KITSAP REGIONAL SHORELINE RESTORATION PROGRAM

Final Report - Grant PO-00J08501-0 Environmental Protection Agency

Anna Smith Park, Bremerton WA – May 2017

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Cover photo: Christina Kereki

Contents

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1.0 PROJECT OVERVIEW

The **Kitsap Regional Shoreline Restoration Program** is an effort to protect and restore the Puget Sound nearshore by supporting willing landowners who wish to remove bulkheads on their shorelines. The **Kitsap Regional Shoreline Restoration Program** was funded by Environmental Protection Agency's (EPA) Puget Sound Watershed Assistance Program, Grant #PO-00J08501-0.

(Reduction in) Shoreline armoring is one of the vital signs selected by the Puget Sound Partnership (PSP) to indicate nearshore health and recovery in Puget Sound. PSP has set the target that the total amount of armoring removed will be greater that the total amount of new armoring in Puget Sound from the year 2011 to 2020 (Puget Sound Partnership [PSP], n.d.). Shoreline armoring is the practice of using physical structures, like bulkheads to protect shorelines from coastal erosion (National Ocean Service, 2016). Constructing bulkheads and rock revetments disrupts the natural process of erosion, which supplies much of the sand and gravel that maintains our beaches. The contribution of natural sediment input to the shoreline is a fundamental ecological process that contributes to the appearance and function of Puget Sound shorelines (Clancy et al. 2009). Over time, shoreline armor may cause once sandy beaches to become rocky and sediment starved, reducing the quality and quantity of habitat for many native species like herring, surf smelt, sand lance and salmon (PSP, n.d.). Research demonstrates that armoring of Puget Sound shorelines affects abiotic attributes and can adversely affect the biota at local scales (Rice 2010). Delthier et al. 2016 found that armoring was consistently associated with reductions in beach width, riparian vegetation, numbers of accumulated logs and amounts and types of beach wrack and associated invertebrates. The large data set of this study allowed scientists for the first time to identify cumulative impacts when increasing proportions of shorelines are armored (Delthier et al. 2016).

Kitsap County geographically straddles the Central and Hood Canal basins of Puget Sound. It boasts 228 miles of shoreline, of which on average more than one third is armored with hard structures such as rock or timber bulkheads. The eastern portion which drains to the Central basin is more developed, and 42% of this shoreline is armored. The more rural western portion drains to the Hood Canal, and 25% of this shoreline is armored.

The Program spearheaded important work to close a critical data gap - mapping the geologic characteristics of Kitsap County's shorelines. A sediment source analysis that mapped sediment sources (i.e. feeder bluffs) along reaches of the shoreline was as a first step. The report titled, *Restoration Feasibility and Prioritization Analysis of Sediment Sources in Kitsap County* (Qwg Applied Geology et al. 2012) summarized this comprehensive effort. All potential sediment sources were characterized through a compilation of available datasets on historical shoreline conditions and current shoreline armor. A science-based assessment was also developed to identify reaches best suited for restoration and protection using potential for (large) sediment inputs and other physical attributes criteria. Protection focused on areas currently providing substantial unimpeded sediment inputs to the shore. Restoration focused on areas with potential to contribute substantial sediment inputs to the drift cell and are currently disconnected from the shore environment. This spatially explicit data showing prioritized reaches gave direction on where on-the-ground restoration efforts should be focused for this Program, and continues to provide guidance.

The majority of shoreline restoration opportunities in Kitsap County occur on private land. The County has the highest number of residential parcels (7806) on the shore of all Puget Sound counties (Coastal Geologic Services 2014).This Program finds a nexus between interested landowners and restoration opportunities on private shores. Many private landowners are unaware of appropriate restoration actions for their property and/or are

unwilling or unable to pay for them. This is a collaborative effort between Kitsap County and the landowner to design and implement a shoreline restoration project on the landowner's private property. The ecological objective of these restoration projects is to reconnect the nearshore to the uplands by removing all or some degree of hard armor; this reconnection aims to improve sediment transport processes that maintain the health of the beach. From a societal perspective, the restoration projects demonstrate how practical restoration actions can occur on private lands. They show examples of varying degrees of armor removal and combinations of softer alternatives for shore protection (such as log/rock installation, slope bioengineering and bank stabilization though plantings).

Shoreline landowners were invited by postcard to take an online survey to gauge their interest in voluntary shoreline restoration on their private properties. One hundred and seventy-eight responses were gleaned from a mail-out of 1364 addresses (about 13% of those contacted). Using these survey results in conjunction with the priority restoration reach and drift cell information (from the *Restoration Feasibility and Prioritization Analysis of Sediment Sources in Kitsap County* (Qwg Applied Geology et al. 2012) helped the Program to identify willing homeowners whose sites could provide the most benefits to the nearshore.

For those responses that indicated they would like follow-up, phone calls were made and from which there were eight leads. These leads transpired into eight site visits by staff project manager and staff geologist/engineer to assess for general feasibility and program fit. Four properties were assessed further by a contracted, licensed geologist with experience in coastal geologic processes. These assessments qualitatively examined the feasibility of bulkhead removal/shoreline modification, shoreline stability and erosion issues, and potential risk to existing structures. These geologic reports led to more serious conversations with the interested homeowners, and in turn led to the development of two private bulkhead removal projects. In order to participate, homeowners were required to sign a mutually-agreed upon landowner agreement that outlined their responsibilities which included maintaining the project for 10 years. They were also required to make a financial commitment and share 10% of the project's construction costs.

