Technical Memorandum

Siting Study for Relocation of the Goleta Outfall Vault

PREPARED FOR

Goleta Sanitary District

PREPARED BY

DUDEK
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August 14, 2017

TECHNICAL MEMORANDUM

To:	**Steve Wagner, P.E., Goleta Sanitary District**
Authors:	**Neil Harper, P.E., Jane Gray**
Subject:	**Siting Study for Relocation of the Goleta Outfall Vault**
Date:	**August 14, 2017**

1 PROJECT BACKGROUND AND OBJECTIVES

1.1 Background:

Goleta Sanitary District (GSD or District) owns and operates a regional water resource recovery facility that has an average annual dry weather rated capacity of 9.8 million gallons per day (MGD) and a permitted capacity of 7.64 MGD. Non-utilized effluent flows are dechlorinated and flow out the District's 36-inch outfall and into the Pacific Ocean. The subject outfall crosses under the Goleta Slough and Goleta Beach County Park (Park). Extreme marine conditions and major storms in January and February 2017 eroded approximately 20 to 25 feet landward into Goleta Beach County Park and exposed the westernmost concrete face of the existing vault and cathodic protection facilities vault (See **Photograph 1**).

Photograph 1. Exposed Face of Goleta Outfall Vault and Cathodic Protecion Facilities

This vault is an important facility for the District because it allows access into the outfall pipeline. In addition, the location of the vault is significant because it demarks where the outfall changes pipe materials (from reinforced concrete pipe (RCP) to lined and coated steel) and the horizontal bearing and vertical slope of the pipeline also change. Furthermore, it houses cathodic protection facilities that mitigate corrosion for the steel portion of the pipeline that continues out under the Pacific Ocean.

In January 2017, the vault became exposed and subject to wave attack due to sudden extreme winter weather events and high surf. GSD placed approximately 70-80 tons of rock rip-rap (approximately 50 ft. long by 5-6 ft. high by 7 ft. deep) in front of the structure to prevent further erosion and protect the structure. In February 2017, to fill a void that had formed adjacent to the revetment in front of the vault, GSD placed approximately 20 tons of rock rip-rap (approximately 20 ft. long by 4 ft. deep by 5 ft. high) authorized by the Coastal Commission pursuant to Emergency Coastal Development Permit (CDP) No. G-14-17-0011.

Additionally, to address the damage along unprotected areas of the shoreline and reinforce the Park against potential future wave action and swells, the County received approval from the Coastal Commission for an emergency permit (CDP No. G-4-17-0015) to place approximately 3,000 tons of up to 5 ton rock along 386 linear feet of unprotected portions of the Park shoreline that were significantly eroded due to powerful surf and repeated wave attack. The County also deposited rock along approximately 40 feet (included in the 386 linear feet quoted above) in front of the subject outfall vault as shown in **Photograph 2** to protect against repeated wave attack and to prevent effluent from being deposited onto the beach and nearshore waters.

Photograph 2. Rock Revetment Protection for Outfall Access Vault

1.2 Objectives:

The objective of this study is to develop and evaluate alternatives for relocating and/or rehabilitating the outfall vault and associated facilities. Evaluation of the alternatives will include, but not be limited to, construction considerations (sequencing, phasing, impacts to surrounding, etc.), feasibility and expected longevity, hydraulic considerations (temporary bypass sizing and impacts to the outfall/treatment plant effluent facilities), construction costs, project durations, project permitting requirements, and project costs.

After the evaluation of alternatives is complete, this study will conclude with a recommended project concept.

2 DEVELOPMENT OF ALTERNATIVES

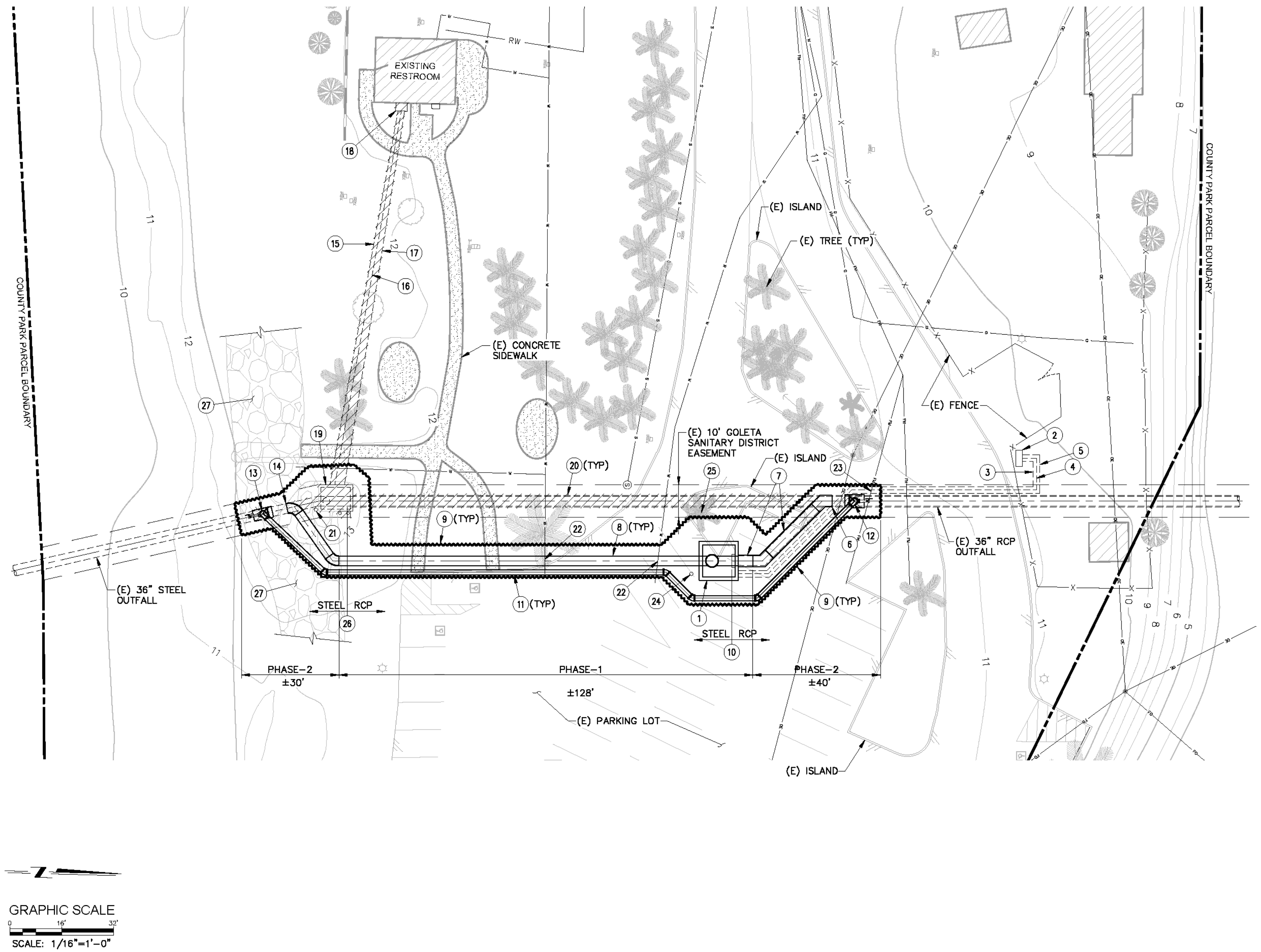
Dudek and the District conducted a meeting, reviewed available record drawings, and conducted a site visit to Goleta Beach to review the outfall vault, appurtenant facilities, and the existing site conditions and constraints.

