Golden Gate National Recreation Area

Contract No. P13PC00160

TITLE I REPORT

PMIS 217962

Stinson Beach Parking Lot Storm Damage Repairs

August 2015

Prepared by:

HOLLADAY ENGINEERING CO.

ENGINEERS • CONSULTANTS

32 N Main • PO Box 235 • Payette, ID 83661

208 642 3304 • hec@holladayengineering.com

MEETING REPORT

Meeting Dates: June 1, 2015

Meeting Location: Stinson Beach (Golden Gate National Recreation Area)

Project: Title I Scoping Trip – Stinson Beach Parking Lot Storm Damage Repairs Project

Project No.: PMIS #217962 Prepared By: Doug Argo, Holladay Engineering

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Attendees:

Chris Carpenter, PE	NPS, GOGA Civil Engineer
Mike Ryan, PE	NPS, GOGA Civil Engineer
Xavier Agnew	NPS, GOGA Law Enforcement Officer
Darren Fong	NPS, GOGA Environmental Clearance
Chris Rodriguez	NPS, GOGA Maintenance Supervisor
Doug Argo	Holladay Engineering Company (HEC)

PROJECT DESCRIPTION / NEED:

Stinson Beach is located in the Northern District of the Golden Gate National Recreation Area (GOGA) in Marin County, approximately 15 miles north of San Francisco

It is a very popular summer destination and is easily accessible from a major highway. This area of the Park can experience a peak usage of 10,000 visitors on warm holidays. The Stinson Beach public areas are divided into three main areas, South, Central and North, each served by public comfort stations, picnic areas, beach access and parking lots as shown on the Site Aerial Photo, Figure 1.

Site Aerial Photo, Figure 1

Notes:
1 – North Parking Lot
2 – Parkside Café
3 – Existing Outfall Location
4 – South Parking Lot
5 – Easkoot Creek
6 – Existing Berm
7 – Park Access Road

Photo 1: North Parking Lot Drainage

The North and South parking lots have poor grading with respect to site drainage. Water from direct rain fall runs off the uneven asphalt surface randomly onto adjacent grassy areas, but numerous puddles remain on the surface of the asphalt until it evaporates or infiltrates through the pavement (see Photo 1).

Easkoot Creek begins east of the Stinson Beach Federal Government Property (Stinson Beach) and flows along the eastern boundary from the Central to the North parking lots. The creek channel capacity adjacent to Stinson Beach has decreased over the past several years due to storm events depositing sediment eroded from higher up in the water shed. Easkoot Creek over flows its channel during 5-10 year storm events and flows northwest across the Northern parking lot. A small non-engineered berm (1-2 feet in height above the surface of the parking lot asphalt) composed primarily of local material that is plowed off the parking lot after large storm events serves as the primary flood water barrier between the North parking lot and private properties to the north. Marin County Flood Control and Water Conservation District (Marin

County) maintains a sediment basin adjacent to the Parkside Café. Per discussions with Chris Choo of Marin County, Marin County has built a berm between this basin and the Park's access road. The top of the berm is to be maintained at 0.75 feet above the Park's access road surface, and the basin is to be cleaned out regularly (see Figure 1). These efforts are designed to keep the water flowing into the Park's North parking lot at similar volume to the volume which flowed into the parking lot prior to the sediment basin being installed.

In May 2014, an engineering study was completed by ESA Engineering (ESA) to provide solutions for the run-off concerns located along the northwest boundary between Stinson Beach and the private land owners. The report recommended relocating the flooding outfall (and only public beach access) for the North parking lot from the northwest corner to the southwest corner of the parking lot, adjacent to the comfort station. The new outfall would be oriented at an angle to the beach, rather than perpendicular, in an attempt to reduce wave run-up during storm events. The bottom of the new outfall was to be at elevation 15 feet. The asphalt surface of the parking lot is at approximately Elevation 14+/- based on topographic survey data provided by a survey firm, BKF, in 2013. Part of the fall 2014 project included installing a berm at the outfall discharge to act as a barrier to wave run-up on the parking lot. The intent of the berm at the outfall was that it would be low enough that the overflow from Easkoot Creek would over-top the outfall berm before over-topping the berm protecting the neighboring property to the north.

In fall of 2014, the park hired a contractor to complete the work. In December of 2014, the park experienced a typical 5-10 year storm that caused Easkoot Creek to over flow its flood channel. The water from Easkoot Creek flowed northwest across the parking lot toward the old outfall where it then ponded and turned south toward the newly constructed outfall/beach access. Ponding occurred at the new outfall, but as the water continued to rise it became apparent that the height of the outfall berm was not correct or had shifted over time and that over-topping of the berm along the north side of the North parking lot might occur. In response, park personnel breached the outfall berm with hand tools. The resulting damage was

Photo 2: Flood Damage to Parking Lot

Photo 3: Flood Damage at Parking Lot Outfall

similar to the last storm damage in winter of 2013. Flood water eroded sand and silt materials and the sides of the dunes creating an incised channel to a depth of three to five feet. Damage included undermining of the parking lot which in turn caused the asphalt pavement to fail locally around the outfall (see Photos 2 and 3).