The final phase of the Program (in the last year) utilized a different strategy to assist landowners with bulkhead removal projects on their private properties. In order to make the best use of remaining grant funds which were not enough to cover the cost of an entire project from design to construction, the program supported two designs for private bulkhead removal projects using a model of cash reimbursement. This cash reimbursement model was being used at the same time in a coinciding program, *Shore Friendly Kitsap* that provides incentives to homeowners to remove all or part of their bulkheads. This cross-over with Shore Friendly Kitsap, allowed the Kitsap Regional Shoreline Restoration Program take advantage of their findings that homeowners could be successful in directing their own projects when given the appropriate assistance and guidance. It also let us connect with more homeowners who were interested in shoreline restoration and in making positive impacts on their shoreline properties.

In 2012, the Program began with its first bulkhead removal site on County Parks' land in Dyes Inlet at Anna Smith Children's Park, which has a popular clam-digging beach. Six-hundred and fifty linear feet of concrete bulkhead were removed from the beach to provide increased beach habitat and increased public access. This site was and continues to be used as a public demonstration site to show people the benefits of armor removal, and simply what such a project looks like on-the-ground. Overall, the Program was successful in coordinating and supporting two armor removal projects on private shorelines from project inception through construction, as well as two final designs for armor removal/restoration on private shores.

The Program also had an educational piece which aimed to reach the broader public, as well as landowners with shoreline properties. A dedicated webpage for the Program was linked the Department of Community Development's website. This webpage was a place for the public to find information about the Program, including opportunities for shoreline landowners to get technical and financial assistance for their private shoreline restoration projects. The webpage provided links to informational resources on the importance of unimpeded, natural shorelines, like the Sediment Source Analysis report. This webpage also hosted the online survey that helped the County to document the interest the public had in learning more about shoreline health and ecology, as well as their interest in private shoreline restoration. In response to the survey question: "If costs were not an issue, would you consider altering or removing armoring on your property and planting vegetation as an alternative, if it would help to restore natural shoreline conditions" – we found that of those who replied, 26.1% answered yes and 34.8% answered maybe. These percentages seemed very encouraging and appeared to reflect some public support. A public workshop was also held for the general public to help them better understand the Program's intent. We had keynote speakers who presented on coastal geology and shoreline processes, and the plans for bulkhead removal at the Anna Smith Children's Park demonstration site, as well as the park's history. This educational workshop also acted as an avenue to get people potentially interested in private restoration connected with the Program.

The Program's Partners, Washington Sea Grant and Washington State University (WSU) Kitsap County Extension also had a large influence on shoreline education and outreach by training and utilizing the Kitsap Watershed Stewardship Program volunteers in shoreline monitoring. These dedicated citizens volunteered their time and became proficient in collecting beach profile data for physical and biological attributes. They assisted in collecting monitoring data pre and post restoration at the Anna Smith Children's Park bulkhead removal site, to document beach changes. After the restoration was complete, an interpretive sign about the bulkhead removal project, designed by Kitsap County staff, was installed at the beginning of the beach trail at Anna Smith Children's Park (See Appendix for design of interpretive sign).

This final report is written to meet the requirements of Environmental Protection Agency's (EPA) Grant #PO-00J08501-0. The final report for the **Kitsap Regional Shoreline Restoration Program** intends:

- To provide concise summaries of the completed, bulkhead removal projects,
- To provide brief assessments of the restoration projects' performance and present qualitative monitoring results,
- To highlight the lessons learned in implementing these projects and,
- To present a discussion on how to achieve long-term outcomes that increase nearshore health.

2.0 SUMMARIES FOR SHORELINE RESTORATION PROJECTS

Through the Kitsap Regional Shoreline Restoration Program, one public and four private shoreline armor removal/restoration projects were supported. These project sites were located in central and north Kitsap County. Three projects were completed from design through to construction: projects #1. Dyes Inlet-Barker Creek, #2. Anna Smith Children's Park, #5. President Point, and two projects were completed through final design: projects #3. Dyes Inlet-Mosher Creek and #4. Suquamish-Pebble Beach (Figure 1). The written format for the following summaries of the shoreline restoration projects was modeled after the presentation of case studies in Appendix A: Case Study Report of the *Marine Shoreline Design Guidelines* (MSDG) (Johannessen et al. 2014). Appendix A includes 24 case studies that cover six general design techniques commonly used on Puget Sound shores.

The summaries of the constructed Kitsap shoreline restoration projects are presented similarly in efforts to be consistent with the previous case studies cited by the MSDG, and to touch on similar information. It also provides a concise and easy-to-read summary. The summaries include an overview summary table, project background, design and construction approach, current conditions and performance assessment, as well as a qualitative monitoring results presented by an online story map.

The MSDG performance assessment uses the benefits and negative impacts criteria to score the projects in a quantitative approach defined by Appendix A (pgs. A1 - A18, MSDG) (Johannessen et al. 2014.). The positive benefits scores were combined with the negative impacts score to give a total net score, described as a Benefit-impact index (See Tables 1-3). This total score partially reflects project performance with regards to suitability and design quality. The score also allows for the relative comparison between similar type projects.

Since the Kitsap shoreline restoration projects were designed using a combination of techniques, the performance assessments incorporated all corresponding technique-specific criteria (i.e. bulkhead removal, bank re-slope, large wood, and beach nourishment design specifics). The benefit-impact (BI) scores derived from the performance assessment give a sense of how the project is working. However, because the length of time after bulkhead removal varies for these three projects (construction dates of 2012, 2014 and 2015), it is difficult to directly compare their performance. Obviously, there is more monitoring data to consider for an older project.