At the conclusion of the meeting, it was determined that rehabilitating the existing vault and appurtenances was not a viable alternative because portions of existing cathodic protection anode well were destroyed and the vault was exposed by the early 2017 storms and wave attacks. Moreover, the District and Dudek concluded that future similar storm events and wave attacks could comprise and potentially destroy the vault. If the vault were destroyed, the effluent pipeline would likely be compromised resulting in effluent spilling onto the beach and into the Pacific Ocean.

Based on this conclusion, two alternatives for relocating the vault and appurtenant facilities were developed and are shown in **Figures 1 and 2**. As shown on these figures and noted previously herein, the existing outfall pipeline changes materials from RCP to steel inside the vault. This transition will be maintained in the new vault and construction of a new cathodic protection anode well will be required to mitigate corrosion for the steel portion of the outfall which extends out into the Pacific Ocean. This approach matches the current outfall construction.

In the process of developing the alternatives, Dudek, the District, and representatives from Cushman (a local general contractor) reviewed and refined the alternatives. It was concluded that it would be more cost effective and less risky (due to the length of time a temporary bypass pipeline would need to be operated and maintained) to construct a parallel pipeline and make connections to the existing outfall. This would also allow for the abandonment of the existing outfall where a new parallel outfall would be constructed which would reduce project costs.

Figure 1. Outfall Vault Relocation Option Alternative 1



CONSTRUCTION NOTES

1. NEW REINFORCED CONCRETE OUTFALL ACCESS VAULT (APPROX. 10' X 10' 20' (DEEP)).
2. NEW CATHODIC PROTECTION PANEL.
3. NEW CONDUIT AND WIRING (POSITIVE CABLE FROM ANODE TERMINAL BOX).
4. NEW CONDUIT AND WIRING (NEGATIVE FROM ANODE TERMINAL BOX).
5. NEW ADDITIONAL CONDUIT.
6. CONNECTION TO EXISTING 36–INCH RCP OUTFALL.
7. NEW 36–INCH RCP OUTFALL.
8. NEW 36–INCH STEEL OUTFALL.
9. TEMPORARY SHORING.
10. NEW TRANSITION FROM STEEL TO RCP.
11. TEMPORARY BYPASS OUTFALL.
12. 36–INCH RCP X BYPASS PIPELINE SIZE "HOT–TAP" CONNECTION AND TEMPORARY PLUG.
13. 36–INCH STEEL X BYPASS PIPELINE SIZE "HOT–TAP" CONNECTION AND TEMPORARY PLUG.
14. CONNECTION TO EXISTING 36–INCH STEEL OUTFALL.
15. ABANDON 1–INCH CONDUIT AND WIRING (POSITIVE CABLE FROM ANODE TERMINAL BOX).
16. ABANDON 1–INCH CONDUIT AND WIRING (NEGATIVE CABLE FROM ANODE TERMINAL BOX).
17. ABANDON 1–INCH CONDUIT.
18. DEMOLISH EXISTING CATHODIC PROTECTION PANEL.
19. REMOVE EXISTING REINFORCED CONCRETE ACCESS VAULT.
20. ABANDON 36–INCH OUTFALL PIPING BETWEEN CONNECTION POINTS AND DEMOLISH INTERFERING PORTIONS OF EXISTING 36–INCH OUTFALL AS NEEDED.
21. REMOVE PORTION OF EXISTING ANODE WELL AND ABANDON REMAINDER OF FACILITY.
22. MAINTAIN EXISTING WATER UTILITY/SERVICE DURING CONSTRUCTION. RECONSTRUCT IMPACTED PORTIONS OF WATER FACILITIES TO MATCH EXISTING ALIGNMENT AS PRACTICABLE.
23. MAINTAIN EXISTING SEWER FORCEMAIN UTILITY/SERVICE DURING CONSTRUCTION. RECONSTRUCT IMPACTED PORTIONS OF SEWER FORCEMAIN FACILITIES TO MATCH EXISTING ALIGNMENT AD PRACTICABLE.
24. NEW ANODE WELL.
25. REMOVE AND RELOCATE TREE. LOCATION TO BE DETERMINED.
26. EXISTING TRANSITION FROM STEEL TO RCP.
27. EXISTING STONE REVETMENT.

