast, prestressed concrete members that are fabricated in an off-site casting yard, and then delivered to the project site in pieces. Generally, there is a total of three pieces per span per girder. The girder segments are first erected on top of the previously constructed piers. Then the midspan segment are placed between the pier segments and spliced using post-tensioning cast-in-place deck slab, and a second stage of longitudinal post-tensioning is applied along the entire superstructure to transform the girders into a continuous bridge superstructure. See Figure 3-43-4 for an example of this bridge type. The concreted diaphragms between the girders are also reinforced for complete superstructure continuity. This structure type is a feasible option for span lengths up to 225 feet. Some of the drawbacks associated with this bridge type are the hauling of the girder pieces that are long and heavy. The splicing of the girders that provides continuity to the structure, as well as a connection between the superstructure and the columns, could require the use of falsework that would be difficult for the heights associated with this project. Consideration would be given to temporary fill placed beneath the support tower to reduce the height of these temporary towers.

Figure 3-4 – Precast Spliced Girder, US 101 Petaluma River Bridge

3.3.4 Cast-in-Place Segmental Box Girder using Balanced Cantilever Construction

This bridge type is a variation of the precast, prestressed bridge type shown above; however, the segments are cast-in-place. See Figure 3-53-5 for an example of this bridge type. It can be used for long span lengths with repetitions. Normally, the length of each segment in this method should be considered between 10 to 20 feet. This construction method usually begins by building piers, followed by casting both superstructure segments simultaneously on both sides of the piers. Each segment is then tied to the previous segment by post-tensioning tendons. The properties of concrete mix design, such as its strength, are important, because the concrete should have adequate strength for pre-stressing within 1 to 3 days. This process can continue for each pair of segments, normally between 4 to 7 days. This method requires high accuracy and quality control, so it puts a lot of demand on the contractor. Similar to the precast, prestressed segmental option, this type provides a feasible option for applications that require large bridge deck areas due to the initial investments involved.

Figure 3-5 – CIP Segmental Box Girder, Folsom Dam Bridge

3.4 Foundation Alternatives

Based on current knowledge of the site's subsurface materials from initial geotechnical considerations to date, the bridge columns are planned to be supported on caps founded on a cluster of drilled cast-in-place piers. The use of larger-diameter cast-in-place drilled-hole piers is assumed due to the hard pile driving anticipated at the project site. Other pile types, such as the use of driven steel-pipe piles, as well as driven conventional concrete piles, would also be considered. Each foundation type would be evaluated for their appropriateness during further project development following subsurface geotechnical investigations and material testing.

3.5 Bridge Features

The following features are planned on the bridge:

- Caltrans-approved edge barriers—anticipating "see through" barriers;
- Suicide prevention barrier;
- Emergency phone service;
- Five-foot shoulders;
- Deck drains;
- One opening for possible utilities; and
- Electrical conduits in the barriers with pull boxes.

Sidewalks are not being considered due to the remote rural nature of this site.

3.6 Constructability

The four bridge types being studied would require a slightly different construction approach and method. However, the substructure elements are common to all of them. For example, the construction of all the substructure elements, such as the pile installation, shoring, construction of the pile caps, footings, abutments, wingwall/retaining walls, and the pier columns are all similar for each bridge type.

The Precast, Prestressed Segmental Box Girder using Balanced Cantilever Construction involves the superstructure precast segments being erected by cantilevering out from opposite sides of the pier (see Figure 3-6). The segments would be added either at the same time, or alternately to each cantilever to maintain a relatively balanced system. Often, segments would offset by one-half segment length to reduce the out-of-balance moment. After the cantilevers from each adjacent pier reach midspan, a cast-in-place closure segment is placed followed by additional post-tensioning. The balanced cantilever method is most economical for span lengths greater than about 160 feet relative to Precast, Prestressed Segmental Box Girder span-by-span construction. For span lengths greater than about 450 feet, the weight and size of the segments near the piers reduces the feasibility of using precast segments in balanced cantilever construction. In the balanced cantilever method, precast segments are lifted into place using ground- or water-based cranes, deck-mounted lifters at the end of each cantilever, or an overhead gantry. The selected method depends on the number of spans, contractor's preference, and available access. An overhead gantry would typically be supported at three piers.

Figure 3-6 – Typical Erection of Precast Elements

The construction of the cast-in-place concrete box girder option would require placement of the concrete in the tall formwork for the superstructure. The entire system would have to be supported from ground level using falsework during its construction. The use of falsework for the heights being planned for this structure would be extensive and costly. The use of temporary fill to support the falsework during construction of the bridge would provide a more cost-effective way of building this bridge. Other construction methods, such as incremental launching or movable scaffolding system, may reduce the cost. Once the concrete attains the desired strength, post-tensioning would be applied; and subsequently falsework (and temporary fill used to support the falsework) would be removed.