An online story map, *Nearshore Restoration Activities in Kitsap County*, was created to document the restoration project sites (Dyes Inlet-Barker Creek, Anna Smith Children's Park, and President Point), post-bulkhead removal using photos. The story map catalogues photos at the three bulkhead removal sites over a period ranging from 1-4 years depending on when the construction was completed. Each project site is featured under its own 'tab' (or section), and shows an overview aerial which the corresponding photo stations. The story map is a qualitative way to view changes over time, and we discovered is effective as a monitoring tool.

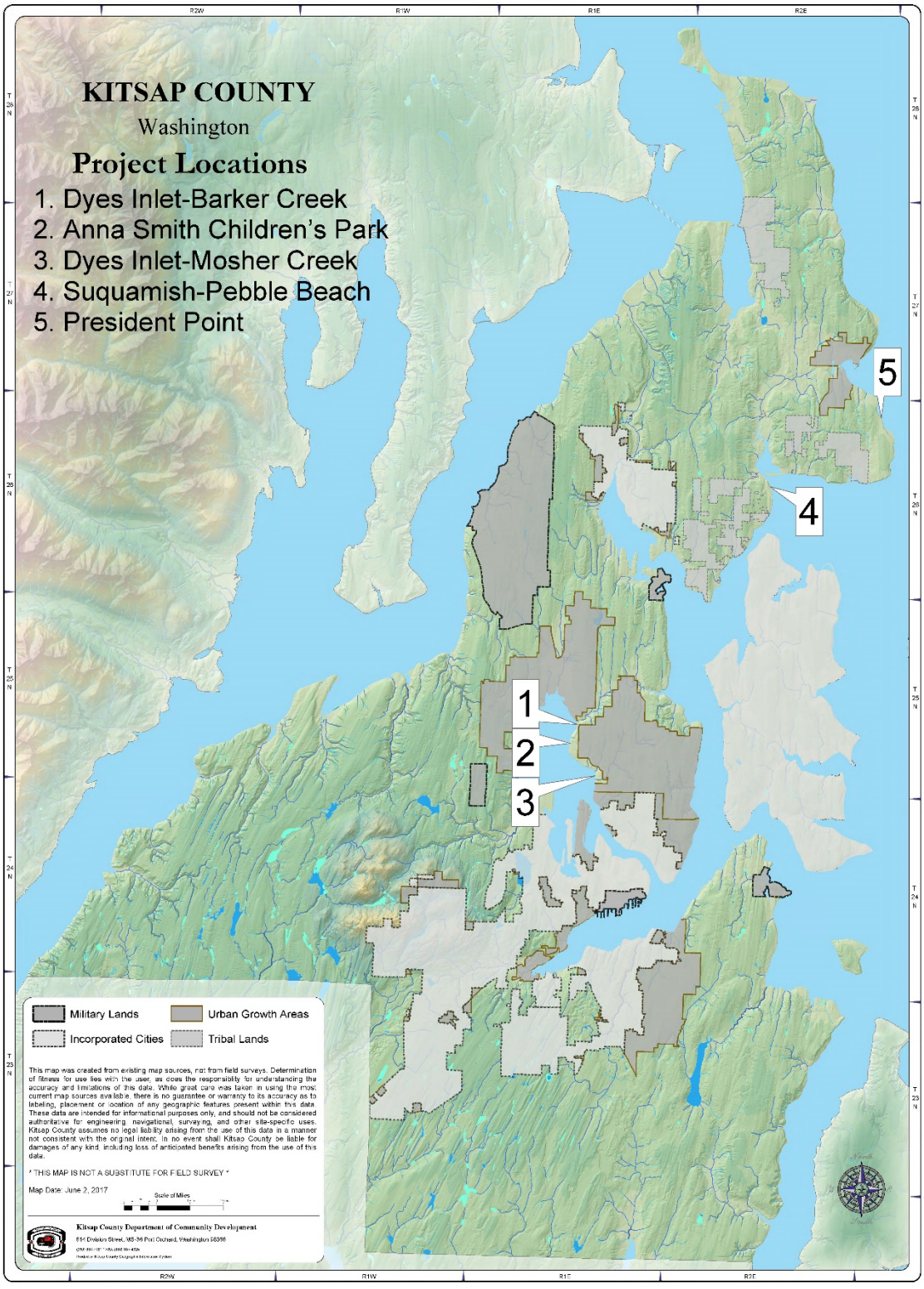


FIGURE 1. LOCATIONS OF SHORELINE RESTORATION AND ARMOR REMOVAL PROJECTS IN KITSAP COUNT

2.1 ANNA SMITH CHILDREN'S PARK – Bulkhead Removal (2012)

<table>
<tr><td>Waterbody: Dyes Inlet</td><td>Shoretype: Bluff backed beach</td><td>Net Shore drift cell:
KS-18-19</td><td>Direction: North</td></tr>
<tr><td colspan="2">Project Elements: Concrete bulkhead removal

Construction date: August 2012</td><td colspan="2">Objective: To remove 650 foot concrete bulkhead and allow tidal cycle to restore beach processes as part of the Kitsap Regional Shoreline Restoration Program</td></tr>
<tr><td>Fetch: 1 mile
Wave Energy: moderate
Aspect: SW</td><td>Land use: Public county park, unincorporated Kitsap County

MHHW: 9.2'

Toe Elevation: 9.2'</td><td>Structures: Original 1910 house and restroom building are located at approx. 25 feet from the top of slope, at a horizontal distance at least 200 feet from the shoreline</td><td>Performance assessment indicator for design:

Benefit-Impact Index: 17</td></tr>
</table>

Project Background

The deteriorating bulkhead at Anna Smith Children's Park was a continual problem for safe shoreline access since the 1990's. The broken concrete slabs and debris acted as a physical barrier and prevented park users from walking down to the beach safely. After the first initial consideration to replace the bulkhead, Kitsap County's Parks Department and Department of Community Development saw that there was an opportunity to create a better, more holistic project.