NOTES:

1. UNLESS NOTED OTHERWISE, ALL EXISTING FACILITIES WILL REMAIN.
2. FACILITIES THAT REQUIRE REMOVAL AND REPLACEMENT SHALL BE REPLACED IN KIND SUCH AS PAVEMENT, STRIPING, TRAFFIC MARKERS AND DEMARCATIONS, CONCRETE WALKS AND GUTTERS, IRRIGATION SYSTEM(S), LANDSCAPING, FENCING, ETCETERA.
3. THE CONCEPTUAL DESIGN SHOWN HEREON IS BASED ON A PDF BACKGROUND FROM 2011. IT IS RECOMMENDED TO OBTAIN A CURRENT TOPOGRAPHIC SURVEY PRIOR TO ADVANCING DESIGN FURTHER.

FIGURE 1

GOLETA BEACH OUTFALL VAULT RELOCATION OPTION ALTERNATIVE 1

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Figure 2. Outfall Vault Relocation Option Alternative 2

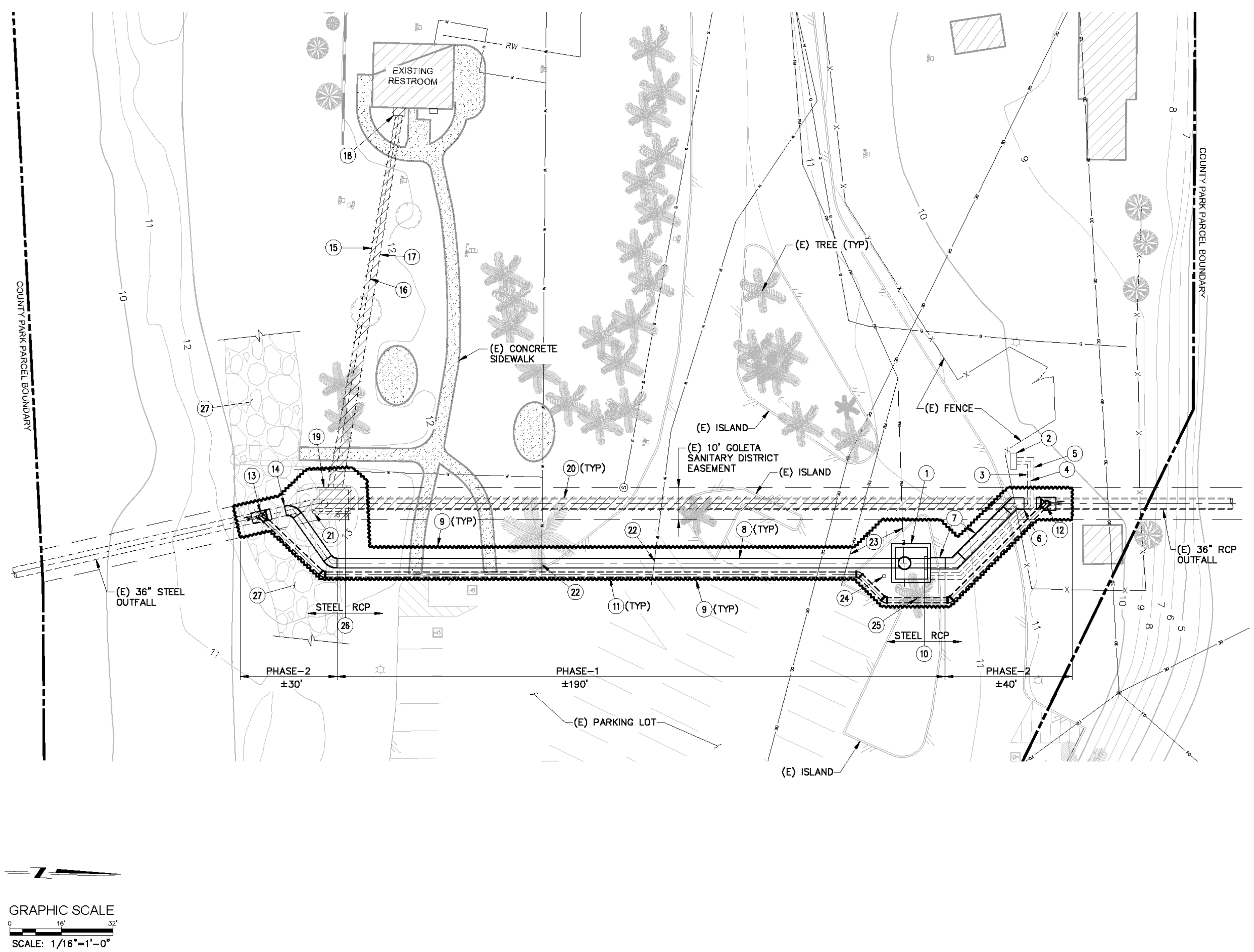

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FIGURE 2

GOLETA BEACH OUTFALL VAULT RELOCATION OPTION ALTERNATIVE 2

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3 PEER REVIEWS OF PREDICTED COASTAL EROSION AND IMPROVEMENT PLANS

Dudek retained GeoSoils, Inc. to conduct a peer review of the coastal erosion improvement plans that are being prepared by consultants working for the County of Santa Barbara and to determine the feasibility of the alternatives shown in **Figures 1** and **2**. The peer review concluded that both alternatives are feasible. Should the revetment be removed, the beach retreatment is predicted to approach the vault location in alternative 1 in approximately 40 years, and approach the vault location in alternative 2 in approximately 60 years. The peer review memorandum is contained in **Appendix A**.