In spring of 2015, GOGA received emergency repair funding for the winter 2014 storm event. Dredging of the creek is not considered an option for addressing the overflow problem.

PROJECT SCOPING OBSERVATIONS AND DETAILS

A field visit was conducted on June 1, 2015. The recent site history was reviewed with respect to recent flooding of the parking lots and the resulting damage to the edge of the North parking lot at the location of the outfall. The following points summarize key elements of the discussion and field observations:

1. The outfall surface was designed to be at Elevation 15 per the ESA report, which required approximately 1 foot of water to pond on the parking lot surface prior to allowing water to flow through the new outfall.
2. The present width of the outfall channel is approximately 16 feet at the base.
3. The depth of the pond over the parking surface was approximately one to two feet deep based on reports from Park personnel who observed the area during the December 2014 flood event. Park personnel then breached the berm in the outfall so that water would not flow over the berm along the north side of the North parking lot.

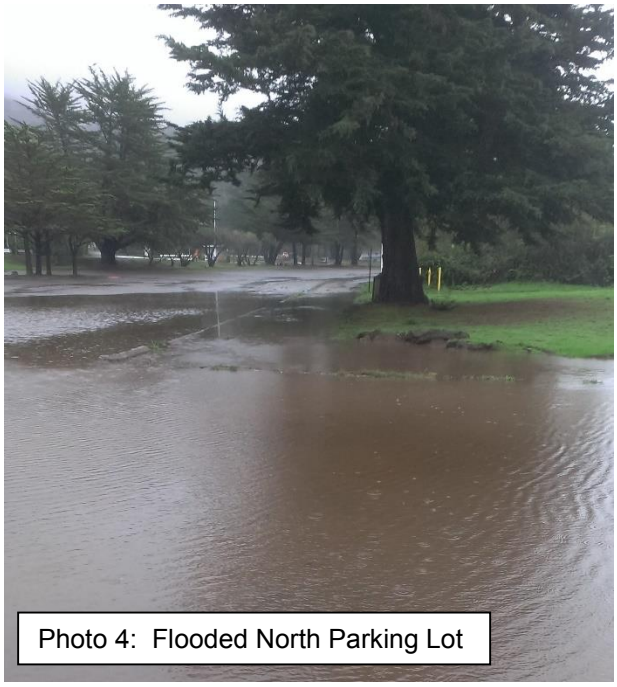


Photo 4: Flooded North Parking Lot

4. The top of the berm, located along the north edge of the North parking lot, was observed to be irregular and variable in height. The top of the berm appeared to be approximately one to two feet above the surface of the adjacent asphalt at the time of our June 1, 2015 site visit. Subsequent Park survey measurements of the berm and parking lot confirmed this estimate.
5. Wave run-up during past storm surge events has deposited debris and sediment on the surface of the North parking lot.
6. Park personnel could not remember a significant storm surge event occurring since the new angled outfall has been constructed.
7. Pedestrians use the outfall to access the northern portion of the beach. This access is likely to continue in the future.
8. The peak flow at the sediment basin adjacent to the Parkside Café is estimated to be approximately 175 cubic feet per second (cfs) during an 8-year flood event for

Easkoot Creek (as described in the memorandum from O'Connor Environmental, Incorporated (OEI) to Marin County dated March 23, 2014 and titled "Easkoot Creek Parkside Sediment Basin Hydraulic Analysis.") Marin County has chosen to operate the sediment pond with a 0.75 foot berm and keep the basin cleaned of sediment. Under these conditions, the estimated overflow from the creek into the Park parking lot is 8 to 12 cfs during an 8-year flood event on Easkoot Creek. Note that per the memorandum mentioned above, the amount of overflow into the Park's parking lot during an 8-year flood event could vary between 8 cfs and 59 cfs depending on the condition of the sediment basin and the adjacent berm.

Marin County estimates that the amount of water which overflowed into the Park's North parking lot during the December 2014 flood was similar to the volume which overflowed into the parking lot during the February 2014 flood.

9. A hard erosion resistant soil layer was observed in the outfall erosion scar at a depth of three to five feet below the parking lot surface after the last flood event. This material appears to be a hard clay based on the observations of Park personnel.

PROJECT GOALS

1. The outfall repairs are to be designed such that the overflow water (from Easkoot Creek) which enters the Stinson Beach North parking lot will flow to the ocean without flowing north out of the parking lot onto private property during the selected storm event. The Park desires to limit repairs after such a storm event to moving sand back to repair the erosion channel through the beach.
2. The outfall repairs are not to interfere with pedestrian access or future developments of the outfall area to the extent practicable.
3. The outfall should reduce the amount of damage caused by wave run-up which occurs during storm surges. However, this goal is secondary to passing overflow water from Easkoot Creek.
4. Establish elevation for berm along North parking lot and provide berm design to channel overflow water from Easkoot Creek toward the outfall for a 7-10 year storm event.