It was an obvious observation that the dilapidated bulkhead built in the 1960's was not preventing erosion or providing stability to the upland bank. The two County departments collaborated and married the idea of improving beach access with the improvement of the beach's ecological conditions. By simply removing the 650 foot concrete bulkhead, the project could improve natural shoreline processes including the supply and input of beach-building sediments, and improve the habitat for spawning forage fish. The proposed project was a suitable fit for the Kitsap Regional Shoreline Restoration Program. Design, permitting and construction was fully funded by the program. This public site has become one of Kitsap County's only public demonstration sites for bulkhead removal.

Sealevel Bulkhead Builders Inc. won the informal bid ($48,067) and was awarded the contract. Kitsap County staff acted as the project manager and was on site during construction. Construction was completed in August 2012 and took 4 days.

Design and Construction

The project objectives were to:

- Remove approximately 650 feet of a 4-foot tall concrete bulkhead, associated angular rock and rip-rap and wood debris.

- Reconnect beach with upland to restore sediment supply processes, and encourage the health of natural shoreline processes.

The simplicity of the proposal, which was defined by the straightforward removal of the bulkhead did not warrant an engineered design. The design or site plan was developed by the county project manager in-house.

The main elements of the project approach included:

- Beach access by barge.
- Concrete bulkhead (approximately 72 CY), rip-rap, angular rock (approximately 100 CY) and wood debris removal by excavator.
- All machine work done within a work corridor of 20 feet from the bulkhead wall to avoid and minimize impacts to shellfish (clam beds). Material for removal was staged in two locations at the Ordinary High Water (OHW) mark. Angular rock on the beach beyond the 20 foot work corridor was hand-picked.
- Beach sands that had been impounded by the bulkhead were redistributed naturally by the tidal cycles.
- No major grading or moving beach materials occurred nor soft-shore protection measures installed.

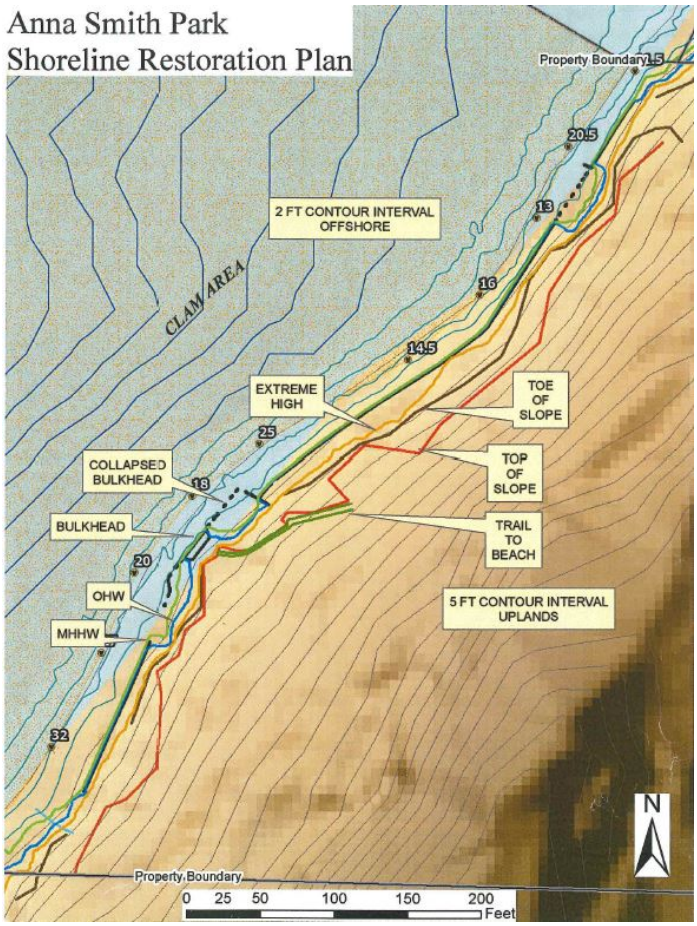


FIGURE 2. ANNA SMITH PARK SITE PLAN FOR BULKHEAD REMOVAL PROJECT

The site plan (Figure 2) shows the 4-foot concrete bulkhead for removal (black line), the OHW (blue line) and the MHHW (green line) marks, as well as the extent of the clam beds (native little neck and manila). The extent of clam beds was determined by a field survey performed by the Suquamish Tribal shellfish biologist, Vivienne Barry. Elevation heights of clams found along upper extent of clam presence are shown on the map. This spatial information informed the size of the work corridor.

Current Conditions

Technique Condition

The project site has moderate wave energy and has been adjusting gradually to the bulkhead removal over the course of 4.5 years. Most noticeable bank erosion has been occurring where there were most concentrated areas of beach-fill material behind the bulkhead. In those areas, the ordinary high water mark has relocated itself higher on the beach, and at a slightly higher elevation. In the last year, some smaller trees at the northern end of the park have fallen into the shore area. Also of interest, are areas of the bank that are now undercut with some exposed roots of large big leaf maple trees near the access trail to the beach. No slides have been documented in the immediate vicinity of the park's shore. This park is popular with the public who dig for clams. No positive or negative public comments responding to the restoration have been received by the parks superintendent.

Upland threats

There are three structures situated on the park parcel: a restroom building, a historic residence and carport. Both the restroom and historic house with associated carport are located approximately 40 feet from the top of slope, and respectively, 195 and 265 horizontal feet from the shoreline (approximate OHW mark). There is no evidence that these structures have been impacted or threatened by the bulkhead removal.