4 OUTFALL HYDRAULIC IMPACTS OF ALTERNATIVES

The 36-inch outfall is approximately 1.4 miles in length, and conveys peak wet weather flows of up to 30-MGD per GSD. Dudek prepared hydraulic calculations based on the Alternatives 1 and 2 to determine the hydraulic impacts to the outfall. The friction losses through the existing pipeline and Alternatives 1 and 2 for a 30-MGD flow rate are summarized in **Table 1**.

Table 1. Hydraulic Losses in 36-inch Outfall at 30-MGD Flow Rate

Alignment	Length (ft)	Headloss (ft)
Existing	7,392	24.5
Alternative 1	7,406 + (4) additional bends	25.1
Alternative 2	7,403 + (4) additional bends	25.0

As shown in **Table 1**, the hydraulic impact of alternatives 1 and 2 are an additional 0.6 feet and 0.5 feet of friction loss respectively. This means that there will be an additional 0.5 feet or 0.6 feet of water height (or pumping head) depending on the selected alternative at the treatment plant effluent discharge facilities when compared with the alignment of the existing outfall at the 30-MGD flow rate and identical tidal conditions at the terminus of the outfall.

The hydraulic impacts to the treatment plant effluent discharge facilities and outfall should be confirmed and further analyzed in more detail during preliminary and final design of these improvements. Additional improvements and/or adjustments to plant operation of facilities may be needed.

5 HISTORICAL OUTFALL FLOW RATE RANGE AND TEMPORARY BYPASS

One important consideration for construction is determining the range of flows a temporary bypass pipeline will need to be sized for and the duration the bypass will need to be operated.

As noted in the preceding section, peak wet weather flows can be up to 30-MGD, and, therefore, it would be desirable to avoid construction of the improvements during the wet season.

The District provided the historical expected annual average dry weather flows in the outfall. As presented in **Table 2**, the dry weather flow from non-colleges is static year-round at 4.5-MGD. Reclaimed water demands fluctuate throughout the year and flows from Santa Barbara City College and UC Santa Barbara are 0.2-MGD and 0.5-MGD respectively when these institutions are in regular academic session.

Average dry weather flow rates in the outfall are reduced from mid-May to late September, and therefore, the required size of the bypass may be able to be reduced to carry these flows plus a safety factor. This provides a more than ample duration of four months for the construction of the two connections to the existing facilities (shown as Phase 2 in **Figures 1** and **2**) where flows are reduced and the likelihood of a wet weather event is minimal.

Table 2. Summary of Typical Annual Average Dry Weather Outfall Flows

Service Area Customers	Late-Sept to Mid-May	Mid-May[1]	Mid-Jun[2]	Late-Aug[3]	Late-Sept[4]
Non-College Customers	4.5 MGD	4.5 MGD	4.5 MGD	4.5 MGD	4.5 MGD
Santa Barbara City College (SBCC)	0.2 MGD	-	-	0.2 MGD	0.2 MGD
UC Santa Barbara (UCSB)	0.5 MGD	0.5 MGD	-	-	0.5 MGD
Reclaimed Water Demand	(0–1.6) MGD	(-) 1.6 MGD	(-) 1.6 MGD	(-) 1.6 MGD	(0-1.6) MGD
Total Reported Effluent Flow:	**5.1 MGD (Max)**	**3.4 MGD**	**2.9 MGD**	**3.1 MGD**	**3.6 MGD (Max)**

1. SBCC out of regular academic session
2. UCSB out of regular academic session
3. SBCC back in session
4. UCSB back in session

6 CONSTRUCTION CONSIDERATIONS

During the development and refinement of alternatives 1 and 2 the following construction considerations were addressed:

- Locating the proposed facilities to minimize the interruption and temporary bypass durations for the outfall.
- Temporary bypass facilities including the “hot-tap” and temporary plug/line-stop.
- Temporary shoring and dewatering facilities.

- Locating the vault and other facilities to minimize park traffic and parking impacts both during and post construction.
- Sequencing and phasing to minimize impacts to park access traffic (both vehicular and pedestrian).
- Sequencing and phasing to minimize impacts to outfall operational impacts.
- Disruption of utilities (water, gravity sewers, forcemain). As shown on Figures 1 and 2, the impacted utilities will require highlines or other temporary measures to keep the effected utilities in operation during construction. The subject utilities will require reconstruction/relocation in kind.
- Relocation of tree(s).
- Permanent and temporary construction easements are discussed subsequently in this memo.
- Removal and abandonment of facilities.

Each of these considerations and other items that arise will need to be addressed in more detail during preliminary and final design of the selected project.

7 CONSTRUCTION COST OF ALTERNATIVES

Construction cost estimates were prepared for both alternatives and are presented in **Table 3**. It should be noted there are no contingencies included in these cost estimates. A project cost contingency is included in the project cost estimates subsequently presented in this memo.

Table 3 Construction Cost Estimates for Alternatives

Alternative	Estimated Construction Cost ($)
1	$ 1,770,000
2	$ 2,050,000

A more detailed breakdown of the construction cost for each alternative is contained in **Appendix B**.