CONCLUSIONS

Water flowing across the asphalt pavement onto the sand will rapidly erode the sand and/or gravel at the edge of the asphalt and then rapidly undermine the edge of the asphalt even at relatively low flows. The berm across the outfall and subsequent ponding of water above the parking lot surface during the December 2014 flood added additional energy which increased erosion at the outfall when the berm was breached. We expect that even without the berm, the water flowing through the outfall would have damaged the edge of the parking lot. An armored outfall is required to protect the parking lot during flood events.

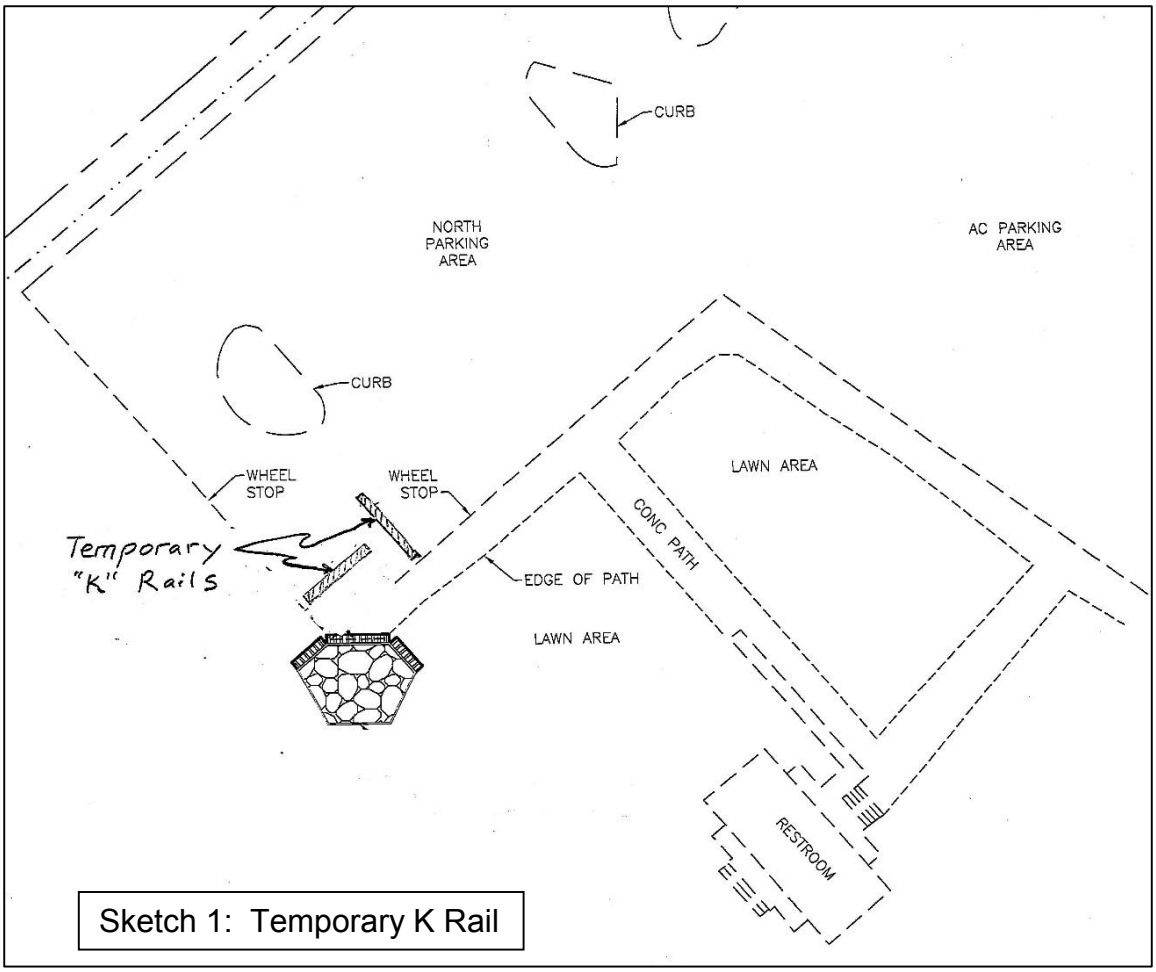
The berm along the north side of the North parking lot is variable in height and is not well constructed. An improved berm should be constructed to contain the design flows within the parking lot until the water can pass through the outfall.

The angle of the outfall relative to the beach was selected to reduce wave run-up during storm surges. The effectiveness of this design element has not been tested as Park personnel have not observed heavy storm surges since the new outfall was installed.

REPAIR OPTIONS

HEC recommends that two modifications be constructed: (1) an armored outfall should be constructed, and (2) an improved berm should be constructed. Three concepts are presented for the armored outfall and two concepts are presented for the improved berm. Please note that both improvements are recommended. Class C cost estimates are provided in Appendix A as a means to compare relative costs for each option.

