HARO, KASUNICH AND ASSOCIATES, INC.

CONSULTING GEOTECHNICAL & COASTAL ENGINEERS

Date: 27 April 2023
Client: City of Carmel
Subject: Carmel Beach Coastal Protection Assessment
Reference: Carmel Beach Adaptation Plan
Project No.: 12176

CARMEL BEACH COASTAL PROTECTION ASSESSMENT REPORT

EXECUTIVE SUMMARY

Previous evaluations of coastal protection structures have focused on maintenance and repair. For this evaluation HKA inventoried the length, footprint and other factors. Using engineering judgment HKA determined the effectiveness of restacking rip rap revetment structures and lateral/vertical extensions of both revetments and vertical seawalls. HKA estimated the existing life of structure until it ceases to adequately provide protection for the bluff and roadway. HKA provided this written condition and assessment report and tabular inventory.

In December 2022 through February 2023 Haro Kasunich and Associates Inc. evaluated the condition of the coastal protection structures and stairways that were visible at Carmel Beach. Fortunately, severe winter storms and ocean wave runup scoured portions of the beach in early 2023, temporarily removing beach sand that covered the lower portions of some coastal protection structures, allowing them to be inspected. These structures consisted of 8 publicly owned seawalls, 6 publicly owned revetments and 11 publicly owned stairways were inspected. Two privately owned seawalls (S1 and S11), one at each end of the beach were viewed fom the beach but not inspected in detail. One coastal access path retaining wall that is not subject to wave runup or wave impact was viewed but not evaluated. It total we inspected 5537 lineal feet of coastline, which contained 4119 lineal feet of coastal armoring.

The Appendices in this report include a Coastal Protection Datasheet (in Appendix A) listing and detailing numerous characteristics of the coastal protection structures we evaluated; as well as a Coastal Protection Map (in Appendix B) locating and labeling the coastal protection structures we evaluated. Vertical seawalls are labeled with S, sloping revetments are labeled with R and stairways are labeled with ST. Our evaluation began at the Frank Lloyd Wright home at the south (downcoast) end of Carmel Beach and ended at Pescadero Creek at the north (upcoast) end of

Carmel beach.

All but one of the publicly owned seawalls are presently providing adequate protection. One seawall is in need of replacement (S10; at the Dunes Outfall); potential collapse of this structure poses a risk to beach users. We recommend this seawall have a high priority for replacement; a detailed set of plans and specifications will be required for that work. One spot on another seawall at a failed storm drain outlet needs repair (S7; by 10th Avenue), which we rank as a medium priority. There was an area of exposed concrete grout on the beach seaward of S3; by 13th Avenue; this poses a hazard to barefoot beach users. In our opinion most of the seawalls have at least 30 years of remaining useful life, with the exception of seawall S10 at the Dunes Outfall, which could fail anytime in the next 10 years.

Of the 6 rip-rap revetments, only 4 could be assessed because the other two (R5 and R6) were buried by beach and dune sand. All four of those revetments need repair, with 3 of them found to be high priority and 1 to be medium priority. None of the 4 are providing adequate protection along their full lengths. The anticipated repairs at 3 of the revetments (The north 1/3 of R1, the south 1/4 of R3, and the north 1/3 of R4) consist of restacking the quarrystone rip-rap boulders; a detailed set of plans and specifications will be required for that work. The north 1/3 of one of the revetments (R1; by Santa Lucia Avenue) is oversteepened and potentially unstable, posing a safety risk to beach users. Revetment R2 (in Cooks Cove between 12th and 13th Avenue) is composed of undersized quarrystone and is failing. The south 1/4 of Revetment R3 (between 11th Avenue and 12th Avenue) is poorly stacked had has evidence of instability. The north 1/3 Of Revetment R4 consists of very undersized rock that provides little coastal protection. We recommend the two revetments that were buried by beach and dune sand be inspected and evaluated whenever they are next exposed.

Of the 11 stairways we inspected, we found that 9 are in need of repair. We found that 4 have high priority for repair; 4 have medium priority for repair; and 3 have low priority for repair. Three have bent or broken or missing guards and/or handrails. Two were undermined and had vertical drop-offs from the lowest stair tread to the beach as a result of natural beach scour. Three terminate at an elevation before they reach the beach, requiring beach users to traverse slippery irregular rip-rap or bedrock surfaces to traverse the remaining distance to the beach. Two have worn and irregular tread surfaces. Three appear to have substantial corrosion of hardware and reinforcing bar. Further evaluation of the structure by an independent licensed structural engineer

(and if need be a licensed corrosion engineer) should be scheduled to verify the structure is safe for public use. Regular maintenance of all stairways is essential for pedestrian safety. Of the 11 stairways inspected, we found that 3 pose risks to stairway users during periods (seasons) of beach scour, 5 will pose risks to stairway users until they are repaired, and 1 is unknown until a structural and corrosion inspection is completed, which we recommend be a high priority.

Table 1 is a condensed version of Appendix A, containing selected data and findings concerning the coastal protection structures and stairways that Haro Kasunich and Associates Inc. evaluated.

TABLE 1 City of Carmel Coastal Protection Data Page 1 of 3

4/21/2023 Haro Kasunich and Associates, Inc.

Structure Identifier	Approximate Location	Adequate Protection?	Repair Needed?	Risk to Beach Users	Priority of Repair	Estimated Existing Life of Structure Until it Ceases to Protect Coastal Access Path, Stairs and Roadway (Yrs)	Notes
Seawalls							
S1	At FLW House	YES	UNKNOWN	NO	NA	30+?	Private Property, Upcoast Corner Will Need Maintenance at Some Future Point
S2	FLW Home to Santa Lucia Avenue	YES	NO	NO	VERY LOW	30+	Good Condition, Slight Undermining Noted in Two Spots
S3	13th Avenue	YES	NO	YES	VERY LOW (Upcoast) LOW (Downcoast)	Upcoast Part = 50 Downcoast Part = 20+	In Cove, Sloppy Pumped Concrete on Beach, Downcoast Part is Subject to Slow Undermining
S4	N of 13th Avenue	YES	NO	NO	VERY LOW	Most =30+	Mostly Good Condition; Founded on Bedrock Platform
S5	Outfall at 12th Avenue	YES	NO	NO	VERY LOW	30+	Good Condition, Monitor Annually
S6	Scenic Rd Retaining Wall	YES	NO	NO	NA	Not a Coastal Protection Structure	Short Coastal Path Wall Not Subject to Wave Impact
S7	Between Stairways 6 and 7	YES	YES	NO	MEDIUM	30	Wall Crack Below Failed Metal 16 " Dia Storm Drain Pipe Thru Seawall; Pipe Replacement Needed
S8	Retaining Wall at 8th Ave	YES	NO	NO	VERY LOW	30+	Blufftop Retaining Wall Around Pump Station
S9	Outfall at 8th Ave	YES	NO	NO	VERY LOW	20	CMP Storm Drain Headwall ; 60 LF Scattered Rip-rap Below; Rip-rap Foundation Condition Uncertain
S10	Dunes Outfall	NO	YES	YES	HIGH	0 to 10 Until Collapse	Failing/Failed 3'x3' Box Culvert Storm Drain Outfall Wall; Needs Replacement
S11	At Pescadero Creek Home	YES	UNKNOWN	NO	NA	30?	Private Property; Not Evaluated, No Obvious Need for Repairs is Evident

TABLE 1 City of Carmel Coastal Protection Data Page 2 of 3

4/21/2023 Haro Kasunich and Associates, Inc.

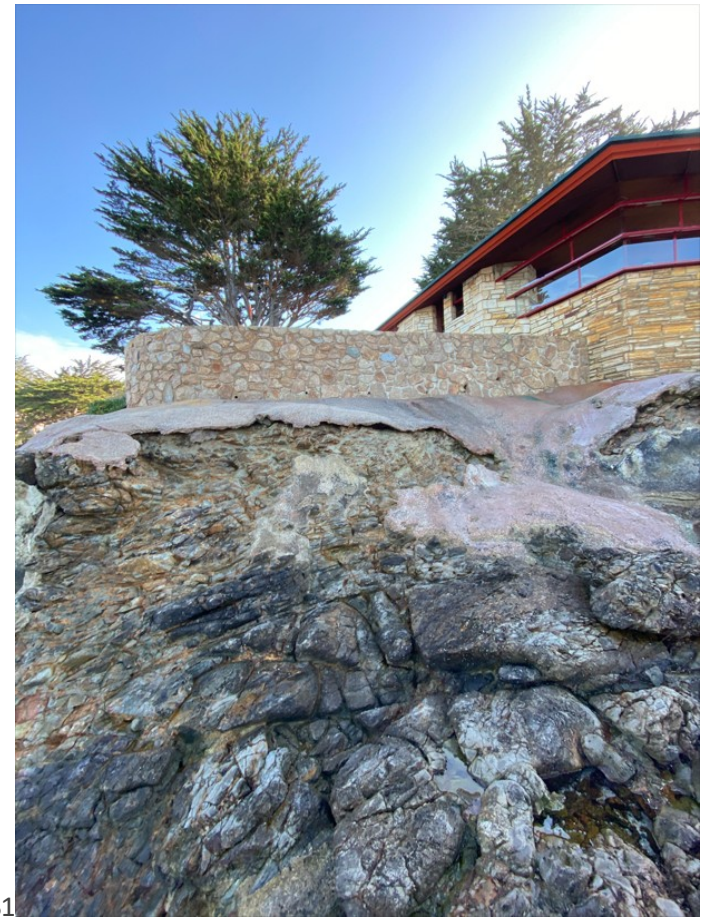
Structure Identifier	Approximate Location	Adequate Protection?	Repair Needed?	Risk to Beach Users	Priority of Repair	Estimated Existing Life of Structure Until it Ceases to Protect Coastal Access Path, Stairs and Roadway (Yrs)	Notes
Revetments							
R1	Between S2 and S3	NO Upcoast 1/3	YES Upcoast 1/3	YES	HIGH	Upcoast 1/3 = 0	Upcoast 1/3 Oversteepened, No Filter Fabric Unstable, Potentially Unsafe
R2	Between S3 and S4	NO	YES	NO	HIGH	0 to 5	Failing Structure, Has Voids, Undersized Quarrystone
R3	Between 11th and 12th Ave	YES Upcoast 3/4	YES Downcoast 1/4	NO	MEDIUM (Downcoast 1/4) VERY LOW (Upcoast 3/4)	Downcoast 1/4 = 10 Upcoast 3/4 = 30	Downcoast 1/4 Poorly Stacked, Has Had Instability; Upcoast 3/4 REJA 1983
R4	Between 10th and 11th Ave	NO Upcoast 1/3	YES Upcoast 1/3	NO	HIGH (Upcoast 1/3) UNKNOWN (Downcoast 2/3)	Upcoast 1/3= 0 to 5 Downcoast 2/3 = Unknown	Undersized rock Upcoast 1/3 ; Few Quarrystones Visible; Back Beach Vegetated 12/2022; Monitor When Exposed
R5	Between 8th and 10th Ave	MAYBE	Unable to Assess	NO	Unable to Assess	Unknown	Few Quarrystones Visible 1/2023; Monitor When Exposed; May Be Founded on Sand; Downcoast End Has Slumped;
R6	At Ocean Avenue	MAYBE	Unable to Assess	NO	Unable to Assess	10 to 30 years?	Few Quarrystones Visible 1/2023; Monitor When Exposed; May Be Founded on Sand; Downcoast End Has Slumped;

TABLE 1 City of Carmel Coastal Protection Data Page 3 of 3

4/21/2023 Haro Kasunich and Associates, Inc.