8 PROJECT DURATIONS

The project duration for alternatives 1 and 2 is the same and is as follows:

- 12 months for engineering and permit acquisitions
- 6-9 months for construction

9 PERMITTING AND JURISDICTIONAL AGENCIES

Both of the project alternatives will require permits and permit coordination with the following agencies: Regional Water Quality Control Board (Regional Water Quality Control Board), Army Corps of Engineers, California Department of Fish and Wildlife, California Coastal Commission and Santa Barbara County.

While the exact parameters of the project are yet to be determined, given the scope proposed with the alternatives, the estimated timeline for permit processing and issuance is anticipated to be six to twelve months. Presuming the District contracts permit coordination and services, in addition to fees, the estimated costs are anticipated to be $60,000.

10 EASEMENTS

Based on alternatives 1 and 2, a new permanent will be required for the proposed facilities, and a portion of the existing easement (around the portion of the outfall to be abandoned) can be vacated. The existing easement is 10 feet wide and is centered on the outfall pipeline.

Based on the size and depth of the outfall, the District may want to consider obtaining a 20 foot wide easement about the proposed facilities. In addition, a temporary easement for construction will be needed. The cost(s) of the temporary and permanent easements are unknown at this time.

11 PROJECT COST OF ALTERNATIVES

Project cost estimates were developed for each alternative using the estimated construction costs, estimated support costs (for engineering design (preliminary design, final design, and bidding/construction support services), project administration by the District, permitting, construction management, and an overall project contingency of twenty percent. There are no costs for CEQA because the project is categorically exempt.

More detailed project cost estimates for the two alternatives and are contained in **Appendix C**, and summarized in **Table 4**.

Table 4 Project Cost Estimates for Alternatives

Alternative	Estimated Project Cost ($)
1	$ 3,150,000
2	$ 3,650,000

12 EVALUATION OF ALTERNATIVES

Table 5 presents the advantages and disadvantages of alternatives 1 and 2.

Table 5 Advantages and Disadvantages of Alternatives

Alternative	Advantages	Disadvantages
1	1. Reduced length of outfall pipeline replacement which reduces the project and construction costs. 2. The construction of the outfall line does not extend into the northerly most parking lot corridor which reduces the traffic impacts during construction. 3. This alternative requires fewer utility relocations and maintaining of utilities during construction which reduces both project risk and project costs.	1. Anticipated life is approximately 40 years which is approximately 20 years less than alternative 2. 2. Locates outfall vault in/on smaller parking island more centrally in parking lot. The parking lot will require modification (possibly island modifications to allow the District continuous access to the vault.
2	1. Anticipated life is approximately 60 years which is approximately 20 years longer than alternative 1. 2. Does not locate the outfall vault in/on smaller parking island more centrally in parking lot.	1. Increased length of outfall pipeline replacement which increases the project and construction costs. 2. The construction of the outfall line extends into the northerly most parking lot corridor which has traffic impacts during construction. 3. This alternative requires more utility relocations and maintaining of utilities during construction which increases both project risk and project costs.

13 CONCLUSION AND RECOMMENDATIONS

Based on the information presented herein it is recommended that the District proceed with alternative 1 and budget $3,150,000.

Appendix A
Peer Review

GeoSoils, Inc.

Geotechnical • Geologic • Coastal • Environmental

5741 Palmer Way • Carlsbad, California 92010 • (760) 438-3155 • FAX (760) 931-0915 • www.geosoilsinc.com

MEMORANDUM

REGISTERED PROFESSIONAL ENGINEER
DAVID W. SKELLY
No. RCE 47857
Exp. 12-31-17
CIVIL
STATE OF CALIFORNIA

DATE: July 28, 2017 **W.O.** S7292

TO: Neil Harper, PE and Jane Gray, Dudek

FROM: David Skelly, PE, GeoSoils Inc

SUBJECT: Goleta Sanitary District Vault Protection Plan Review and Potential Relocation

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REFERENCES: "Goleta Sanitary District, Armor Rock Protection for Ocean Outfall, Part C -Drawings," by Brown and Caldwell Consultants, dated January 1994.

"National Assessment of Shoreline Change Part 3: Historical Shoreline Change and Associated Coastal Land Loss Along Sandy Shorelines of the California Coast", Open File Report 2006-1219, by United State Geologic Survey, dated 2006.

"Goleta Beach, County of Santa Barbara, APN 071-200-009,017, CDP Exhibit Map, Goleta Beach West Revetment," Sheets 1-3, by Penfield & Smith, dated December 2014.

"Goleta Beach Emergency Protection Rock Revetment," by Moffatt & Nichol and Stantec, dated February 2017.

"Goleta Beach Outfall Vault Relocation Option Alternative, Figure 1 and Figure" by Dudek Engineering + Environmental, dated July 2017

PLAN REVIEW

The permit information provided to GeoSoils Inc. (GSI) does not contain any project or permit design parameters to assess if the revetment design is consistent with the parameters. These design parameters would include: design wave height, design wave period, design beach profile, design ocean water level (including sea level rise [SLR]), shoreline retreat rate, overtopping analysis, and design life of the structure. In addition, it is GSI's experience that the California Coastal Commission (CCC) requires a coastal hazard investigation for a CDP that involves shore protection. No project hazard analysis has been provided to GSI.

The location of the revetment toe is typically based upon the expected scour depth with some additional depth as a factor of safety. The Moffatt & Nichol-Stantec (M&N-S) design of the revetment at Goleta Beach is based upon a higher toe elevation (scour depth) and a steeper structure slope than the 2014 Penfield and Smith plans for the County. The County of Santa Barbara December 2014 plans shows a revetment section that extends from elevation ~+12 feet NAVD88 to about elevation +1 feet NAVD88, a slope of about

2.1/1.0 (H/V), with a on-offshore footprint of about 18 horizontal feet. The M&N-S plans have the revetment extending from about +13 feet NAVD88 to about +2 feet NAVD88, a slope of about 1.5/1.0 (H/V), with a on-offshore footprint of about 18 horizontal feet. The primary differences between the two in the revetment section design are the design toe (scour depth) of the revetment and the slope. If the actual scour depth is lower than the toe depth, and in consideration of the steep slope, the revetment stone may move. Stone movement typically adversely impacts the structure performance.