With respect to the wave run-up during storm surge, the angled orientation of the outfall and pathway as recommended by ESA has merit. Also, based on observations by Park personnel, storm events which will have a high storm surge typically have more advance warning than storm events which might produce a flood. Based on this advance warning, the Park could keep two concrete "K-rails" or "Jersey Rails" at hand which could be moved into the parking lot just in advance of the predicted storm and removed following the storm. These rails would serve to further reduce the energy of the waves entering the parking lot. The rails would be oriented to allow sea water through as shown in Sketch 1. HEC recommends that the Park test this approach during the next storm surge event.



Sketch 1: Temporary K Rail

ALTERNATIVES TO PROTECT PAVEMENT AT OUTFALL

Option 1: Gabion Blanket

A concrete cut-off wall will be required along the edge of the asphalt pavement where the water will flow out of the parking lot into the outfall. The cut-off wall should be perpendicular to the long axis of the outfall. The top of the cut-off wall should match the surface of the parking lot. The bottom of the cut-off wall should extend at least 2.5 feet below the surface of the parking lot. The wall could either be constructed of cast-in-place concrete or large precast concrete blocks (2.5 feet square in cross-section) with precast blocks being used in the cost estimate. Compacted crushed rock would be placed behind the cut-off wall, and the asphalt would be patched back flush with the cut-off wall. A gabion blanket would be placed to protect the soil below the cut-off wall from erosion. The gabion blanket would be approximately 1-foot thick and the top of the gabions would be approximately 6-inches below the top of the cut-off wall. The gabions would be horizontal for 3 feet, and then slope down at approximately 5H:1V (horizontal to vertical) for a horizontal distance of approximately 21 feet. Compacted crushed rock would be placed to support the gabions, and a filter material would be installed between the crushed rock and the gabions. Sand would be placed over the gabions to fill the outfall channel up even with, but not higher than, the top of the cut-off wall. The surface of the sand would be horizontal for approximately 10 feet, and then begin sloping down to the beach at an inclination of at least two percent.

Precast concrete wheel stops could be installed to keep vehicles from driving off the parking surface onto the adjacent grass or sand, but the wheel stops should not be placed in front of the outfall. This area should be painted as a designated walk-way and labeled “No Parking”.

During a flood event, the water flowing out of the parking lot would rapidly erode the sand down to the gabions. The gabions would resist the erosion and protect the edge of the asphalt. After the flood event, the Park could replace the eroded sand and restore the outfall to the grade as described above. Care would be required to cover the gabions with a minimum of 12 inches of sand prior to traveling over them with small equipment such as skid-steer loader. Where slow movements without turning are expected, such as during final grading of the sand in the throat of the outfall, a sand cover of at least 6 inches is sufficient.

The 8-year flood was selected for design of the outfall and berm along the north edge of the North parking lot. Marin County’s model of Easkoot Creek indicates that approximately 8 to 12 cfs would enter the parking lot during this flood event, and this is the amount which is estimated to have entered the parking lot during the December 2014 flood. With a width of 16 feet, the design flow would be approximately 5-inches deep at the outfall. As previously noted, the overflow volume from the creek is highly dependent on the amount of aggradation in the channel and the maintenance of the sediment basin and its adjacent berm. Marin County’s model indicates that up to 59 cfs could overflow into the parking lot during the same 8-year flood. The proposed outfall would pass 59 cfs with a flow depth of approximately 14 inches.

Option 1 minimizes the potential for water ponding on the asphalt parking surface of the North parking lot. The gabions are buried by at least 6 inches of sand, so there is no

potential trip hazard from the gabions. The gabions would be designed to withstand the flow of the water discharging from the parking lot, and corrosion due to salt water may be resisted by either over-sizing the galvanized wire or using synthetic basket material. However, gabions are somewhat susceptible to damage from significant wave action, especially if the waves contain logs or other large debris. If a storm surge event occurred during or just after a flood event, the gabions could be severely damaged.

Option 2: Riprap Blanket

Option 2 is similar to Option 1 with the exception that the gabion blanket is replaced by riprap. The riprap blanket would be approximately 2 feet thick with a similar configuration as the gabion blanket described in Option 1. The flow characteristics at the outfall and the potential for water ponding on the asphalt parking surface are the same as described for Option 1.

Option 2 has all the benefits of Option 1 with the additional benefits that the riprap is not subject to corrosion issues due to salt water, and the riprap is more resistant to damage from wave action during a storm surge. The riprap blanket is easier to construct than the gabion blanket. The riprap would be buried in the same manner as described for the gabions in Option 1, so it would not create a trip hazard. After a flood event, the Park could replace the eroded sand and restore the outfall to the grade as described in Option 1. The sand cover required over the riprap would be a minimum of 6 inches thick with 12 inches preferred to protect the rubber tires of the loader from damage on the riprap.

Option 3: Cutoff Wall/Spillway

A reinforced concrete cutoff wall could be constructed such that the foundation extended into the erosion resistant native clay layer which was observed by Park personnel after the last flood event. The cutoff wall would have an estimated height of 6 feet. Water falling several feet generates significant energy and will rapidly begin eroding even a firm clay layer. Therefore, an energy dissipation mechanism would be required. Such a wall could incorporate an energy dissipation slab as part of the footing. The wall could either be a gravity or a cantilevered structure with cantilevered typically being somewhat less expensive because of the lesser quantity of concrete and steel required. The wall would be designed to withstand full hydrostatic pressure as drain pipes which extended through the wall would be prone to plugging when buried for years at a time.