Beach characteristics

Prior to removal, it was observed (qualitatively) that the upper beach substrate consisted of mixed pebbles, finer sand/mud, and as the beach progressed into the lower intertidal area, a muddy substrate appeared more predominant. Also present in the lower intertidal area was scattered angular rock that had mobilized over time from the bulkhead fill. Small changes were observed immediately after removal, like an initial pulse of finer grained material (sands) into the upper beach area that had originated from behind the bulkhead. Less scattered angular rock was also observed after the project because much of it had been removed as possible, which had been part of the project's scope.

The adjacent beaches on either side of the park prior to the bulkhead removal appeared in many ways similar to the project site. The adjacent beaches were not armored, and yet the composition of the beach substrate looked very similar to the project site pre-removal. However, one noticeable difference was the more diverse character of the adjacent shorelines, such as the more large wood on the beach, downed wood/trees lying perpendicular to the shore, and more undercut banks. Since bulkhead removal general observations have been made that these natural features have been increasing.

Performance

TABLE 1. DESIGN-SPECIFIC BENEFITS AND NEGATIVE IMPACTS SCORING MATRIX FOR THE ANNA SMITH PARK BULKHEAD REMOVAL PROJECT. DESIGN-SPECIFIC PARAMETERS INCLUDE THOSE FOR BULKHEAD REMOVAL TECHNIQUE.

Category	Parameter	Rating	Score	Rationale
Benefits	Removed structures restoring natural processes	Med-high	5	All of bulkhead removed, majority of angular rock fill removed
	Sediment volume augmented	Med	2	Input from feeder bluff allowed
	Input/exchange of LWD, detritus	High	3	Entire structure removed, that acted as cross-shore and along shore barrier
	Backshore vegetation enhanced	None	0	Did not include backshore planting. There was no area to establish a backshore vegetation community.
	Marine riparian vegetation enhanced	Low	1	No planting was completed. The riparian area was vegetated and did not need augmentation.
	Low cost and simple installation	High	3	Approx. $70 / linear foot
Impacts	Structures bury backshore and intertidal areas	Low	-1	Some angular rock fill and concrete debris left on beach, which has become exposed with time.
	Structures impound littoral sediment	None	0	No structures to impound littoral drift
	Coarser/steeper beach profiles created	None	0	No change noted
	LWD/detritus recruitment reduced	None	0	No impact
	Adjacent end erosion	None	0	No impact
	Required maintenance level	None	0	None required since removal
Design-specific Benefits	Restored cross-shore connectivity	Med	2	High to medium bank with moderate sediment input
	Reclaimed or created backshore/upper intertidal substrate	Med	2	Most angular rock fill removed and upper intertidal area is reclaimed
Design-specific Impacts	Infrastructure threatened	None	0	Three structures are located far from beach and not threatened
	Off-site erosion increased substantially	None	0	No impact
Benefit Index			**18**	
Impact Index			**-1**	
Total BI Index			**17**	

The total BI index of 17 indicates that total benefits outweigh the negative impacts. Of all three completed armor removal/restoration projects this project scored the highest. This index of 17 is two points higher than the second highest index. This score appears reasonable compared with the MSDG case study which documents index scores that range from 8-18 for four bulkhead removal projects (Table 5-3, pg. 5-5 in the MSDG).

2.2 Monitoring by Citizen Scientists: Post-bulkhead removal at Anna Smith Park 2012-2016

The monitoring effort to document changes at Anna Smith Park post-bulkhead removal was spearheaded by citizen scientists. Washington State University Kitsap County Extension (WSU) and Washington Sea Grant coordinated Kitsap Watershed Stewardship Program volunteers who provided field support. This effort was led by Jeff Adams, Marine Ecologist at Washington Sea Grant, and the following monitoring summary was written by him.

In response to the impending shoreline armor removal project at Anna Smith Park in 2012, Kitsap County worked with Washington Sea Grant (WSG) to explore tools at hand that could be used to monitor the project without additional financial resources to support the effort. Because WSG was piloting citizen-assisted physical and biological shoreline profiles at another site in Kitsap County, the decision was made to extend the use of those protocols to Anna Smith Park before construction and to continue monitoring annually after the removal project was completed to determine physical and biological responses. Volunteers with the Kitsap Watershed Stewardship Program contributed approximately 200 hours to monitoring at Anna Smith Park. The biological and sediment protocols available for use for the pre-restoration monitoring of the project were not appropriate for the expected changes, and the most useful data to show changes at the site proved to be the physical profiles.

FIGURE 3. STEWARDSHIP VOLUNTEER, BOB MCBRIDE ASSISTING WITH DATA COLLECTION AT PROFILE 3.

Monitoring Methods

The methods used at the beginning of the project were a slightly modified version of the Island County BeachWatcher shoreline monitoring protocols (Island County/WSU Beach Watchers 2003). These include:

- Physical profile: Two 8' poles with a 10' line between them were used to measure rise and fall of the beach at roughly 10' intervals. The landward pole had a hole at 5' through which the viewer would match the horizon to a height measure on the waterward pole. The height above or below 5' on the waterward pole indicated the rise or fall of the beach.
- Biological profile: For each 10' section of beach where a vertical measurement was taken, the plants, seaweed and animals within a 16'x10' rectangle that were visible with the naked eye and living on the surface (macroepibenthos) were recorded as "present" to the lowest reasonable taxonomic level. Substrate type was also recorded for each profile section. The protocols called for presence and dominance of substrate and were used in the pre-restoration monitoring. After the bulkhead was removed, we began estimating percent cover of substrate types, but the differences in approach before and after the restoration decrease the utility of the substrate data.
- Biological density: At tidal elevations of 0', 10' and 12', three quadrats, each 8' apart were used to record density and percent cover of the macroepibenthos.