For the precast post-tensioned California wide-flange spliced girder construction, the pier segments would first be erected on top of the piers. The middle segment would then be placed in between the pier segments and spliced together with post-tensioning. However, the use of temporary support towers at girder splice locations—one at each span—is anticipated. This may also require the use of temporary fills under the support towers due to the height of the bridge. Concrete would be poured in the deck slab and the diaphragms, prior to the longitudinal post-tensioning of the girders. The minor finishing items would then be constructed for completion of the bridge.

3.7 Seismic and Geotechnical Considerations

Use of Caltrans Seismic Design Criteria (SDC 2.0) with some minor modifications is planned. SDC 2.0 is meant for “ordinary bridges,” and allows significant damage that may require the closure and subsequent repairs of the bridge in a post-earthquake scenario, but remains standing (no collapse) after a design earthquake. This would allow a good balance in providing a safe but economical structure. However, one important element of the bridges on this project that requires special attention and deviation from SDC 2.0 is associated with the heights of the bridge columns. The bridge columns, which are as tall as 225 feet, would require deflection control during a design earthquake. This would be studied in further detail, and a limit to control deflection would be considered in subsequent design phases.

Fault rupture would also be considered, because there are two faults that cross the bridge. These two are the Salt Lake Fault and the GG-2 fault. Neither of these is considered a primary source, but they could have sympathetic movement in an earthquake on the Great Valley Fault, which passes below the site. WLA (2002) estimated that surface ruptures would be on the order of 2.4 to 4 inches for the GG-2 fault, and 4.5 to 16 inches on the Salt Lake Fault.

3.8 Further Design Considerations

The following are further design considerations to be managed throughout subsequent project development:

- Deflection and serviceability of the bridge under designed wind loads;
- Deflection and serviceability of the bridge under design seismic loads;
- Drivability and construction of piles;
- Subsurface condition;
- Transportation of bridge members, including girder segments, on the existing roadway system;
- Construction considerations of the bridge superstructure due to the high profile;
- On-site concrete batch plant and precast yard; and
- Possible use of non-standard shoulder width (roadway item).

3.9 Estimated Quantities and Disturbance Areas – Bridge

The estimated bridge construction quantities and disturbance areas due to construction are summarized in Appendix B. These quantities are likely to change as the work is advanced.

4.0 Plan Sheets

Table 4-1 lists the roads and bridge drawings that are presented under separate submittal.

Table 4-1. List of Roads and Bridge Drawings

Drawing No.	Main Title	Subtitle
STS-305-C-2601	ROAD MODIFICATIONS	ROAD OVERVIEW MAP
STS-306-C-7611 to 3602	ROAD MODIFICATIONS	SITES LODOGA ROAD OPTION 1A & B, AND BRIDGE CROSSINGS
STS-307-C-2603 to 3601	ROAD MODIFICATIONS	SOUTH ROAD
STS-308-C-7602 to 3601	ROAD MODIFICATIONS	NORTH ROAD ACCESS ROAD
STS-309-C-2601 to 3601	ROAD MODIFICATIONS	COUNTY ROADS
STS-310-C-2601 & STS 311-C-2601	ROAD MODIFICATIONS	NORTH AND SOUTH SADDLE DAM ACCESS ROADS
STS-312-C-2601	ROAD MODIFICATIONS	ACCESS ROADS
STS-312-C-2602	ROAD MODIFICATIONS	PARK RECREATIONAL AREA ROADS

5.0 References

AECOM (2020a). Design Criteria, Draft Technical Memorandum. August.

AECOM (2020b). Sites Reservoir Roadway/Bridge Feasibility Design Kick Off Meeting. June 10.

American Association of State Highway and Transportation Officials (AASHTO) (2018). “A Policy on Geometric Design of Highways and Streets”, 7th Edition.

Caltrans Highway Design Manual (HDM), 6th Edition.

Sites Project Authority (2020). Sites Project Value Planning Alternatives Appraisal Report. April 13.

William Lettis and Associates (WLA) (2002). Phase II Fault and Seismic Hazards Investigation North of Delta Offstream Storage Integrated Storage Investigations.