This structure would extend a much shorter distance from the parking lot which results in less care being required when backfilling the sand after a flood event.

ALTERNATIVES TO CONSTRUCT THE BERM ALONG THE NORTH SIDE OF THE NORTH PARKING LOT

HEC recommends that the berm along the north edge of the North parking lot be raised to a minimum of two feet above the elevation of the parking lot surface at the outfall location. This would require raising the berm an average of approximately 6 to 12 inches. The berm should extend from approximately 10 feet east of the east edge of the parking lot (field fit to natural contours) to the juncture with the sand dune beyond the west edge of the parking lot. Two alternatives for berm construction are outlined below:

Option 1: Structural Fill Berm

The berm could be constructed of compacted structural fill. The structural fill should consist of well-graded sand and gravel with 10 to 20 percent silt. The fill should be moisture conditioned and compacted to at least 95 percent of maximum dry density as determined by ASTM D 698 (standard Proctor). The crest of the berm should be at least 1 foot wide and the sideslopes of the berm should be 2H:1V or flatter.

A berm constructed of compacted crushed rock is less susceptible to damage from foot traffic, wind, and rain, and is anticipated to only require maintenance every five years. Planting the berm with drought tolerant grasses could further reduce maintenance.

Option 2: Cement Treated Fill Berm

Alternatively, the berm could be constructed of compacted structural fill blended with dry Portland cement. The structural fill should consist of well-graded sand and gravel with 10 to 20 percent silt. Dry Portland cement should be blended into the structural fill at a rate of approximately 12 percent (by weight). The mixture should be moisture conditioned and compacted to at least 95 percent of maximum dry density as determined by ASTM D 698 (standard Proctor). The crest of the berm should be at least 1 foot wide and the sideslopes of the berm should be 2H:1V or flatter. The cement will harden the structural fill and make it more resistant to erosion from wind, rain, or foot traffic.

The advantage to constructing the berm in this manner is two-fold: reduction in long-term maintenance and reduced risk of over-topping. We estimate that berm maintenance would be required at approximately 10-year intervals. Maintenance could likely be accomplished using a small crew with a small loader, rototiller, and compactor. The risk of over-topping is reduced because the berm is more likely to maintain the as-constructed crest height than is a simple structural
fill berm.

RECOMMENDATIONS

HEC recommends Option 2 for construction of the outfall and Option 1A (Crushed rock berm) for the construction of the berm as providing the best value for the repairs. The location of the proposed outfall is shown in Photo 5.