Structure Identifier	Approximate Location	Adequate Protection?	Repair Needed?	Risk to Beach Users	Priority of Repair	Estimated Existing Life of Structure Until it Ceases to Protect Coastal Access Path, Stairs and Roadway (Yrs)	Notes
Stairways							
ST1	Martin Way	NA	YES	UNKNOWN** *	MEDIUM***	Regular Maintenance Essential	Corroded Structural Elements, Footing on Bedrock
ST2	Santa Lucia Avenue	NA	YES	NO	LOW	Regular Maintenance Essential	Downcoast Railing Bent from Log Impact
ST3	13th Avenue	NA	NO	YES During Scour Events	NONE NOW	Regular Maintenance Essential	Great Condition, Stairs End on Elevated Bedrock Platform; Consider Extending Stairs to Scoured Beach Level
ST4	12th Avenue	NA	YES	YES	HIGH	Regular Maintenance Essential	Hazardous; Undermined in EG Fig 1 (2016) Corroded Hardware
ST5	11th Avenue	NA	YES	YES During Scour Events	MEDIUM	Regular Maintenance Essential	Concrete Treads Worn; Stairs End on Elevated Bedrock Platform; Consider Extending Stairs to Scoured Beach Level
ST6	S of 10th Avenue	NA	YES	YES	MEDIUM	Regular Maintenance Essential	Needs Minor Tread Work; Corroded Rebar Exposed; Concrete Spalling
ST7	N of 10th Avenue	NA	YES	YES During Scour Events	HIGH***	Regular Maintenance Essential	Toe of Stairs Undermined by Scour 1/2023; Hazardous; Easton (2016) Said Look at 2008 CRP Photo
ST8	9th Avenue	NA	YES	YES During Scour Events	HIGH	Regular Maintenance Essential	Stairway Terminates Before Reaching Beach During Scour, Needs Seaward Extension Across Revetment
ST9	8th Avenue	NA	YES	YES	MEDIUM	Regular Maintenance Essential	Rock and Mortar Steps; Worn Natural Rock Surfaced Treads Create Slippery Condition
ST10	Ocean Avenue	NA	NO	NO	NONE NOW	Regular Maintenance Essential	Coastal Overlook and Boardwalk Not Subject to Wave Impact
ST11	Dunes	NA	YES	YES	HIGH	Regular Maintenance Essential	Hazardous; Broken Guard and Handrail on Upcoast Side of lowest Run

REPORT AND PHOTOGRAPHS


S1

Photograph 1: Privately Owned Seawall S1 on December 22, 2022

Photograph 1 shows a seawall located on private property at the well-known Frank Lloyd Wright designed oceanfront home at the southern end of Carmel Beach on December 22, 2022. It appears to be in good condition. At some point it will need maintenance and/or repair. Close inspection was not possible without entering onto the private property.

Photograph 2: Unnamed shotcrete between S1 and S2 on December 22, 2022

Photograph 2 shows some shotcrete or gunite fascia exists on the bedrock portion of the coastal bluff face between S1 and S2 (where located on the map contained in Appendix B) north from the Frank Lloyd Wright home on December 22, 2022. Its age, origin, and position relative to the boundary between the privately owned and publically owned upland parcel's common boundary line is unknown. It looks to be in good condition.

Photograph 3: Seawall S2 on December 22, 2022

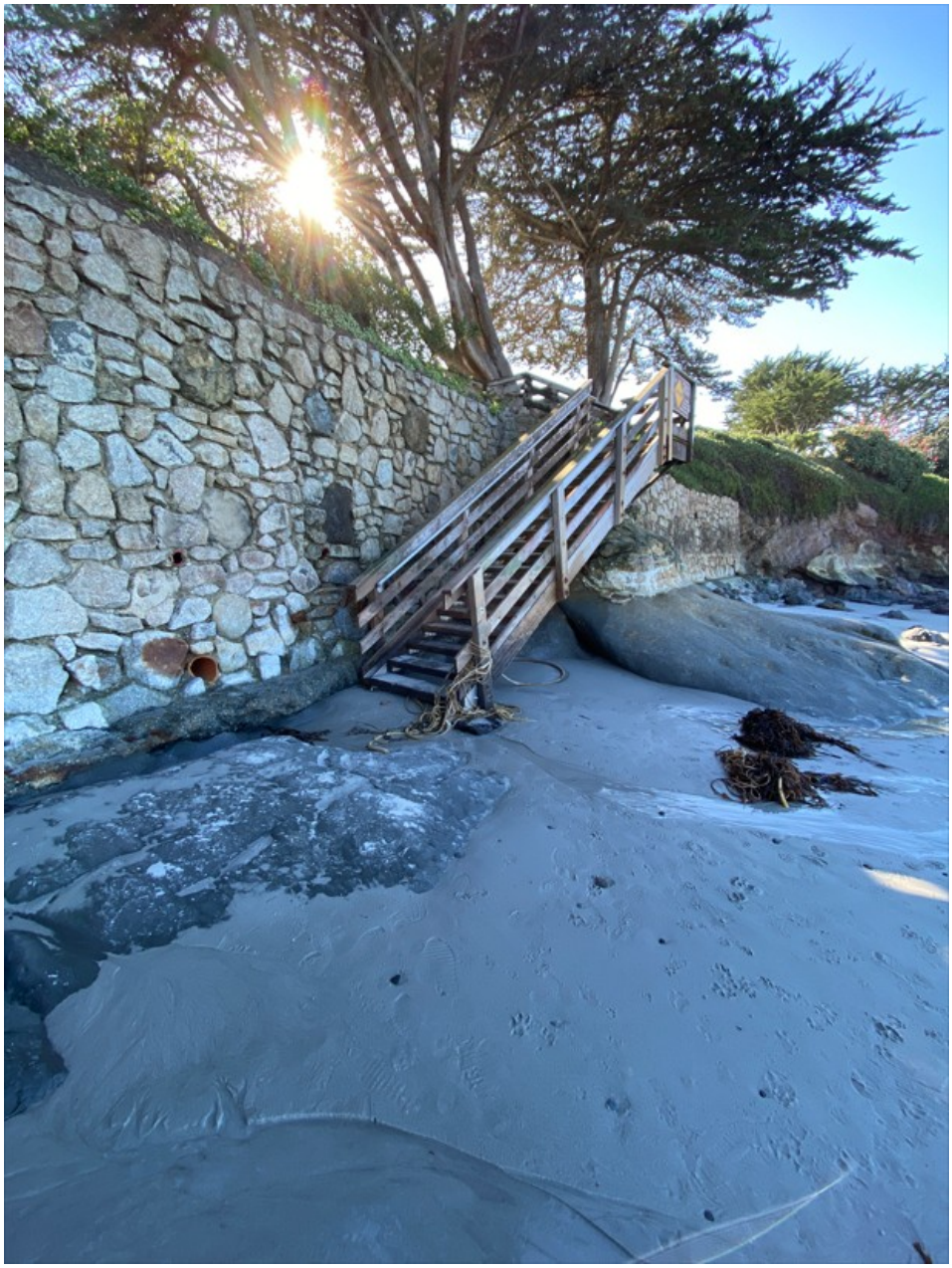
Photograph 3 shows a view looking north at Seawall S2, which extends from the Frank Lloyd Wright home to Santa Lucia Avenue, on December 22, 2022. This seawall is in good condition.

Photograph 4: Stairway ST1 on December 22, 2022

Photograph 4 shows Public Access Stairway ST1 located at Martin Way on December 22, 2022 which is in average condition.

Photograph 5: Public Access Stairway ST1 on December 22, 2022

Photograph 5 shows Public Access Stairway ST1 on December 22, 2022. Corrodible fasters and brackets were used on this stairway and those are deteriorating. At some point it will need maintenance and/or repair. Visually it appears satisfactory to us at this time. Further evaluation of the structure by an independent licensed structural engineer (and if need be a licensed corrosion engineer) should be scheduled to verify the structure is safe for public use, and recommend any needed repairs.



Photograph 6: Showing Stairway ST1 on January 30, 2023

Photograph 6: shows Stairway ST1 along Seawall S2 on January 30, 2023. The beach sand level was scoured lower compared to December 2022. The Seawall S2 foundation is exposed and is bearing upon sandstone bedrock; no maintenance is presently recommended.

Photograph 7: Showing Stairway ST1 in February 2016 (Photo from Easton Geology)

Stairway ST1 was unsupported in 2016 as shown in Photograph 7 by Easton Geology. The landing area is ian irregular surface and the seawall footing is slightly undermined. We recommend it be verified that the stairway structure is presently founded upon bedrock. Repairs appear to be needed due to corrosion of fasteners and hardware. We rank the repair as a medium priority, pending structural and corrosion inspection, which we rank as a high priority. There is an unknown risk to users of the stairs.