Appendix A

Estimated Quantities and Disturbance Areas – Roads

PRELIMINARY QUANTITIES FOR ROADS

ROADWAY IMPROVEMENTS

	TYPE	ROAD NAME	TOTAL ROAD LENGTH (FT)	ROADWAY WIDTH (FT)	FOOTPRINT AREA (ACRE)	ROADWAY EXCAVATION (CY)	ROADWAY EXCAVATION (Excess Suitable Material to be Stockpiled) (CY)	ROADWAY EXCAVATION (CUT TO HAUL/WASTE) (CY)	ROADWAY EXCAVATION (ROCK CUT) (CY)	ROADWAY EMBANKMENT (From Excavated Suitable Material) (CY)	CLASS 4 AGGREGATE SUBBASE (CY)	CLASS 2 AGGREGATE BASE (CY)	HOT MIX ASPHALT (TYPE A) (TON)	TACK COAT (TON)
1	Public Roadway	Sites Lodoga Road Realignment, Option 1A	24,307	34	85	2,436,000	1,549,000	233,000	105,900	547,500	23,600	23,600	31,900	23.7
2	Public Roadway	Sites Lodoga Road Realignment, Option 1B	28,972	34	232	2,601,000	0	248,800	113,100	11,382,000	25,800	25,800	34,420	25.7
3	Public Roadway	Huffmaster Road Realignment	47,200	32	116	13,994,000	8,977,000	1,346,900	524,800	3,145,000	42,000	42,000	56,640	42.0
4	Public Roadway	Sites Lodoga Road Realignment, Alt 4 - South Rd	60,260	32	139	16,969,000	10,656,000	1,607,800	890,900	3,814,000	53,600	53,600	71,590	54.0
5	Maintenance/ Construction	North Road (Access Road - Road 69)	27,200	24	60	262,200	136,700	25,400	7,900	92,100	18,100	36,300	0	0.0
6	Local/ Construction	County Road 69	11,224	28	8	26,200	23,000	2,600	0	600	8,700	8,700	11,790	9.0
7	Local/ Construction	County Road D	2,700	28	1	6,100	5,400	600	0	100	2,100	2,100	2,810	2.1
8	Local/ Construction	County Road 68	14,250	28	7	33,200	29,100	3,300	0	700	11,100	11,100	14,930	11.1
9	Local/ Construction	County Road F/McDermott Road	21,240	28	28	49,600	43,500	4,960	0	1,090	16,600	16,600	22,300	17.0
10	Maintenance	Saddle Dam Road - North	11,191	15	25	314,600	162,000	30,300	11,800	110,500	0	14,000	0	0.0
11	Maintenance	Saddle Dam Road - South	18,232	15	27	558,700	276,300	52,500	33,500	196,300	0	22,800	0	0.0
12	Maintenance	Access Road A1	7,638	15	14	144,900	78,500	14,400	1,100	50,900	0	9,500	0	0.0
13	Maintenance	Access Road B1	2,082	15	4	65,600	31,600	6,100	4,900	23,100	0	2,600	0	0.0
14	Maintenance	Access Road B2	3,789	15	7	105,100	50,600	9,700	7,900	36,900	0	4,700	0	0.0
15	Maintenance	Access Road C1	5,191	15	10	333,500	183,000	33,300	0	117,200	4,300	4,300	5,800	4.5
16	Maintenance	Access Road C2	3,537	15	7	227,300	124,700	22,700	0	79,900	0	4,400	0	0.0
17	Maintenance	Comm Road North	7,498	15	14	148,200	81,300	14,800	0	52,100	0	9,400	0	0.0
18	Maintenance	Comm Road South	4,529	15	9	89,500	49,100	9,000	0	31,500	0	5,700	0	0.0
19	Recreation	Day Use Boat Ramp (From Sites Lodoga Rd - Westside)	2,233	30	5	143,500	78,700	14,300	0	50,400	1,860	1,860	2,510	1.5
20	Recreation	Peninsula Hills Recreation Area	19,711	30	48	552,900	295,800	54,500	8,300	194,300	16,400	16,400	22,170	16.5
21	Recreation	Stone Corral Recreation Area/Sites Dam	13,319	30	32	323,000	175,000	32,100	2,400	113,500	11,100	11,100	14,800	10.5
22	Public Roadway	Existing Sites Lodoga Road	19,982	22	15									
23	Public Roadway	Existing Maxwell Sites Road	9,398	24	8									
24														

BRIDGE IMPROVEMENTS

ROAD	BRIDGE No.	PC/PS SLAB SINGLE SPAN REPLACEMENT (L=70',W=36') (SQFT)	CONCRETE BARRIER (TYPE 842) (LF)	TUBULAR RAILING (LF)	BAR REINFORCING (LBS)
County Road 69	Br. No. 11C0257 - Bridge Replacement	2,520	220	220	160
County Road 69	Br. No. 11C0001 - Bridge Replacement	2,016	192	192	100
County Road F	Br. No. 11C0174 - Bridge Replacement	1,749	146	146	83