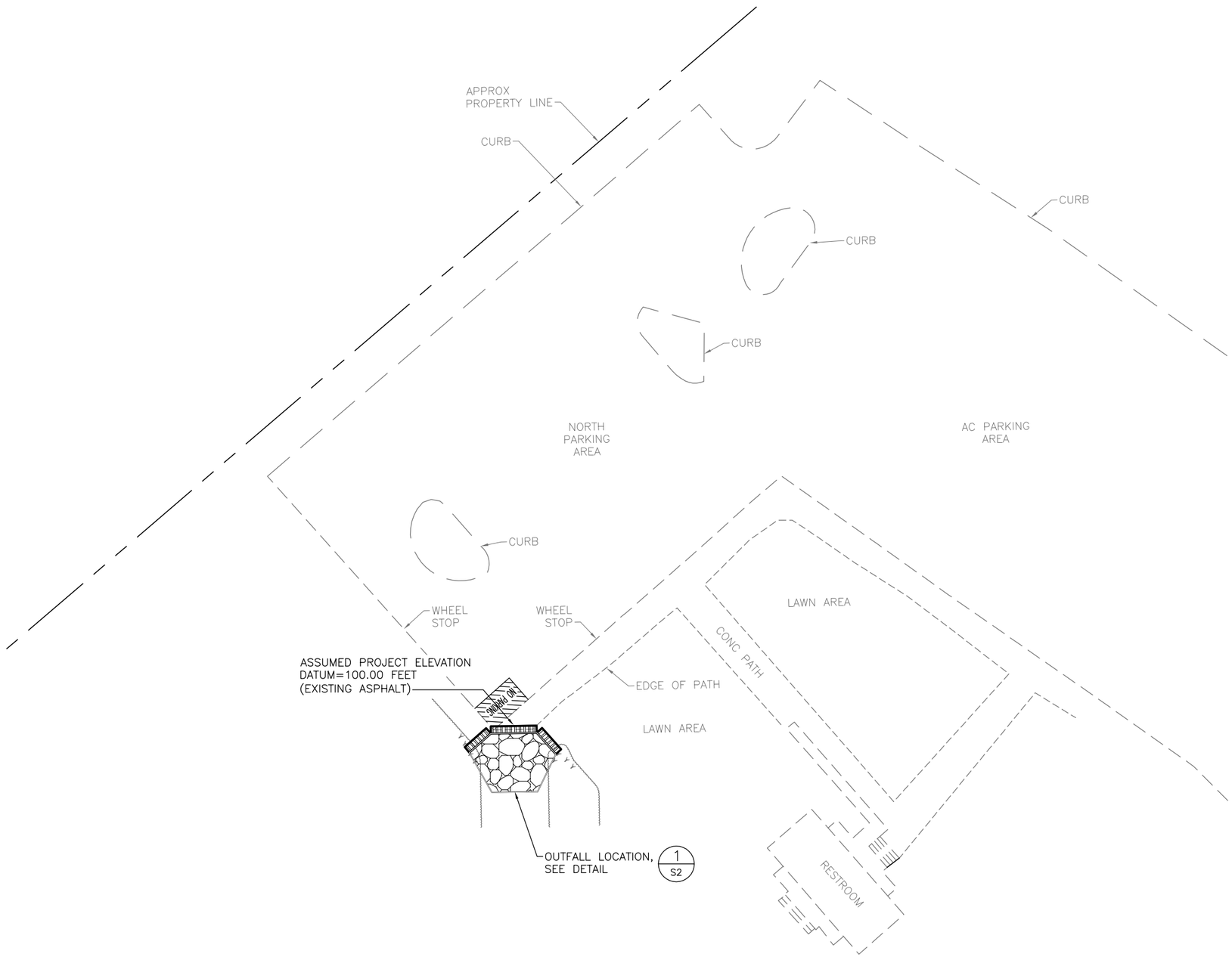
Photo 5: Proposed Outfall Location

SELECTED OPTIONS

The Park composed a review team to evaluate the options presented above. The review team determined that the best value would be provided by building the outfall using precast concrete blocks and riprap (Outfall Option 2), and building the berm using compacted crushed rock (Berm Option 1A). HEC developed construction details for these two options which are included in Appendix B.

APPENDIX B

DESIGN DETAILS FOR SELECTED OPTIONS



SITE PLAN

20 0 20 40
SCALE OF FEET

NOTE: THE PARK HAS ENVIRONMENTAL REQUIREMENTS FOR MATERIALS IMPORTED INTO THE SITE WHICH ARE IN ADDITION TO CAL–TRANS SPECIFICATIONS. THE PARK HAS PRE–APPROVED FOLLOWING SOURCES FOR THE MATERIALS LISTED:

MARK WEST: SANTA ROSA– ALL MATERIALS

STONEY POINT: COTATI– ALL MATERIALS

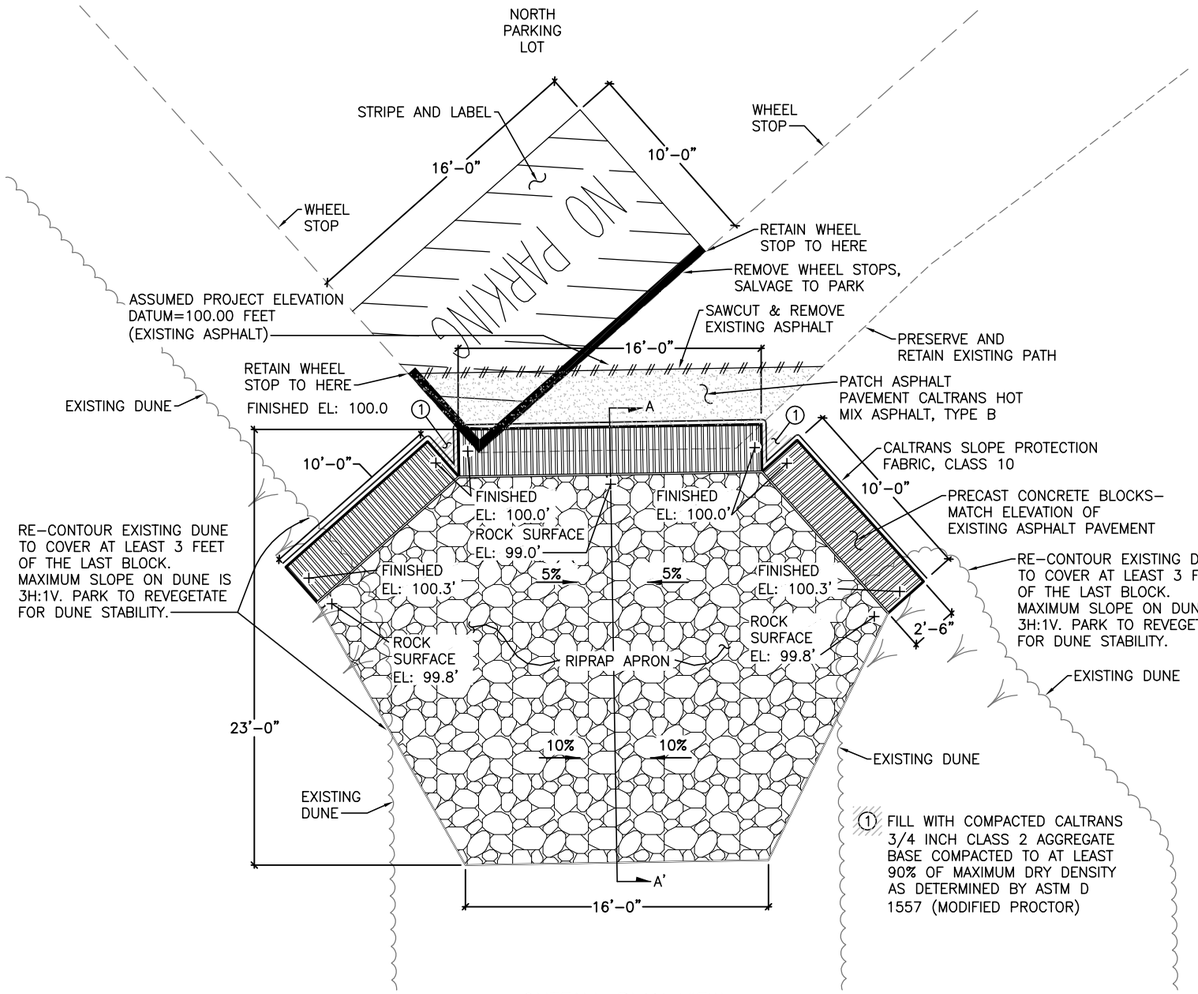
DUTRA: SAN RAFAEL–RIPRAP, YES
–AGGREGATE BASE, NO

ALL OTHER SOURCES REQUIRE TESTING

REGISTERED PROFESSIONAL ENGINEER
DAVID BARTON BROOKE
NO. 70417
EXP. 9/30/16
CIVIL
STATE OF CALIFORNIA

David Barton Brooke
8/03/15

DESIGNED: D.B. BROOKE CADD: B. GREENAN TECH. REVIEW: D . ARGO DATE: 7/2015	SUB SHEET NO. S1	TITLE OF SHEET SITE PLAN STINSON BEACH PARKING LOT STORM DAMAGE REPAIRS–OUTFALL LOCATION STINSON BEACH GOLDEN GATE NATIONAL RECREATION AREA	DRAWING NO. PMIS/PKG NO. 217962 SHEET 1 OF 2



OUTFALL PLAN VIEW

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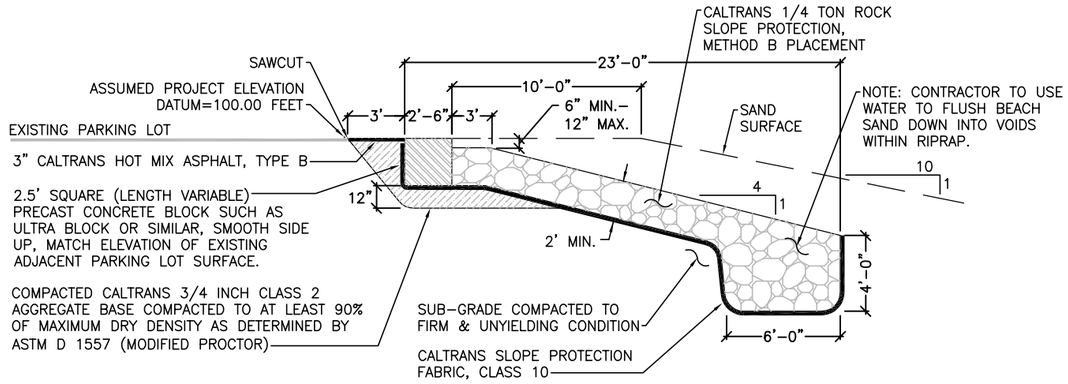