Photograph 8: Showing Seawall S2 on January 30, 2023

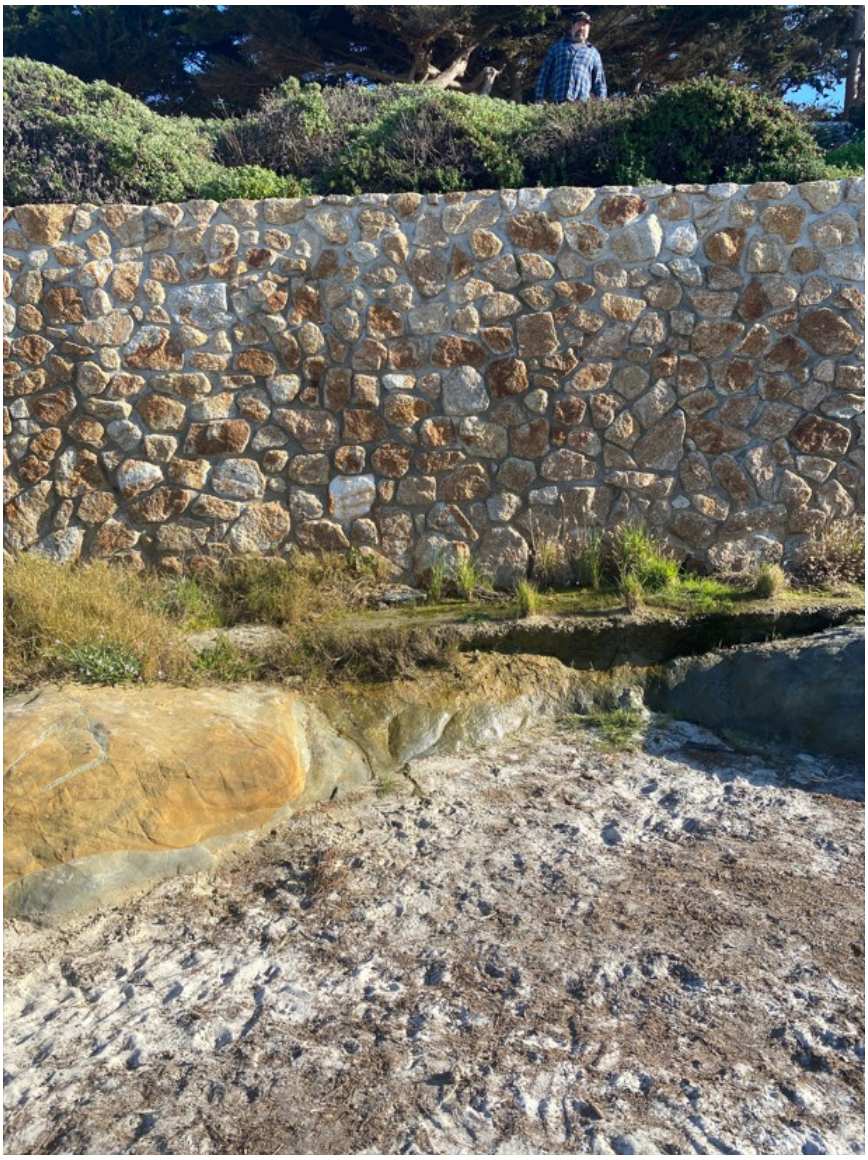
Photograph 8 shows Seawall S2 on January 30, 2023 inspection. No rip riprap revetments seaward of the seawall were evident during our inspection. Some bedrock platform exposures are observed seaward of seawall, indicating scour levels were near the bottom of the sand deposit.

Photograph 9: Seawall S2 on December 22, 2022

Photograph 9 shows Public Access Seawall S2 on December 22, 2022. The exposed portion is in excellent condition. The seawall foundation is buried by beach sand, which is normal. After severe ocean storms in January 2023 we revisited this location and almost all of this seawall's foundation was still buried by beach sand. Whenever it is next exposed by natural beach sand scour processes, it should be inspected. That may not be for a decade, but could be possible this winter. No repairs appear needed at this time and the seawall does not pose any extraordinary risks to beach users. This seawall appears to have more than 30 years of remaining life.

Photograph 10: Storm Drain near NorthNorthern End of Seawall S2 on December 22, 2022

Photograph 10 shows a Storm Drain Outfall near the north end of Seawall S2 on December 22, 2022. Storm runoff had gullied the beach sand at that location. Minor erosion had occurred adjacent to the seawall foundation footing. This location should be periodically monitored as time passes, so that if repairs are needed (such as plugging cavity under the footing) they can be done in a timely manner. No repair work is presently needed.



Photograph 11: North End of Seawall S2 on December 22, 2022

Photograph 11 shows an area at the northern end of Seawall S2 on December 22, 2022, where the edge of the seawall footing is exposed and it has been slightly undermined. Easton Geology inspected this location as well. Photograph 12 (below) is an Easton Geology photograph of the north end of Seawall S2 showing it was undermined in 2016. Comparison of that photo with the 2022 photo (above) shows there has been very little change in the conditions; there has been no continued undermining during that 7 year period. It is likely that this area was buried in beach sand during most of those 7 years; when the bedrock supporting the footing is buried, wave action does not contact the bedrock and no erosion or bedrock retreat occurs under the footing.

Photograph 12: Easton Geology Photograph of the North End of Seawall S2 in June 2016

Photograph 13: North End of Seawall S2 on December 22, 2022

Photograph 13 shows the very northern tip of Seawall S2 on December 22, 2022, where noticeable groundwater seepage is present.The end of the seawall was historically undermined and a repair consisting of a small concrete patch was done in the past. This area appears to be in reasonable condition, and the seawall appears to be stable.

Photograph 14: Public Access Stairway ST2 on December 22, 2022

Photograph 14 shows the seaward portion of Public Access Stairway ST2, located at Santa Lucia Avenue, on December 22, 2022, which is in good condition. The south handrail of ST2 is bent; likely from a wave carried log impacting it. The stairway seems functional despite this minor damage. The bottom of the stairway foundation is buried by beach sand, which is the normal condition.

Photograph 15: Showing Revetment R1 and Stairway ST2 on January 30, 2023

Photograph 15 shows Revetment R1, which is located between Seawalls S2 and S3, and shows Stairway ST2 during our January 30, 2023 inspection after severe ocean storms occurred in January 2023 and it was still buried by beach sand. Whenever it is next exposed by natural beach sand scour processes, it should be inspected. That may not be for a decade but could be possible this winter. The estimated life of Stairway ST1 is 30 years or more. The south railing is bent from floating log impact. This does not pose a substantial risk to users of the stairs. We rank the repair as a low priority.

Photograph 16: Showing Revetment R1 on January 30, 2023

Photograph 16: shows Revetment R1 on January 30, 2023.

Photograph 17: Revetment R1 on December 22, 2022

Photograph 17 shows the southern end of Revetment R1 on December 22, 2022, which consists of ovelysteep riprap, making it relatively unstable. One displaced boulder (a "fugitive" rock) can be seen poking out of the beach sand seaward of the revetment. Historic instability and the use of undersized boulders to construct this revetment have caused cavities to develop in the revetment and have diminished the erosion protection it provides. We recommend the holes in the revetment structure be filled and the 1 to 4 ton rocks be restacked. It is presently unsafe.

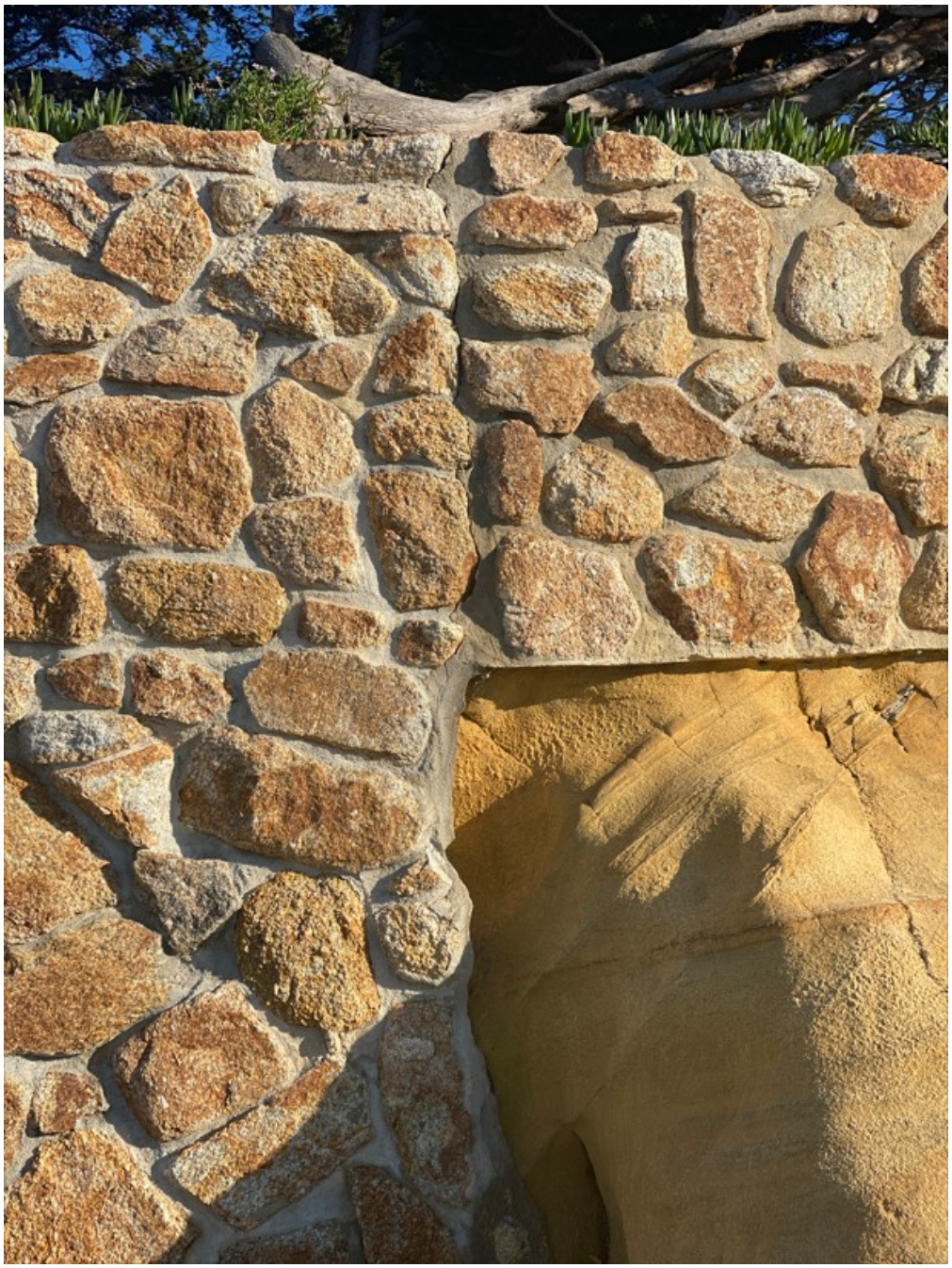
Photograph 18: Revetment R1 Showing Undersized Overly Steep Riprap on December 22, 2022

Photograph 19: Revetment R1 on December 22, 2022

Photograph 19 shows the northern end of Revetment R1 on December 22, 2022, which consists of overly steep riprap at a 0.5:1 (H:V) gradient. The northern 1/3 of the Revetment R1 riprap is unstable, poses risks to beach users, and we recommend it has a high priority for repair. We recommend bringing in additional larger riprap quarrystone boulders to lower the revetment gradient. Alternately the revetment could be removed and replaced with a vertical seawall to match the appearance of the other nearby seawalls along Carmel Beach.