Ultimately, we determined the approach to collecting biological data was not appropriate for the goals of the project. Because the beach to be gained through bulkhead removal was intended to be composed of the fine gravel used by forage fish, such substrate is mobile and doesn't support macroepibenthos. More appropriate measures of change would include monitoring wrack composition and invertebrate fallout. These approaches were used in 2016 and will be compared to nearby reference and armored sites. At the time of this report, analysis of wrack and fallout samples has not been completed.

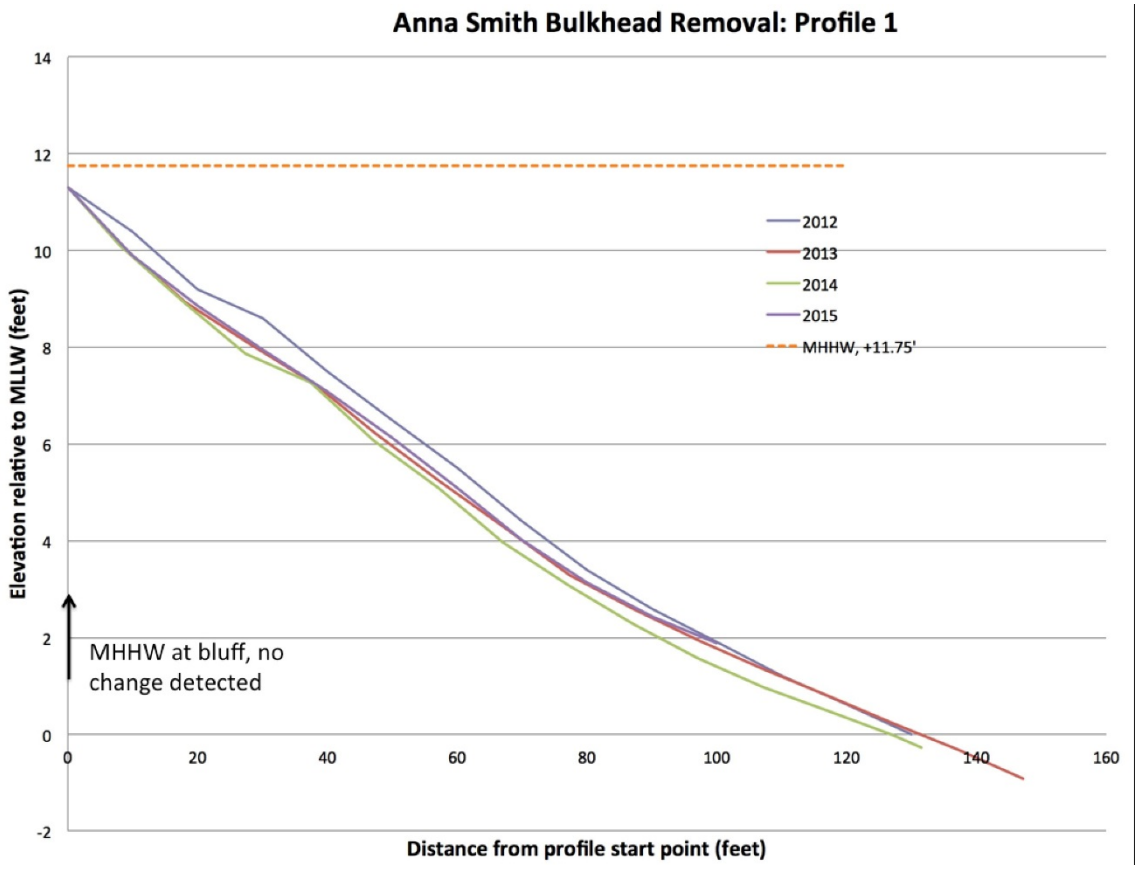
In 2014, to improve the accuracy of the physical profiles, we began using a survey transit to measure changes in elevation along the profile line. Monitoring was conducted once annually during the first two weeks of August.

Monitoring Results

The results highlighted in this document and the most telling of the data collected are the physical profiles. Profile 1 was unarmored before the project and monitored to serve as a control. Profile 1 was the most southern of the profiles and located close to the park's southern boundary. Profiles 2-4 were located approximately 200 feet apart, and proceeded northwards with profile 4 at the most northern park boundary. The armoring at Profiles 2-4 was removed after the 2012 pre-restoration monitoring.