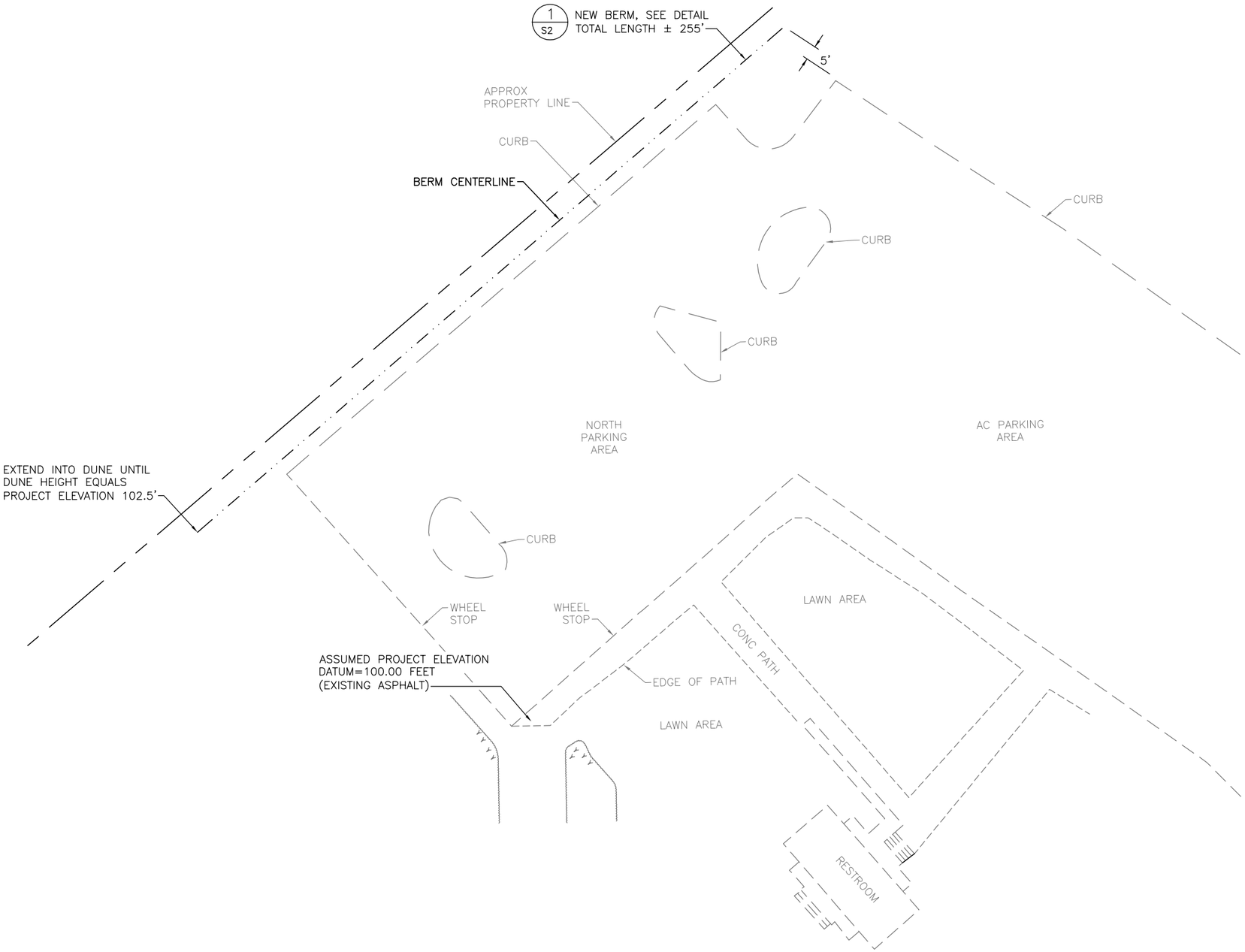
OUTFALL CROSS–SECTION (A–A')

1/S2 OUTFALL DETAIL
NOT TO SCALE

REGISTERED PROFESSIONAL ENGINEER
DAVID BARTON BROOKE
NO. 70417
EXP. 9/30/16
CIVIL
STATE OF CALIFORNIA

David Barton Brooke
8/03/15

DESIGNED: D.B. BROOKE CADD: B. GREENAN TECH. REVIEW: D . ARGO DATE: 7/2015	SUB SHEET NO. S2	TITLE OF SHEET OUTFALL DETAIL STINSON BEACH PARKING LOT STORM DAMAGE REPAIRS–OUTFALL LOCATION STINSON BEACH GOLDEN GATE NATIONAL RECREATION AREA	DRAWING NO. PMIS/PKG NO. 217962 SHEET 2 OF 2



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DAVID BARTON BROOKE
NO. 70417
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CIVIL
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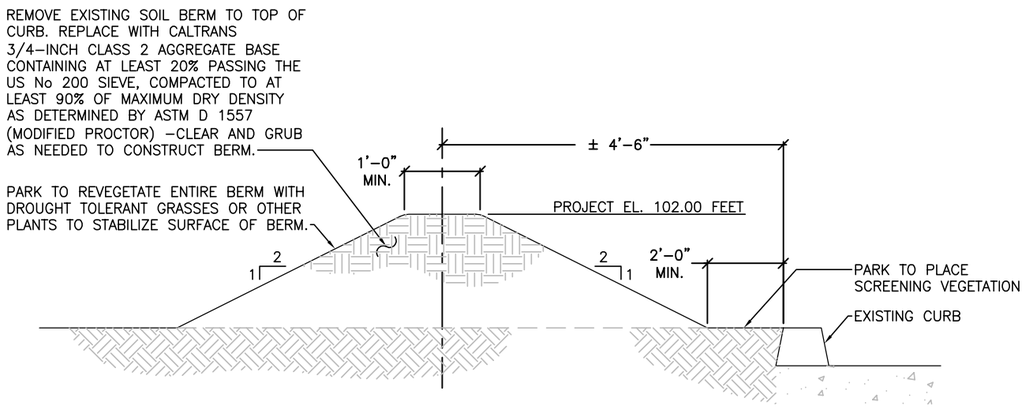

1/S2 BERM CROSS–SECTION
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REGISTERED PROFESSIONAL ENGINEER
DAVID BARTON BROOKE
NO. 70417
EXP. 9/30/16
CIVIL
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