Photograph 20: Showing Revetment R1 and the Southern End of Seawall S3 on January 30, 2023

Photograph 20 shows Revetment R1 and the South End of Seawall S3on January 30, 2023.



Photograph 21: Very Southern End of Seawall S3 on December 22, 2022

Photograph 21 shows Seawall S3 where it's foundation is founded on bedrock and steps upward at the very southern end of Seawall S3, which is located near 13th Avenue, on December 22, 2022. A vertical crack, which appears to be a shrinkage crack or expansion crack,is visible, but is not of concern.

Photograph 22: Southern End of Seawall S3 on December 22, 2022

Photograph 22 shows a view looking to the south along Seawall S3 on December 22, 2022.

Photograph 23: Concrete Debris on Beach at Base of Seawall S3 on December 22, 2022

Photograph 23 shows Seawall S3 on December 22, 2022 which has pumped concrete debris located on the beach at base of the seawall. Easton Geology inspected Seawall S3 in February 2016 and again in June 2016 for the City. Photograph 24 from Easton Geology shows that the beach was more scoured then than during our 2022 and 2023 inspections.

Photograph 24: Southern End of Seawall S3 in February 2016 Photographed by Easton GeologyShowing Pumped Concrete Repair of Undermining of Seawall S3

Photograph 25: Looking North at Seawall S3 on December 22, 2022

Photograph 25 is looking north along Seawall S3 on December 22, 2022. At that time the seawall foundation was buried by beach sand, which is normal. After severe ocean storms in January 2023, we revisited this location and it was still partially buried by beach sand. This seawall, including the portion of the foundation we were able to inspect, appears to be in satisfactory condition. Whenever it is next exposed by natural beach sand scour processes, it should be inspected. That may not be for a decade but could be possiblеduring any winter. Except for the possible removal of some of the pumped concrete on the beach at the southern end, no repairs appear needed at this time, and the seawall does not pose any significant risks to beach users. This seawall appears to have more than 30 years of remaining life.

Photograph 26: Seawall S3 Showing Missing Rock on December 22, 2022

Photograph 27: Public Access Stairway ST3 on December 22, 2022

Photograph 27 shows the seaward portion of Public Access Stairway ST3 located at 13th Avenue, on December 22, 2022, which is in good condition. Seawall S3 is on both sides of ST3.

Photograph 28: Showing Public Access Stairway ST3 with Seawall S3 on Both Sides On January 30, 2023

Photograph 28 shows the seaward portion of Public Access Stairway ST3 on January 30, 2023, when beach sand levels were scoured much lower in elevation than in December 2022. Stairway ST3 is primarily a rock and mortar set of steps that appear to be performing well. This staircase terminates onto a bedrock platform that was an approximately 5 feet vertical height drop from the platform down to beach level at the time of the photograph. This is not a safe transition for public use and it should be investigated for a safer alternative stair termination that accounts for scoured beach conditions. Stairway ST3 repairs do not appear to be needed, but extension of the stairs does appear to be prudent. There is risk to users of the stairs because they do not extend to beach level during periods of low sand levels from scouring. We rank extension of the stairs to beach level as a low priority if they are securely closed off at both the top and bottom during times of low beach levels.

North of Public Beach Access Stairway ST3, Seawall S3 had an exposed foundation in February 2016. Easton's June 2016 letter states "exposed undercuts *(identified and documented in February 2016)* between the wall footing and the underlying bedrock within the 13th Avenue Cove *(referred to as S3 in this document)* were filled with concrete" *(between February and June 2016) (italicized portions added by HKA for clarity)*. Photographs 29 and 30 from Easton Geology illustrate the condition of S3 in 2016.

Photograph 29: Seawall S3 Just North of ST4 in February 2016 (Easton Geology)

Photograph 30: Seawall S3 Just North from ST4 in February 2016 (Easton Geology)

Photograph 30 shows that the footing of Seawall was bearing on bedrock and slightly undermined in 2016.

Photograph 31: Looking South at Seawall S3 Adjacent to ST3 on January 30, 2023

Photograph 31 shows Seawall S3 at the south end of Cooks Cove, adjacent to ST3, showing its foundation is still bearing on a sandstone bedrock platform, and the footing remains slightly undermined. It is still performing well, and we have no recommended maintenance at this time. We note that when beach sand levels are naturally higher, the footing is buried and naturally protected from wave impact, resulting in no undermining occurring during those time periods, which are typically present in most years all year long. We recommend the undermining shown in Photographs 30 and 31 be photographically monitored whenever it is exposed, to verify the that undermining is occurring atover time.

Photograph 32: North End of Seawall S3 on December 22, 2022

Photograph 32 shows the north end of Seawall S3 where it adjoins Revetment R2 on December 22, 2022. The north end of Seawall S3 was historically slightly undermined, and the resultant cavities have been repaired with concrete patchwork, and or grouted riprap. The north end of Seawall S3 appears to be stable.

Photograph 32: Showing Revetment R2 between Seawalls S3 and S4 on January 30, 2023

As shown in Photograph 32, the beach at Revetment R2, which is located between Seawalls S3 and S4, had similar sand levels on January 30, 2023 as it did during our December 2022 inspection.

Photograph 33: Showing South End of Revetment R2 on December 22, 2022

Photograph 33 shows the south end of Revetment R2 on December 22, 2022, which has some displaced fugitive riprap. The revetment surface gradient is not uniform and the coastal erosion protection this revetment provides could be improved from restacking the riprap boulders. Revetment R2 includes a large volume of undersized riprap, which is vulnerable to plucking from wave attack. Revetment R2 poses risks to beach users, and we recommend it as a high priority for repair. The base of the revetment was buried by beach sand during our inspections and so its condition is unknown. Whenever it is next exposed by natural beach sand scour processes, it should be inspected. That may not be for a decade but could be possible any winter.

Photograph 34: Showing North End of Revetment R2 on December 22, 2022

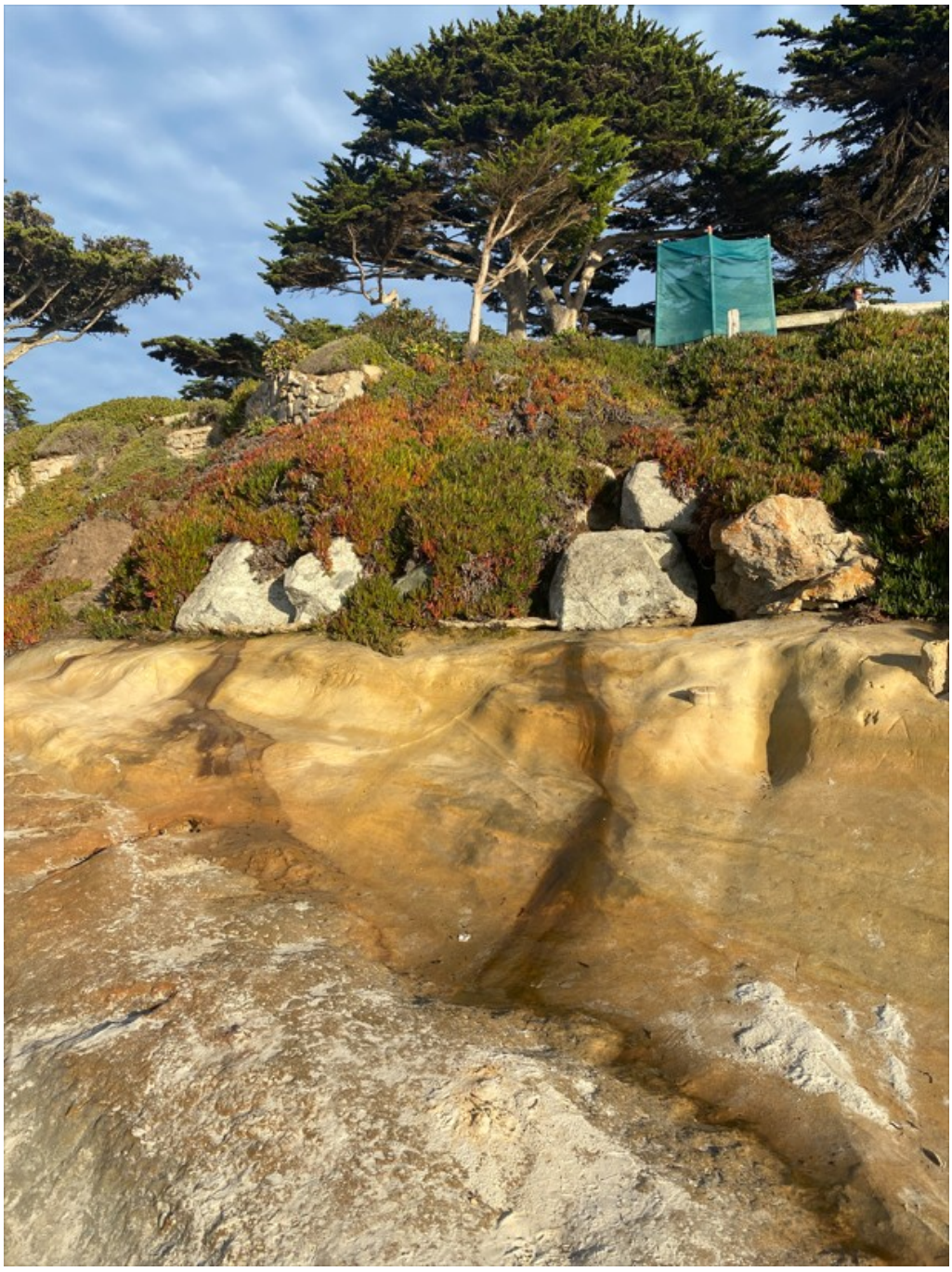
Photograph 34 shows the north end of Revetment R2 on December 22, 2022,

Photograph 35: Showing Seawall S4 on January 30, 2023

Photograph 35 shows the southern portion of Seawall S4 on January 30, 2023 which is in similar conditions to when our December inspection was done. This seawall is in good to excellent condition and is founded on the bedrock platform. No repairs appear to be needed.