A revetment type shore protection is a mobile structure. Movement of the armor stone should be expected and anticipated. The revetment should be observed periodically, especially after the coincidence of high tides and high waves. Re-placement of displaced armor stone or the addition of new armor stone should be anticipated. Maintenance is necessary to insure the proper functioning of the revetment, and to protect all improvements behind it.

Based upon our experience, the emergency protection plans and specifications prepared by M&N-S are in general conformance with standard coastal engineering practice (US Army Corps of Engineers Coastal Engineering Manual). In addition, based upon our experience, the plans and specifications are in conformance with typical CCC coastal development permit (CDP) project plan requirements. However, the CCC may require additional information as described above. Finally, based upon our review of the M&N-S plans, pictures of the revetment work performed to date, and review of Goleta Sanitary District (GSD) vault plans with respect to additional loading from the revetment, the repairs will provide adequate protection to the vault provided the revetment is monitored and maintained. Without additional analysis information such as anticipated SLR, revetment overtopping rate, and shoreline retreat rate, it is difficult to determine how long in the future the revetment will protect the GDS vault.

GSD SLR ADAPTATION DISCUSSION

The most important factor in planning for adaptation of Goleta Sanitary District (GSD) infrastructure to SLR is the anticipated shoreline retreat rate. There is some available erosion information in a report by the United States Geologic Survey (USGS) referenced above. There will be no retreat if the revetment is maintained and adapted to SLR. If the revetment is removed the retreat rate will be on the order of 1 feet/year based upon nearby USGS retreat rates. The second most important factor is the potential for wave runup/overtopping of the revetment impacts on the GSD facilities. If the revetment is damaged and not maintained or adapted to SLR wave runup may reach the vault. The information provided for the shore protection project did not contain any site specific estimates of shoreline erosion or wave runup and overtopping. With the revetment in place and maintained, the movement of the shoreline will be stopped for at least the next two decades, or more. The structure's "useful life" can be extended to adapt to SLR with modification of the revetment, such as raising the height. During the next 20 years it should be anticipated that waves will runup and overtop the revetment, and impact the improvements behind the shore protection. The extent of the impact cannot be assessed without additional analysis of overtopping and the resilience of the improvements that may be impacted.

It should be noted that the USGS report does not appear to expressly cover Goleta Beach. However, it does provide some information on erosion rates in the area. These erosion rates are for unprotected sections of shoreline. Figure 1 (Figure 35 of the USGS report) shows both the long term erosion short terms rates with long term rates about 1 feet/year near the site area. The short term retreat rates are about 3 feet/year. If these rates are used to project future erosion rates it should be noted that the rate may not account for a change in littoral materials, such as a beach material transition from sand to cobbles as the shoreline moves landward. This would result in a lower shoreline retreat rate due to the less mobile cobble material.

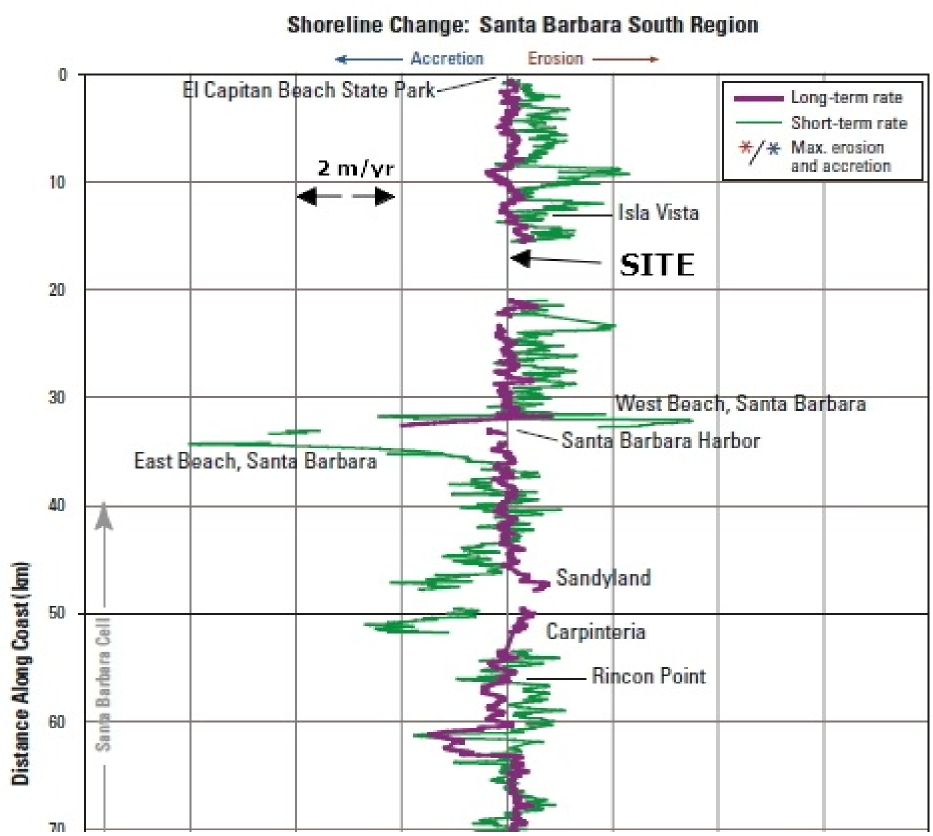

Figure 1. Portion of Figure 35 from the USGS 2006 shoreline change report.