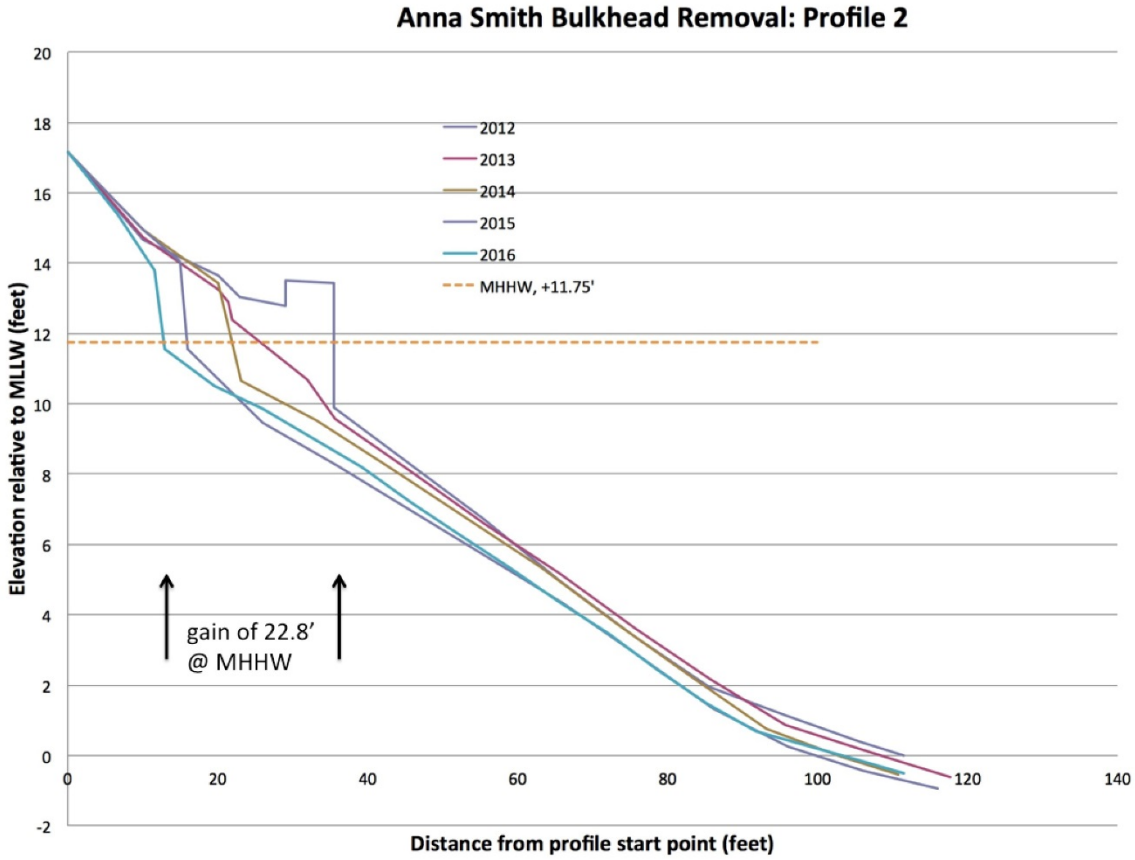
Profile 1

As the control site where the beach extends up under the roots and vegetation at the toe of the natural bluff, no change in available beach was expected.