Photograph 36: Showing North Portion of Seawall S4 on December 22, 2022

Photograph 36 shows the north portion of Seawall S4 on December 22, 2022, which is founded on a natural bedrock platform that is elevated above the beach level. This wall was designed by Neill Engineers and constructed in 2001.



Photograph 37: Showing Unnamed Rip-rap Boulders North of Seawall S4 on December 22, 2022

Photograph 37 shows a few rip-rap boulders located north of Seawall S4 and south of Public Access Stairway ST4 on December 22, 2022. These boulders are founded on a natural bedrock platform that is elevated above the beach level. They presently appear stable.

Photograph 38: Showing Public Access Stairway ST4 on December 22, 2022

Photograph 38 Shows Public Access Stairway ST4, located at 12th Avenue, on December 22,2022. This stairway was undermined as shown in Photograph 39 (below) contained in a letter from Easton Geology dated February 8, 2016

Photograph 39: Undermined Stairway ST4 in February 2016 (Easton Geology)

The undermined portion of Stairway ST4 that was visible in 2016 was not visible during our December 2022 inspection but was subsequently exposed by beach scour and visible in our January 2023 inspection. The metallic hardware for the railing is severely corroded and is expanding and splitting the timber framework of these stairs, which are located at 12th Avenue.

As shown in Photograph 40 (below) the foundation of Public Access Stairway ST4 was not exposed during either our December 2022 inspection or our January 2023 inspection. Whenever it is next exposed by natural beach sand scour processes, it should be inspected. That may not be for a decade but could be possible during any winter.

Photograph 40: Showing Base of Stairway ST4 naturally buried in beach sand on December 22, 2022

Stairway ST4 has severely corroded hardware and fasteners as well as some split timber elements, as shown in Photographs 41 and 42 below. Further evaluation of the structure by an independent licensed structural engineer (and if need be a licensed corrosion engineer) should be scheduled to verify the structure is safe for public use, and recommend any needed repairs.

Photograph 41: Showing Corroded Hardware and Split Timbers on Stairway ST4 on December 22, 2022

Photograph 42: Showing Corroded Hardware and Split Timbers on Stairway ST4 on December 22, 2022

Stairway ST4 repairs appear to be needed due to corrosion of fasteners and hardware, split timbers, and the vertical drop off and lack of foundation support at the base of the stairs during times of beach scour. Extension of the stairs does appear to be prudent. There is risk to users of the stairs because they do not extend to beach level during periods of low elevation sand levels. Due to the vertical drop off we rank extension of the stairs to beach level as a high priority and recommend prompt structural and corrosion inspection. There is a high risk to users of the stairs.

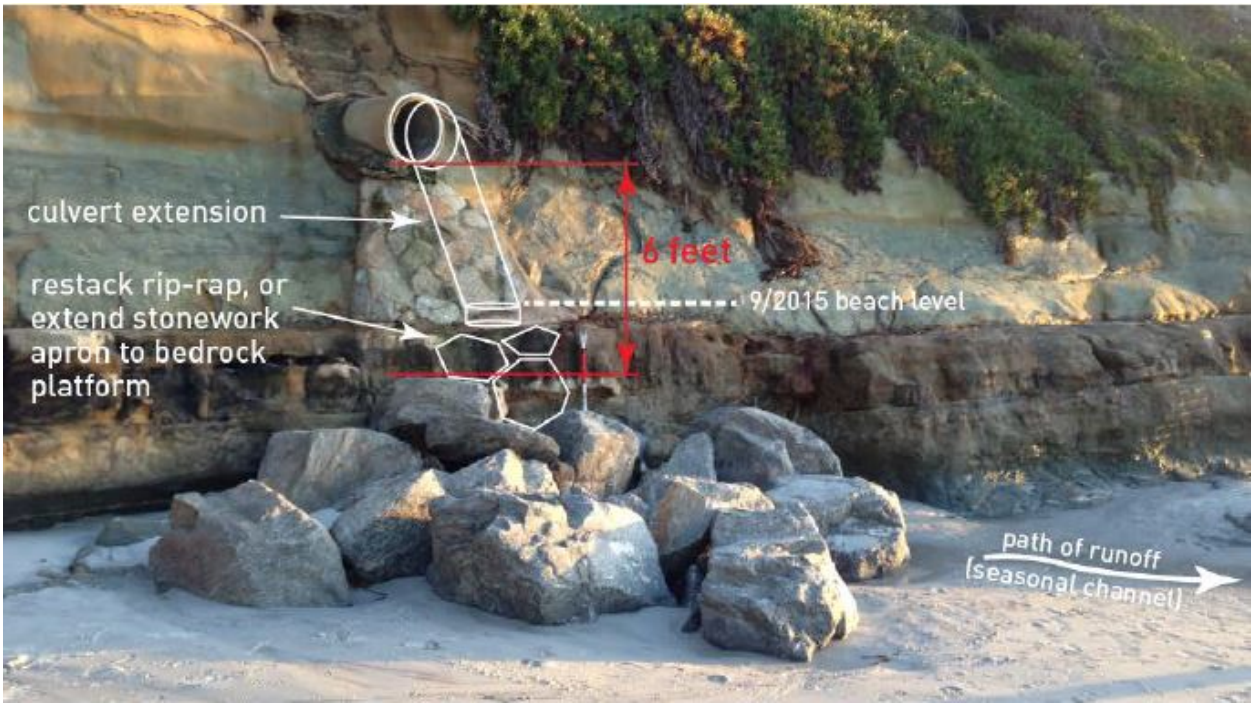
Photograph 43 (below) shows a storm drain outfall just northeast of Stairway ST4 with a rock and mortar seawall that armors the bluff face below the outfall that is Seawall S5. A small amount of riprap below the outfall and Seawall S5 was barely visible during our December 2022 inspection.

Photograph 43: Storm Drain Outfall and Seawall S5 Northeast from Stairway ST4 on December 22, 2022

Seawall S5 is immediately below the storm drain outfall near 12th Avenue.

Photograph 44: Storm Drain Outfall with Minor Armoring Between ST4 and R3 on January 30, 2023

As Photograph 44 shows, a greater amount of riprap below the outfall and Seawall S5 was visible during our January 2022 inspection. The rip-rap dissipates the energy from the runoff flowing onto the beach and serves to reduce bedrock erosion during times of low beach elevation.



Photograph 45: Seawall S5 Just North from ST4 in February 2016 (Easton Geology)
Easton Geology's Recommendations Are Shown on the Photo

Photograph 43 shows a storm drain outfall with minor armoring (Seawall S5) south of Revetment R5 and Stairway ST4 on December 22, 2022. Photograph 44 shows the same outfall and Seawall S5 after during January 2023 when considerable additional sand scour had occurred, exposing the grouted riprap energy dissipater placed on the bedrock platform below the outfall. About 75% of the coastal bluff height consists of erosion resistant bedrock, and appears to be in good shape. A seawall may be needed to slow bluff retreat in the future. Photograph 45 by Easton Geology (above) shows the conditions in February 2016, and includes their recommendations regarding extending the culvert and restacking the rip-rap they made at that time. Seawall S5 has no maintenance recommended by HKA at this time. It appears to have at least 30 years remaining life.

Revetment R5, which is between 8th and 10th Avenue, starts northnorth from Seawall S5.

Photograph 46: Looking South along Revetment R3 towards ST4 on December 22, 2022

Photograph 47: Revetment R3 Showing Scattered Rip-rap Boulders on December 22, 2022

Photograph 47 shows Revetment R3 with scattered rip-rap boulders on December 22, 2022. We recommend that Revetment R3 be restacked to increase coastal protection and reduce the revetment footprint.

Photograph 48: Revetment R3 Showing Area of Rip-rap on December 22, 2022

Where the Public Could Benefit from Quarrystone Re-stacking

The southern 1/4 of the Revetment R3 riprap unstable, poses risks to beach users, and we recommend it as a high priority for repair. The over-steepened portion of R3 should be re-stacked to alower gradient to increase its stability and provide better coastal protection.

Photograph 49: Showing Revetment R3 Looking South on January 30, 2023

Most of the portion of R3 shown in Photograph 49 has begun to slump and requires routine maintenance. needs to be re-stacked. The portion of R3 shown in Photograph 48 appears to have been constructed at a different time using smaller rock that may have been dumped into place rather than placed boulder by boulder, perhaps due to emergency conditions during construction. There is displaced undersized rock at the toe of the revetment at a lower gradient, and the revetment appears to be founded on the sandstone bedrock platform and we expect it will continue to provide service for 10 to 20 years. However, the rip-rap boulders are subject to displacement from wave impact. We recommend a vertical reinforced concrete seawall with rock fascia be designed and planned for and considered as a replacement for this portion of the R3 Revetment. The public coastal access at the top of the bluff is reliant upon bluff toe stability, which is currently provided by the R3 rip-rap armoring.

Photograph 50: Most of Revetment R3 is in Good Condition on December 22, 2022

The northern three-quarters of Revetment R3 is composed of 2-to-4-ton riprap stacked at approximately a 1.5 to 1.7 to 1 (H:V) gradient and looks to be performing well. No maintenance is recommended here.

Photograph 51: Showing the Middle Portion of Revetment R3 on January 30, 2023

Photograph 51 shows the middle portion of Revetment R3 with bearing support on the bedrock platform and on the outboard side of keyway, with the bedrock still providing lateral support of the toe of the structure, except in a couple locations. Twoover-steepened sections could benefit from re-stacking, however, this riprap revetment is in good condition and performing well.

Photograph 52: Showing Revetment R3 Looking North on January 30, 2023

Photographs 51 and 52 show Revetment R3 looking north and south. The portion of R3 shown in Photograph 52 is in great condition.