The USGS has also developed a model called the Coastal Storm Modeling System (CoSMoS) for assessment of the vulnerability of coastal areas to SLR and the 100-year storm, http://walrus.wr.usgs.gov/coastal_processes/cosmos/. There are disclaimers as to the use of the model for permitting and development. Using the current modeling program, CoSMoS3, the vulnerability of the site to different SLR scenarios and the 100-year storm can be assessed. The model output includes wave runup flooding and shoreline erosion. Figure 2 is the CoSMoS output for the 100 cm (3.3 feet) SLR, the revetment in place, and the 100-year storm event. The figure shows that under 100 cm (~3.3 feet) of SLR, the area near the vault and much of the park are not in the flooding or inundation zone. Figure 3 shows the predicated movement of the shoreline with no revetement in place and 100 cm (3.3) of SLR. The shoreline is landward of the current vault location.

Figure 2. CoSMoS output 100 cm SLR and revetment in place.

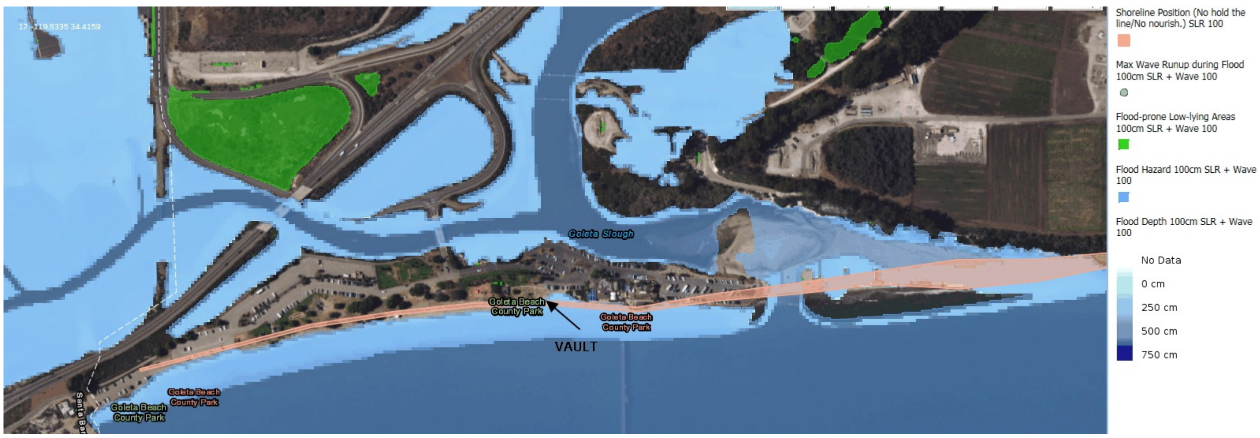

Figure 3. CoSMoS output 100 cm SLR and shoreline movement (no revetment).

The million dollar question is "which prediction model and curve will SLR follow?" The April 2017 "Rising Seas in California" by the California Ocean Protection Council (COPC) provides current SLR estimates within a "likelihood" frame work. The COPC provides SLR estimates based upon emission scenarios known as a "representative concentration pathway" or RCP. The La Jolla estimates are loosely valid through out southern California. Figure 4 provides the April 2017 COPC table of latest SLR estimates and likelihoods of occurrence based upon the best available science.

(c) La Jolla

Feet above 1991-2009 mean	MEDIAN	LIKELY RANGE	1-IN-20 CHANCE	1-IN-200 CHANCE
Year / Percentile	50% probability SLR meets or exceeds...	67% probability SLR is between...	5% probability SLR meets or exceeds...	0.5% probability SLR meets or exceeds...
2030	0.5	0.4 — 0.6	0.7	0.9
2050	0.9	0.7 — 1.2	1.4	2.0
2100 (RCP 2.6)	1.7	1.1 — 2.5	3.3	5.8
2100 (RCP 4.5)	2.0	1.3 — 2.8	3.6	6.0
2100 (RCP 8.5)	2.6	1.8 — 3.6	4.6	7.1
2100 (H++)	10			
2150 (RCP 2.6)	2.5	1.5 — 3.9	5.7	11.1
2150 (RCP 4.5)	3.1	1.9 — 4.8	6.5	11.8
2150 (RCP 8.5)	4.3	3.0 — 6.1	7.9	13.3
2150 (H++)	22			

Figure 4. Table from COPC 2017, providing current SLR estimates and likelihood.

It is not unreasonable to estimate that sea level could be ~0.6 feet higher in 15 years from today and ~1.2 feet in 35 years based upon the “Likely Range” in the table. Additional overtopping analysis with SLR considered would help determine the potential impacts of overtopping for given vault relocation sites. This additional analysis would be more accurate than the CoSMoS analysis.

Alternative 1

This alternative would move the vault approximately 128 feet landward of the existing vault. With the revetment in place this will significantly reduce or eliminate the impact of any wave overtopping on the vault (inundation). If the revetment is removed and the retreat rate is ~3 feet/yr, the shoreline will be at the vault in about 38 years.

Alternative 2.

This alternative would move the vault approximately 190 feet landward of the existing vault. With the revetment in place this will eliminate the impact of any wave overtopping on the vault. If the revetment is removed and the retreat rate is ~3 feet/yr, the shoreline will be at the vault in about 57 years.