PRELIMINARY QUANTITIES FOR ROADS

ROADWAY IMPROVEMENTS

TYPE	ROAD NAME	CLEARING AND GURBBING (ACRE)	TEMPORARY SILT FENCE (LF)	24" PIPE CULVERT (GALVANIZED CORRUGATED METAL) (LF)	BOX CULVERT SINGLE CELL (EA)	PERMANENT BLANKET EROSION CONTROL (HYDROSEED) (SQFT)	ROCK PAD ENERGY DISSIPATOR (18" D x 2' W x 6' L) (EA)	TEMPORARY INLET/OUTLET PROTECTION (EA)	FIBER ROLL (FT)	REMOVE AC SURFACING CY
Public Roadway	Sites Lodoga Road Realignment, Option 1A	101	32,400	4,300	0	402,600	75	150	0	0
Public Roadway	Sites Lodoga Road Realignment, Option 1B	109	32,400	4,290	0	847,600	75	150	0	0
Public Roadway	Huffmaster Road Realignment	117	8,400	8,330	0	781,700	147	294	0	0
Public Roadway	Sites Lodoga Road Realignment, Alt 4 - South Rd	140	10,800	9,940	0	932,600	174	348	0	0
Maintenance/ Construction	North Road (Access Road - Road 69)	78	14,400	1,500	3	124,500	33	132	0	0
Local/ Construction	County Road 69	8	7,200	160	3	0	12	24	66,600	0
Local/ Construction	County Road D	1	3,600	125	5	0	9	18	15,400	0
Local/ Construction	County Road 68	7	2,400	0	3	0	6	12	85,330	0
Local/ Construction	County Road F/McDermott Road	11	3,600	9	0	0	9	18	99,500	0
Maintenance	Saddle Dam Road - North	14	2,400	620	0	51,200	12	12	0	0
Maintenance	Saddle Dam Road - South	22	4,200	1,010	0	83,500	21	21	0	0
Maintenance	Access Road A1	9	1,800	420	0	35,000	9	9	0	0
Maintenance	Access Road B1	3	600	120	0	9,500	3	3	0	0
Maintenance	Access Road B2	5	1,200	185	0	15,300	6	6	0	0
Maintenance	Access Road C1	9	1,200	290	0	23,800	6	6	0	0
Maintenance	Access Road C2	5	1,200	0	0	16,200	6	6	0	0
Maintenance	Comm Road North	9	1,800	410	0	34,300	6	6	0	0
Maintenance	Comm Road South	6	1,200	250	0	20,700	6	6	0	0
Recreation	Day Use Boat Ramp (From Sites Lodoga Rd - Westside)	4	600	120	0	10,200	3	3	0	0
Recreation	Peninsula Hills Recreation Area	27	4,800	1,090	0	90,200	24	24	0	0
Recreation	Stone Corral Recreation Area/Sites Dam	17	3,000	660	0	56,000	15	15	0	0
Public Roadway	Existing Sites Lodoga Road									12,300
Public Roadway	Existing Maxwell Sites Road									6,300

BRIDGE IMPROVEMENTS

ROAD	BRIDGE No.
County Road 69	Br. No. 11C0257 - Bridge Replacement
County Road 69	Br. No. 11C0001 - Bridge Replacement
County Road F	Br. No. 11C0174 - Bridge Replacement

Appendix B

Estimated Quantities and Disturbance Areas – Bridge

QUANTITIES FOR BRIDGES

7/31/2020

Total Bridge Length	7,500	FT
Bridge Width	35.5	FT
Footprint Area	6.1	ACRES

SITES LODOGA ROAD - BRIDGE OPTION 1A

Items	CALCULATED QUANTITY	UNIT	Safety Factor	ROUNDED QUANTITY	UNIT
STRUCTURE EXCAVATION	52,666	CY	1.2	63,600	CY
STRUCTURE BACKFILL	10,778	CY	1.2	13,200	CY
DRILL CUTTINGS DISPOSAL (for CIDH Piles)	24,463	CY	1.2	28,800	CY
CONCRETE AGGREGATE	109,753	CY	1.2	132,000	CY

QUANTITIES FOR BRIDGES

7/31/2020

Total Bridge Length	3,033	FT
Bridge Width	35.5	FT
Footprint Area	2.5	ACRES

SITES LODOGA ROAD - BRIDGE OPTION 1B

Items	CALCULATED QUANTITY	UNIT	Safety Factor	ROUNDED QUANTITY	UNIT
STRUCTURE EXCAVATION	24,355	CY	1.2	28,800	CY
STRUCTURE BACKFILL	5,027	CY	1.2	6,000	CY
DRILL CUTTINGS DISPOSAL (for CIDH Piles)	11,394	CY	1.2	13,200	CY
CONCRETE AGGREGATE	45,585	CY	1.2	55,200	CY