Photograph 53: Profile View of Revetment R3 on January 30, 2023

Photograph 53 is a profile view of Revetment R3. It was constructed following the severe 1983 storms with the toe of riprap revetment structure properly keyed into the bedrock platform, and still is performing well.

Photograph 54: Over-steepened portion of Revetment R3 on December 22, 2022

Photograph 55 shows that small portions near the north end of Revetment R3 are overly steep and could be re-stacked to be more stable and resistant to wave impact energy. During repair of the south 1/4 of R3, this area should be checked and the positions of a few boulders should be adjusted to improve boulder stability.

Photograph 55: Another Profile View of Revetment R3 on January 30, 2023

Photograph 56: Showing Stairway ST5 on January 30, 2023

Stairway ST5 is located at 11th Avenue and terminates on a bedrock platform, which is exposed when natural beach scour has lowered the beach elevation.

Photograph 57: Showing Stairway ST5 on January 30, 2023

Stairway ST5 repairs are needed due to corrosion of the concrete reinforcing, concrete spalling, and worn irregular concrete tread surfaces. We rank the concrete repair as a medium priority to abate slip and fall hazards. There is risk to users of the stairs because they do not extend to beach level during sand scour events. Extension of the stairs appears to be prudent. We rank extension of the stairs to beach level as a low priority if they are securely closed off at both the top and bottom during times when beach sand

elevations are low as a result of periodic natural beach scour.

Photograph 58: Showing Stairway ST5 and North End of Revetment R6 on December 22, 2023

Photographs 57 and 58 show Stairway ST5 before and after the severe January 2023 coastal storms and ocean wave events that resulted in beach scouring. Photograph 58 is a December 2022 photo of ST5 to show the influence of the scour event on beach conditions. This staircase is bearing upon sandstone bedrock platform and appears to be stable. The handrails are in decent shape. The ST5 stair treads are

worn and cracked and should be resurfaced.

We note that Seawall S6, which was initially mapped by Integral Consulting as a seawall, is not actually a seawall, but rather is a blufftop retaining wall located at the top of the bluff along Scenic Road. It is not influenced by the ocean. It appears to be in good condition; no repairs appear needed.

Photograph 59: Showing Bluff South of Revetment R4 on January 30, 2023

At the time of our inspection along the bluff face between Stairway ST5 and Revetment R4, a sandstone bedrock platform was discontinuously exposed, with very few fugitive riprap boulders exposed along the toe of the bluff at beach level. The bedrock exposed in the vertical lower bluff face appears to be erosion resistant and in good shape. No maintenance or armoring is necessary now. However, a future bluff face seawall with artificial rock fascia may be needed in the future to retard long-term erosion.

Photograph 60: Showing Very Few Boulders Exposed in Revetment R4 Area on December 22, 2022

Revetment R4 is located between 9th Avenue and 10th Avenue and was mapped by Integral Consulting extending from Stairway 5 and Stairway 6.

Photograph 61: Northern 1/3 of Revetment R4 Showing Scattered Undersize Riprap Boulders on January 30, 2023

Photograph 61 shows Revetment R4 in profile view showing over 50% of the visible structure is composed of veryy undersized scattered rock, that is subject to displacement and scattering onto the beach from wave action. The northern 1/3 of the Revetment R4 riprap is unstable, poses risks to beach users and we recommend it as a high priority for repair. Because this structure is composed of undersized, unstable rock, it increases the rate of bedrock erosion when the boulders are tumbled by wave action and abrade the bluff and bedrock platform. We recommend bringing in additional larger riprap quarrystone boulders to lower the revetment gradient. Alternately the revetment could be removed and replaced with a vertical seawall to match the appearance of the other nearby seawalls along Carmel Beach.

Photograph 62: Northern 1/3 of Revetment R4 Showing Very Undersized Scattered Rock on January 30, 2023

We recommend that Revetment R4, which is composed of very undersized scattered rock be completely reconstructed or replaced with a vertical concrete seawall faced with rock fascia.

Photograph 63: Showing Few Boulders Exposed at the North End of Revetment R4 On December 22, 2022

Photographs 61, 62 and 63 show Revetment R4, which is comprised of mostly undersized rock and broken concrete debris. The exposed portion of R4 where we observed substantially undersized scattered rock is approximately 225 feet in length and 8 to 10 feet tall. This structure has been undermined and has collapsed. Undersized riprap has been tumbling around in the wave action and is abrading the bedrock platform seaward of the riprap revetment structure toe. Future wave action could cause the steep slope below the path to slump, undermining the large cypress trees and public pathway along Scenic Road. A vertical concrete seawall at the toe of the bluff would be a preferred alternative here, as opposed to the riprap revetment structure, which requires more maintenance, and takes up a larger footprint.

Recommended maintenance and repair is to clean up the undersized riprap and replace it with a properly engineered, riprap revetment structure, founded into the bedrock platform. Alternately, this revetment could be removed, uncovering beach area, and a vertical seawall could be constructed at the toe of the bluff to prevent Scenic Road from being undermined.

Photograph 64: Showing Stairway ST6 on December 22, 2022

Photograph 64 shows Stairway ST6 is located south of 10th Avenue. The base of the stairs was buried in beach sand.

Photograph 65: Showing Recent Maintenance on Stairway ST6 on December 22, 2022

Photographs 65, 66 and 67 show Stairway ST6, which is a combination reinforced concrete (lower portion) to wooden (upper portion) public beach access staircase. The base of the staircase is founded on the sandstone bedrock platform below the beach sand. Several stair treads have spalled concrete areas, exposing highly corroded rebar, which is expanding, resulting in internal pressures within the concrete, which causes the stair treads to spall. This spalling creates a hazardous condition, and we recommend it be repairedand maintained to a safe standard for public use, using corrosion resistant reinforcing bar such as ChromX 4100 or 9100. Stairway ST5 repairs are needed due to corrosion of the concrete reinforcing, concrete spalling, and worn irregular concrete tread surfaces. We rank the concrete repair as a medium priority to abate slip and fall hazards.

Photograph 66: Stairway ST6 Well Founded in Bedrock on January 30, 2023

Photograph 67: Stairway ST6 with Tread Deterioration on January 30, 2023

Photograph 68: South Foundation of Seawall S7 on January 30, 2023

Photograph 68 shows the south foundation of Seawall S7, located between Stairways ST6 and ST7, is bearing on the sandstone bedrock platform. The foundation is in good condition. Seawall S7 is flanked by the north end of R6.

Photograph 69: Storm Drain Outfall near South End of Seawall S7 on January 30, 2023

Photograph 69 shows the south end of Seawall S7 where a 24-inch diameter concrete storm drain culvert outfall is in good condition. No maintenance is recommended here.

Photograph 70: Seawall S7 Foundation on January 30, 2023

Photograph 70 shows the Seawall S7 foundation, which was partially exposed during our inspection. This foundation appears to be a conventional spread footing foundation, approximately 20 inches wide at its toe and embedded in bearing upon the sandstone bedrock platform. The seawall above grade has slowly deteriorating mortar between individual rocks that form the wall face. The seawall foundation appears to be in good condition, and no maintenance is recommended at this time.

Photograph 71: Seawall S7 Foundation on January 30, 2023

Photograph 71 shows a view looking down coast at Seawall S7, showing additional exposed foundation area that is bearing on the sandstone bedrock platform.

Photograph 72: Storm Drain in Seawall S7 on January 30, 2023

Photograph 72 shows a storm drain culvert projecting out of the top portion of S7. This culvert is composed of highly corroded corrugated metal pipe that is 16 inches in diameter and appears to be collapsed about 3 feet landward of the wall. We observed large cracks in the seawall just below the culvert outfall. We recommend replacing this corrugated metal culvert with watertight HDPE N-12 storm drainpipe. We classified this as a medium priority. Except for this area of recommended repair, Seawall S7 has 30 years of remaining life.

Photograph 72: Stairway ST7 on December 22,2022

Photograph 72 shows Stairway ST7, which is located north of 10th Avenue.

Photograph 73: Stairway ST7 on January 30, 2023

Photographs 72 and 73 show Stairway ST7 at different beach scour conditions. Photo 73 shows the lower end of the stairs ending in mid-air at the time of our January inspection. Stairway ST7 repairs are needed due to corrosion of fasteners and hardware, and the vertical drop off and lack of foundation support at the base of the stairs during times of low beach surface elevations from scour. We rank the repair as a high priority and recommend prompt structural and corrosion inspection. There is a high risk to users of the stairs.

Photograph 74: Stairway ST7 on January 30, 2023 Showing Undermining

Photograph 74 illustrates the 2 1/2-foot vertical drop down to current beach sand elevation after the considerable winter scour event. At the time of our inspection the stairs were unsafe for public use in this condition. Extension of the stairs does appear to be prudent. We recommend that the stairs should be structurally evaluated and extended down to a landing constructed on the bedrock platform that they are secured to at their base. There is risk to users of the stairs because they do not extend to beach level during times of low beach sand surface elevations. Due to the vertical drop off we rank extension of the stairs to beach level as a high priority and recommend prompt structural and corrosion inspection. There is a high risk to users of the stairs.

Photograph 75: South Portion of Revetment R5 on January 30, 2023 Showing Bedrock Platform Below Beach Sand and Old Erosional Scarp in Ice Plant Above Revetment

Photograph 75 shows the southern end of Revetment R5, which is located between 8th Avenue and 10th Avenue, and was possibly initially founded on beach sand in an emergency effort to buttress the bluff failure above it. The wave action then likely scoured away the beach sand, and undermined the emergency revetment, causing it to collapse, and spread boulders out onto the beach.

Photograph 76: Showing Collapsed Southern End of Revetment R5 on January 30, 2023

Photograph 76 shows the southern end of Revetment R5, which has partially collapsed, and a majority of the riprap is now fugitive. We recommend re-stacking the fugitive riprap boulders on and at the toe of the existing revetment at a 1.5 to 1 slope gradient with the total base of the revetment structure founded below the beach sand on the bedrock platform.

Photograph 77: Southern Portion of Revetment R5 on January 30, 2023 Showing Steep Slope

Photograph 77 shows the southern portion of Revetment R5 and large cypress trees on the bluff face where driftwood has washed up onto the bluff face by waverunup. The upper portion of the riprap revetment looks steep. The top of the riprap revetment elevation is unknown. The estimated total height of the riprap revetment is 12 to 15 feet high and is likely sloped at a 1.5:1 or 2:1 (H to V) slope gradient.