In conclusion, the vault is reasonably safe from coastal hazards for the next two decades provided the revetment is maintained. It is uncertain as to the County of Santa Barbara’s SLR adaptation strategy, and the impact of SLR on future shoreline erosion rates and extreme wave conditions is also uncertain. With these uncertainties in mind, it is prudent to relocate the GSD vault to an area where the potential impacts from extreme wave runup and shoreline erosion are minimized. Alternatives 1 and 2 accomplish this for the approximate time periods provided above.

Appendix B
Construction Cost Estimates

Engineer's Opinion of Probable Construction Cost

Goleta Sanitary District

Goleta Beach Outfall Vault Relocation Conceptual Design (Alternative 1)

Item	Unit	Unit Cost	Quantity	Cost
Mob., Demob. and Gen Cond (7.5%)	L.S.	$122,400	1	$122,000
Excavation Safety Measures	L.S.	$15,000	1	$15,000
Traffic Control Measures and Plans	L.S.	$12,500	1	$13,000
Survey Staking, Verification of Utility Locations, and Field Dimensions	L.S.	$5,000	1	$5,000
Stormwater Pollution Prevention Plan and Permitting Fees	L.S.	$20,000	1	$20,000
Sheeting, Shoring and Bracing	S.F.	$45	18,050	$812,000
Dewatering Allowance	L.S.	$150,000	1	$150,000
Excavate and Export	C.Y.	$20	2,726	$55,000
Demolition/Removal Existing Vault and Anode Well	L.S.	$25,000	1	$25,000
Demolition/Abandon Existing Cathodic Protection Panel, Conduit and Wiring	L.S.	$2,500	1	$3,000
Hot-Tap and Temporary Plug	Each	$40,000	2	$80,000
Temporary Bypass Installation and Equipment	L.S.	$50,000	1	$50,000
Subgrade Preparation Allowance	L.S.	$15,000	1	$15,000
New Reinforced Concrete Outfall Access Vault (10'x10'x20')	L.S.	$80,000	1	$80,000
Install New Anode Well	L.S.	$30,000	1	$30,000
36-inch RCP Outfall Pipeline	L.F.	$430	39	$17,000
36-inch Steel Outfall Pipeline	L.F.	$540	146	$79,000
36-inch Access Manway	L.S.	$7,500	1	$8,000
Connection to existing 36-inch RCP	L.S.	$15,000	1	$15,000
Connection to existing 36-inch Steel	L.S.	$20,000	1	$20,000
New Cathodic Protection Panel, Conduits and Wiring	L.S.	$22,500	1	$23,000
Maintain and Reconstruct Existing Water/Sewer Utilities Impacted during Construction	Each	$12,500	4	$50,000
Restore Pavement and Pavement Markings	S.F.	$10	3,200	$32,000
Miscellaneous Site Work Allowance (Tree Relocation, Landscaping, Fencing, Etc.)	L.S.	$50,000	1	$50,000
			Total	***$1,770,000***

Engineer's Opinion of Probable Construction Cost

Goleta Sanitary District
Goleta Beach Outfall Vault Relocation Conceptual Design (Alternative 2)

Item	Unit	Unit Cost	Quantity	Cost
Mob., Demob. and Gen Cond (7.5%)	L.S.	$141,900	1	$142,000
Excavation Safety Measures	L.S.	$15,000	1	$15,000
Traffic Control Measures and Plans	L.S.	$12,500	1	$13,000
Survey Staking, Verification of Utility Locations, and Field Dimensions	L.S.	$5,000	1	$5,000
Stormwater Pollution Prevention Plan and Permitting Fees	L.S.	$20,000	1	$20,000
Sheeting, Shoring and Bracing	S.F.	$45	22,800	$1,026,000
Dewatering Allowance	L.S.	$150,000	1	$150,000
Excavate and Export	C.Y.	$20	3,237	$65,000
Demolition/Removal Existing Vault and Anode Well	L.S.	$25,000	1	$25,000
Demolition/Abandon Existing Cathodic Protection Panel, Conduit and Wiring	L.S.	$2,500	1	$3,000
Hot-Tap and Temporary Plug	Each	$40,000	2	$80,000
Temporary Bypass Installation and Equipment	L.S.	$50,000	1	$50,000
Subgrade Preparation Allowance	L.S.	$15,000	1	$15,000
New Reinforced Concrete Outfall Access Vault (10'x10'x20')	L.S.	$80,000	1	$80,000
Install New Anode Well	L.S.	$30,000	1	$30,000
36-inch RCP Outfall Pipeline	L.F.	$430	39	$17,000
36-inch Steel Outfall Pipeline	L.F.	$540	207	$112,000
36-inch Access Manway	L.S.	$7,500	1	$8,000
Connection to existing 36-inch RCP	L.S.	$15,000	1	$15,000
Connection to existing 36-inch Steel	L.S.	$20,000	1	$20,000
New Cathodic Protection Panel, Conduits and Wiring	L.S.	$22,500	1	$23,000
Maintain and Reconstruct Existing Water/Sewer Utilities Impacted during Construction	Each	$12,500	4	$50,000
Restore Pavement and Pavement Markings	S.F.	$10	3,500	$35,000
Miscellaneous Site Work Allowance (Tree Relocation, Landscaping, Fencing, Etc.)	L.S.	$50,000	1	$50,000
			Total	***$2,050,000***

Appendix C
Project Cost Estimates

Cost Item	Alternative 1	Alternative 2
Construction Cost	$1,770,000	$2,050,000
Engineering (15%)	$265,000	$310,000
Permitting	$60,000	$60,000
GSD Administration (15%)	$265,000	$310,000
Construction Management (15%)	$265,000	$310,000
Project Subtotal:	$2,625,000	$3,040,000
Project Contingency (20%)	*$525,000*	*$610,000*
Project Total:	**$3,150,000**	**$3,650,000**