Photograph 78: Central Portion of Revetment R5 on January 30, 2023

Photograph 78 shows the central portion of Revetment R5, where the coastal access path at the top of the bluff is dependent on bluff toe armoring and stability. A riprap revetment structure which is armoring the toe of the bluff is barely visible,. About 3 to 5 feet of the revetment height is visible The total height of a revetment is unknown, but estimated at 12 to 15 feet. Future wave action could cause the steep slope below the path to slump, undermining the large cypress trees, and public pathway along Scenic Road. A vertical concrete seawall at the toe of the bluff would be a preferred alternative here, as opposed to the riprap revetment structure, which requires more maintenance, and takes up a larger footprint.

Photograph 79: Showing Beach Access Stairway ST8 on January 30, 2023

Photograph 79 shows Beach Access Stairway ST8, which is near 9th Avenue just south of the central part of Revetment R5. It is a wooden stairway that is in good condition; however, it terminates before reaching the beach when the beach sand levels are seasonally low. We recommend that that the stairway be extended approximately 12 vertical feet down to the bedrock platform (which is presently buried by beach sand) at beach level. The existing beach access path across the R5 rip-rap below these stairs is hazardous and poses risk to stair users attempting to cross the revetment. Extension of the stairs is a high priority. This stairway does not have any other maintenance recommended at this time. Extending the stairway across the rip-rap revetment should be done carefully. A detailed design study will be necessary to properly found the stairway in and seaward of Revetment R5.

Photograph 80: Showing South End of Central Portion of Revetment R5 on January 30, 2023

Photograph 80 shows the south end of the central portion of Revetment R5 adjacent to Stairway ST8.

Photograph 81: Small Amount of Revetment R5 Riprap on January 30, 2023

As shown in Photograph 81, in the center portion of Revetment R5 we observed a small amount of visible riprap which was approximately 12 feet long and 6 feet tall. It was not possible to see enough riprap to draw meaningful conclusions regarding the extent, dimensions, condition and need for repair (if any) of this reported structure.

Photograph 82: Showing A Small Amount of Additional Revetment R5 Riprap on January 30, 2023

Photograph 83: Showing Additional Revetment R5 Rip-rap on January 30, 2023

Photograph 84: Showing a Small Amount of Revetment R5 Riprap on January 30, 2023

Photographs 82, 83 and 84 show the location of the center portion of Revetment R5 where we observed approximately 100 linear feet of 3-to 5-foot-high rip-rap that was exposed. It was not possible to see enough riprap to draw meaningful conclusions regarding the extent, dimensions and condition of this reported structure. We suspect most of this revetment structure is below sand level, not visible during our inspection.

Photograph 85: Location of North Area of Revetment R5 on January 30, 2023

We observed the area where the north portion of Revetment R5 was mapped by Integral Consulting. No riprap was visible.

Photograph 86: Stairway ST9 on January 30, 2023

Photographs 86 and 87 show Stairway ST9, which is near 8th Avenue, is a set of rock and mortar landscape or decorative steps. No recommended maintenance at this time is needed. The natural rock (Carmel Stone) treads are becoming worn, and their irregular surface should be evaluated for safety and code compliance by a qualified professional. A detailed study would be required to assess how to protect the stairs from being undermined.

Photograph 87: Toe Conditions at Seaward End of Stairway ST9 on January 30, 2023

Because the treads of Stairway ST9 are worn and have an irregular (bumpy) surface that poses some slip and fall risks to stair users, we recommend they be repaired and classify that as a medium priority.

Photograph 88: Seawall S8 on January 30, 2023

Photograph 88 shows Seawall S8 on January 3, 2023. It is a retaining wall (not a seawall) near 8th Avenue and Stairway ST9 and appears to be supporting a cut slope created to construct a municipal infrastructure system. It is not influenced by ocean wave impact. Seawall S8 appears to have at least 30 years of remaining life and no repairs are needed now.

Photograph 89: Revetment R5 and Seawall S9, Showing Small Amount of Riprap Boulders on January 30, 2023

Photograph 89 shows that Seawall S9 is a storm drainpipe headwall just north of 8th Avenue. No noticeable maintenance is recommended at this time. As exposed during our inspection, the north end of Revetment R5 has scattered riprap in this location and it does not seem laterally continuous. During our inspection, only the crest of the revetment structure was visible during inspection. Seawall S9 appears to have 20 years of remaining life and no repairs are needed now.

Photograph 90: Stairway ST10 Overlook Platform on January 30, 2023

Photograph 90 shows a Public Overlook Platform at the end of a boardwalk at the end of Ocean Avenue, we have named ST10, as seen on January 30, 2023. Our firm (Haro Kasunich and Associates Inc.) assisted in the design of this overlook in 2012. The ST10 wooden platform has reinforced concrete pierssupporting it that appear to be performing reasonably well and we do not note the need for any maintenance at this time. We estimate the anticipated life of the structure is approximately 20 years. We recommend that the platform structure be monitored for deterioration of the wood and corrosion of the metallic hardware and reinforcing. If any problems are noted in the future, appropriate maintenance and repair should be done.

Photograph 91: Revetment R6 Showing Small Amount of Rip-rap Boulders on January 30, 2023

Photograph 91 shows riprap that forms part of the R6 Revetment structure seaward of the end of Ocean Avenue which incorporates a storm drain outfall, as seen on January 30, 2023. The rip rap has an approximately 2:1 (H to V) surface slope gradient and the exposed portion is 6 to 7 feet tall. The remainder of the revetment, including its foundation condition, is buried in sand and is unlikely to be visible until the next extreme scour event. Whenever it is next exposed by natural beach sand scour processes, it should be inspected. That may not be for a decade but could be possible during any winter. Based on what we observed, no maintenance is presently recommended. We estimate the lifespan of this structure is 10 to 30 years, depending upon its foundation condition.

Photograph 92: Seawall S10 on January 30, 2023

Photographs 92, 93, 94 and 95 show Seawall S10 on January 30, 2022. This seawall is a storm drain headwall for a 3 by 3-foot reinforced concrete box culvert located in the dunes area north of Ocean Avenue. It is in poor condition. Photograph 92 shows that the central part of the Seawall S12 foundation is bearing upon sandstone bedrock. In adjacent areas the foundation is partially undermined horizontally up to 16 inches at the toe.

Photograph 93: Central Part of Foundation of Seawall S10 on January 30, 2023

Photograph 93 is a photograph that shows concrete spalling, exposing steel reinforcement.

Photograph 94: Seawall S10 on January 30, 2023

Photograph 94 is a photograph that shows Seawall S12 being undermined where it steps up the coastal bluff on the north side. Also visible is that the guard at the top of the wall is broken creating an unsafe condition there that needs to be remedied.

Photograph 95: Seawall S10 on January 30, 2023

Photograph 95 is a photograph that shows a large structural crack in Seawall S12 above the box. The crack is wider at the top than the bottom and the wall has been displaced. Reinforcing bars have been exposed by spalling concrete. It appears the south side of the seawall has rotated out in the seaward direction. The north side of the seawall appears to bevertical (plumb) and straight. Most of the rebar of the structure is corroded and not salvageable. We recommend reconstruction of the box culvert and seawall in its entirety. The down coast end of the seawall is outflanked and has been partially undermined, contributing to instability on that side of the structure. This structure has 0 to 10 years of remaining service life before it may collapse. It could collapse catastrophically this year. We do not expect it to survive 10 years. We recommend the City budget for and construct a new structure as soon as possible. This structure poses risks to beach users, and we recommend it have a high priority for replacement

Photograph 96: Stairway ST11 on January 30, 2023

Photograph 96 shows Public Beach Access Stairway ST11, located in the dunes area north of Ocean Avenue, on January 30, 2022. Our firm (Haro Kasunich and Associates Inc.) designed this stairway. The lowest elevation run of the stairway has a damaged handrail, minor corrosion in a few spots along the handrail, a broken wooden guard and handrail on the north side of the lowest flight of stairs. The bottom 3 or so feet of the stairs were buried in beach sand at the time of our inspection. We recommend re-inspection during the next natural beach scour event that exposes the lowest portion of the stairs which were founded on bedrock at the time of initial construction. Further evaluation of the structure by an independent licensed structural engineer (and if need be, a licensed corrosion engineer) should be scheduled to verify the structure condition is safe for public use. We recommend the broken guard and handrail be repaired or replaced for the sake of pedestrian safety, and rank that as a high priority, since the current conditions pose slip and fall risks to stair users.

Photographs 97, 98 and 99 show Seawall S11 on January 30, 2022. This is a privately owned seawall and is the furthest north coastal protection structure protecting the furthest north home in the City of Carmel. The total height of the seawall is unknown. Photograph 71 shows the north portion. At the time of our inspection 6 to 10 feet of retaining wall was exposed above the beach sand level. The seawall appeared to be in good condition, and we did not observe any maintenance or repair that was needed.

Photograph 97: South Portion of Privately Owned Seawall S11 on January 30, 2023

Photograph 97 shows the south part of Seawall S11 on January 30, 2022. The south portion is approximately 6 feet high. This portion includes a private access stairway at the south end. The seawall appeared to be in good condition, and we did not observe any maintenance or repair that was needed.

Photograph 98: Central Portion of Privately Owned Seawall S13 Center on January 30, 2023

Photograph 98 shows the central part of Seawall S11 on January 30, 2022. The center portion is approximately 6 feet high. The seawall appeared to be in good condition, and we did not observe any maintenance or repair that was needed.

Photograph 73: North Portion of Privately Owned Seawall S11 on January 30, 2023

Seawall S11 connects to a retaining wall along the margin of Pescadero Creek that has steel H-beam soldier piles and wood lagging. Evaluation of it is outside of our scope of services.

References

Easton Geology, 8 February 2016, Mid-winter Assessment of Shoreline Improvements at Carmel Beach, Carmel-by-the-Sea, California.
Easton Geology, 13 June 2016, Second Winter Inspection of Shoreline Improvements at Carmel Beach, Carmel-by-the-Sea, California

APPENDIX A

Carmel Adaptation Coastal Protection Datasheet
Dated 4-27-2023

APPENDIX A Haro Kasunich and Associates, Inc.

City of Carmel Coastal Protection Datasheet

4/27/2023

Structure Identifier	Approximate Location	Date of Inspection	Length (Ft)*	Visible Height (Ft)	Total Height (Ft)	Guesstimated Footprint Area (Ft^2)	Estimated Surface Slope Gradient (H:V)	Estimated Quarrystone Size Range (Tons)	Estimated Rip Rap Volume (CY)	Adequate Protection?	Repair Needed?	Risk to Beach Users	Priority of Repair	Estimated Existing Life of Structure Until it Ceases to Protect Coastal Access Path, Stairs and Roadway (Yrs)	Note 1	Note 2
Seawalls																
S1	**At FLW House**	**12/22/2022 & 1/30/2023**	27	5	5	162	0:1 (Vertical)	NA	0	YES	UNKNOWN	NO	NA	30+?	Private Property, Not evaluated; Upcoast Corner Will Need Maintenance at Some Future Point	Private Property
S2	**FLW Home to Santa Lucia**	**12/22/2022 & 1/30/2023**	565	8 to 13	8 to 13	1695	0:1 (Vertical)	NA	0	YES	NO	NO	VERY LOW	30+	Good Condition, Slight Undermining Noted in Two Spots	Upcoast End (Last 5 Ft) Has been Undermined and Patched, Some Seepage Below Wall
S3	**13th Avenue**	**12/22/2022 & 1/30/2023**	556	6 to 14	11 to 14?	1668	0:1 (Vertical)	NA	0	YES	NO	YES	VERY LOW (Upcoast) LOW (Downcoast)	Upcoast Part = 50, Downcoast = 20+	In Cove, Sloppy Pumped Concrete on Beach, Downcoast Part is Subject to Slow Undermining	Upcoast Part is Newer Neill Engineers Wall (2010?)
S4	**N of 13th Avenue**	**12/22/2022 & 1/30/2023**	168	6 to 8	6 to 8	504	0:1 (Vertical)	NA	0	YES	NO	NO	VERY LOW	Most =30+	Mostly Good Condition; Founded on Bedrock Platform	
S5	**Outfall at 12th Avenue**	**12/22/2022 & 1/30/2023**	13	8	8	39	0:1 (Vertical)	NA	0	YES	NO	NO	VERY LOW	30+	Good Condition, Monitor Annually	Small Storm Drain Splash Block Armor
S6	**Scenic Rd Retaining Wall**	**12/22/2022 & 1/30/2023**	317	3	3	951	0:1 (Vertical)	NA	0	YES	NO	NO	NA	Not a Coastal Protection Structure	Short Coastal Path Wall Not Subject to Wave Impact	
S7	**Between Stairways 6 and 7**	**12/22/2022 & 1/30/2023**	241	8 to 13	8 to 13	723	0:1 (Vertical)	NA	0	YES	YES	NO	MEDIUM	30	Wall Crack Below Failed Metal 16 " Dia Storm Drain Pipe Thru Seawall; Pipe Replacement Needed	Mortar is starting to deteriorate; maintenance consisting of mortar tuck pointing by a stone mason is needed
S8	**Retaining Wall at 8th Ave**	**1/30/2023**	37	2 to 4	2 to 4	111	0:1 (Vertical)	NA	0	YES	NO	NO	VERY LOW	30+	Blufftop Retaining Wall Around Pump Station	Good Condition
S9	**Outfall at 8th Ave**	**1/30/2023**	13	8 to 10	8 to 10	39	0:1 (Vertical)	NA	0	YES	NO	NO	VERY LOW	20	CMP Storm Drain Headwall ; 60 LF Scattered Rip-rap Below; Rip-rap Foundation Condition Uncertain	Monitor during Scour
S10	**Dunes Outfall**	**1/30/2023**	31	15	15	93	0:1 (Vertical)	NA	0	NO	YES	YES	HIGH	0 to 10 Until Collapse	Failing/Failed 3'x3' Box Culvert Storm Drain Outfall Wall; Needs Replacement	Concrete Cracked, Undermined, Outflanked, Corroded Rebar, Visually Undesirable; Replacement Recommended
S11	**At Pescadero Creek Home**	**1/30/2023**	290	6 to 10	Unknown	2900	0:1 (Vertical)	NA	0	YES	UNKNOWN	NO	NA	30?	Private Property; Not Evaluated, No Obvious Need for Repairs is Evident	Private Property
Revetments																
R1	**Between S2 and S3**	**12/22/2022 & 1/30/2023**	118			2360	Upcoast 1/3 is 1:1	Upcoast 1/3 is 1 Ton		NO; Upcoast 1/3	YES; Upcoast 1/3	YES	HIGH	Upcoast 1/3 = 0	Upcoast 1/3 Oversteepened, No Filter Fabric, Unstable, Potentially Unsafe	Public Will Benefit from Replacement
R2	**Between S3 and S4**	**12/22/2022 & 1/30/2023**	50			1000	3:1?	< 1 Ton		NO	YES	NO	HIGH	0 to 5	Failing Structure, Has Voids, Undersized Quarrystone	Public Will Benefit from Restacking or Replacement; Consider Vertical Wall Here
R3	**Between 11th and 12th Ave**	**12/22/2022 & 1/30/2023**	406	Unknown	Unknown	8120	1.5 to 2.0:1	Upcoast 3/4; 2 to 4 Ton		YES; Upcoast 3/4	YES; Downcoast 1/4	NO	MEDIUM (Downcoast 1/4); VERY LOW(Upcoast 3/4)	Downcoast 1/4 = 10; Upcoast 3/4 = 30	Downcoast 1/4 Poorly Stacked, Has Had Instability; Upcoast 3/4 REJA 1983	Upper 1/2? Covered by Iceplant; Could Not Inspect It
R4	**Between 10th and 11th Ave**	**12/22/2022 & 1/30/2023**	336	Unknown	Unknown	6720	Unknown	Unknown	Unknown	NO; Upcoast 1/3	YES; Upcoast 1/3	NO	HIGH (Upcoast 1/3); UNKNOWN (Downcoast 2/3)	Upcoast 1/3= 0 to 5; Downcoast 2/3 = Unknown	Undersized rock Upcoast 1/3 ; Few Quarrystones Visible; Back Beach Vegetated 12/2022; Monitor When Exposed	Downcoast 2/3 Not Exposed Enough to Inspect Now; Recommend Re-Inspection When Exposed
R5	**Between 8th and 10th Ave**	**1/30/2023**	815	6**	Unknown	16300	Unknown	Unknown	Unknown	MAYBE	Unable to Assess	NO	Unable to Assess	Unknown	Few Quarrystones Visible 1/2023; Monitor When Exposed; May Be Founded on Sand; Downcoast End Has Slumped;	Not Exposed Enough to Inspect Now; Recommend Re-Inspection When Exposed
R6	**At Ocean Avenue**	**1/30/2023**	136	6 to 7			2:1			MAYBE	Unable to Assess	NO	Unable to Assess	10 to 30 years?	Few Quarrystones Visible 1/2023; Monitor When Exposed; May Be Founded on Sand; Downcoast End Has Slumped;	Not Exposed Enough to Inspect Now; Recommend Re-Inspection When Exposed
Stairways																
ST1	**Martin Way**	**12/22/2022 & 1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	UNKNOWN***	MEDIUM***	Regular Maintenance is Essential	Corroded Structural Elements, Footing on Bedrock	Maintenance Is Essential for Pedestrian Safety
ST2	**Santa Lucia Avenue**	**12/22/2022 & 1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	NO	NONE NOW	Regular Maintenance is Essential	Downcoast Railing Bent from Log Impact	Maintenance Is Essential for Pedestrian Safety
ST3	**13th Avenue**	**12/22/2022 & 1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	NO	YES During Scour Events	LOW	Regular Maintenance is Essential	Great Condition, Stairs End on Elevated Bedrock Platform; Consider Extending Stairs to Scoured Beach Level	Maintenance Is Essential for Pedestrian Safety
ST4	**12th Avenue**	**12/22/2022 & 1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES	HIGH	Regular Maintenance is Essential	Hazardous; Undermined in EG Fig 1 (20167), Corroded Hardware	Maintenance Is Essential for Pedestrian Safety
ST5	**11th Avenue**	**12/22/2022 & 1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES During Scour Events	MEDIUM	Regular Maintenance is Essential	Concrete Treads Worn; Stairs End on Elevated Bedrock Platform; Consider Extending Stairs to Scoured Beach Level	Maintenance Is Essential for Pedestrian Safety
ST6	**S of 10th Avenue**	**12/22/2022 & 1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES	MEDIUM	Regular Maintenance is Essential	Needs Minor Tread Work; Corroded Rebar Exposed; Concrete Spalling	Maintenance Is Essential for Pedestrian Safety
ST7	**N of 10th Avenue**	**1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES During Scour Events	HIGH***	Regular Maintenance is Essential	Toe of Stairs Undermined by Scour 1/2023; Hazardous; Easton (2016) Said Look at 2008 CRP Photo	Maintenance Is Essential for Pedestrian Safety
ST8	**9th Avenue**	**1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES During Scour Events	HIGH	Regular Maintenance is Essential	Stairway Terminates Before Reaching Beach During Scour; Needs Seaward Extension Across Revetment	Maintenance Is Essential for Pedestrian Safety
ST9	**8th Avenue**	**1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES	MEDIUM	Regular Maintenance is Essential	Rock and Mortar Steps; Worn Natural Rock Surfaced Treads Create Slippery Condition	Maintenance Is Essential for Pedestrian Safety
ST10	**Ocean Avenue**	**1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	NO	NO	NONE NOW	Regular Maintenance is Essential	Coastal Overlook and Boardwalk; Not Subject to Wave Impact	Maintenance Is Essential for Pedestrian Safety
ST11	**Dunes**	**1/30/2023**	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES	HIGH	Regular Maintenance is Essential	Hazardous; Broken Guard and Handrail on Upcoast Side of lowest Run	Maintenance Is Essential for Pedestrian Safety

Total Armor Length (feet) 4119
Total Coastline Length (feet) 5537

*** = As mapped by Integral consulting; Some structures may not exist or be of different as-built length**
**** = Scattered Spots Along < 10% of Length Observed**
***** = Structural and Corrosion Inspection is High Priority**

APPENDIX B

Carmel Coastal Protection Map
With Structure Identifiers and Structure Lengths
Dated 4-27-2023

S# = SEAWALL NUMBER WITH APPROXIMATE LENGTH IN FEET NOTED

R# = REVETMENT NUMBER WITH APPROXIMATE LENGTH IN FEET NOTED

ST# = STAIRWAY NUMBER

2023-4-27 Carmel Coastal Protection Structures & Stairways

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