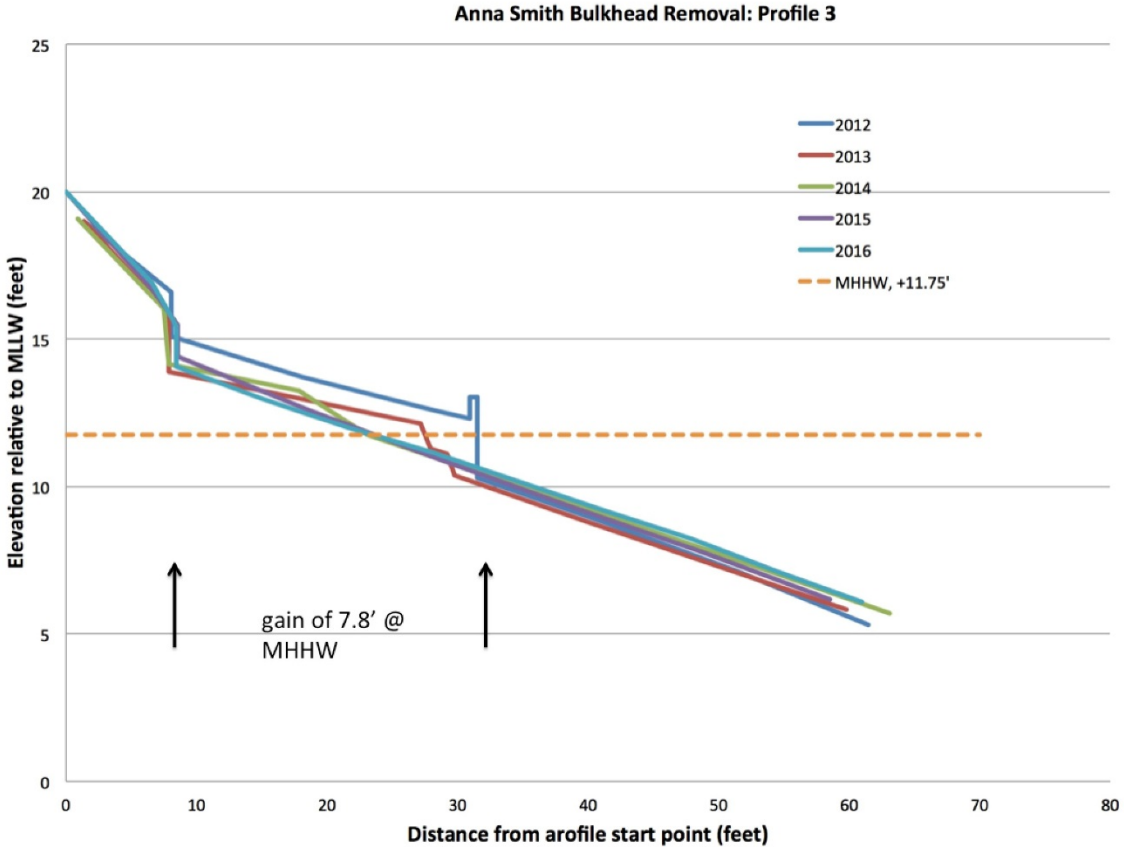
Profile 2

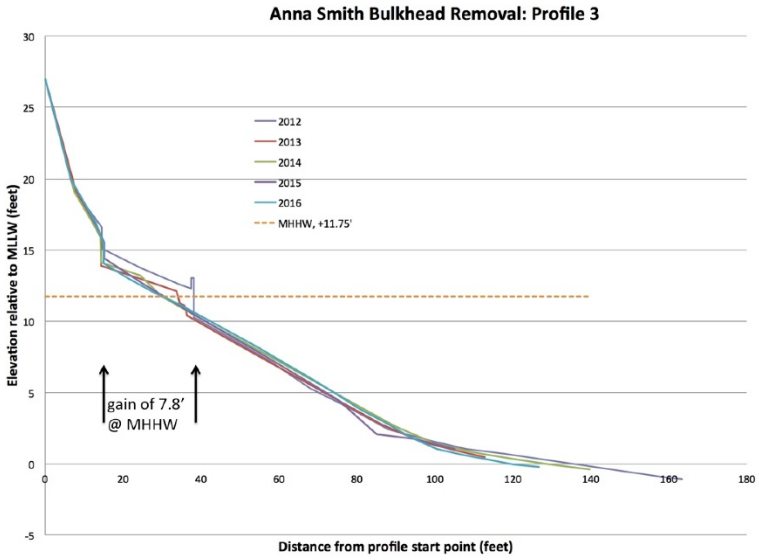
With a large concrete platform and bulkhead, Profile 2 was expected to gain the most beach and produce the most additional habitat. The material behind the bulkhead contained a lot of clay and an even older wooden bulkhead buried within. As a result, erosion at the site has was less immediate than at Profile 3 and appears to be continuing to recede. Between 2012 and 2016, the area at Profile 2 has gained approximately 22.8’ of beach at Mean Higher High Water.



Profile 3

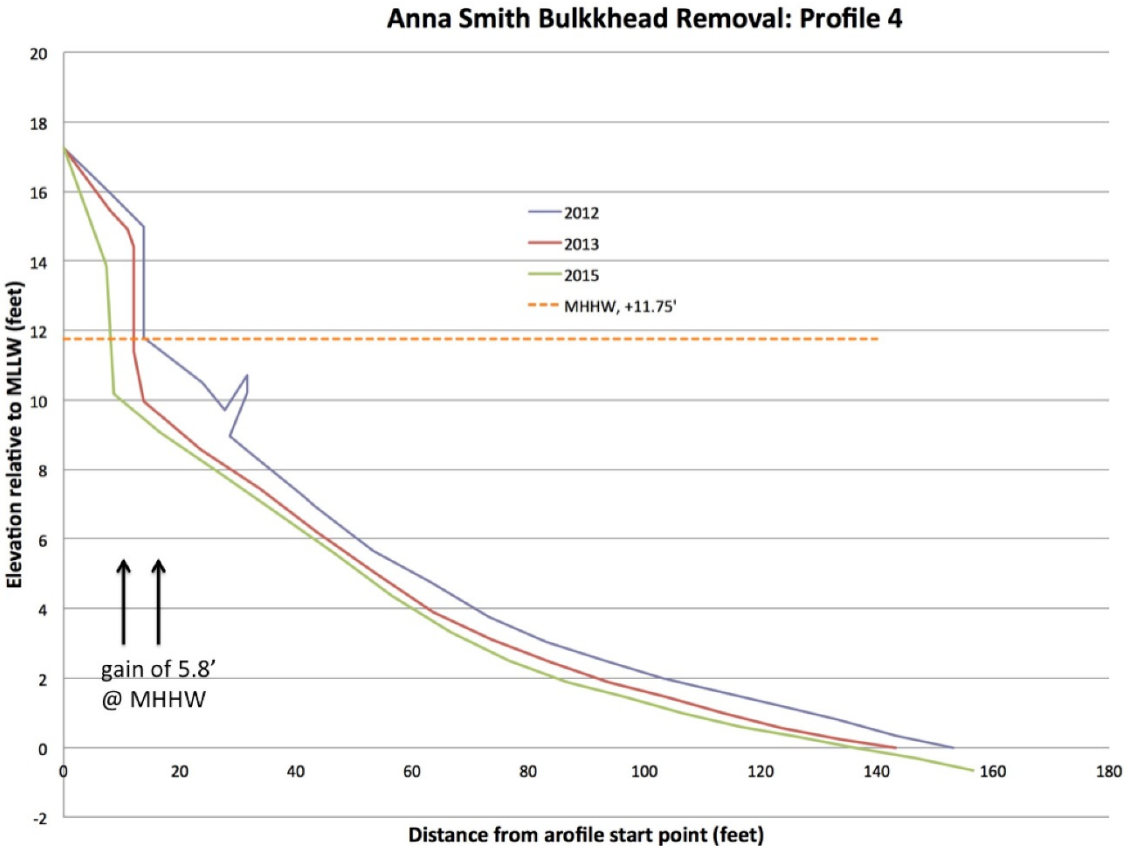
With largely sand and some clay behind the bulkhead at Profile 3, the material behind the bulkhead eroded rapidly after the bulkhead was removed and appears to have stabilized by 2015. Between 2012 and 2016, the area at Profile 2 has gained approximately 7.8’ of beach at Mean Higher High Water. The graph below represent a close up of the area most affected by armor removal with a second graph that represents the entire profile.





Profile 4

Between 2012 and 2015, the area at Profile 2 gained approximately 5.8’ of beach at Mean Higher High Water. Anecdotally, the area has reached a relatively stable bluff, but a profile will be repeated in the future to determine if the bluff has continued to recede.



The online story map *Nearshore Restoration Activities in Kitsap County*, also presents a visual of changes at the beach with monitoring photos taken over the years at photo stations. To view additional monitoring photos of Anna Smith Park project site up to four years after bulkhead removal, go to the ‘Anna Smith Park Concrete Bulkhead’ tab of the online story map. As you proceed through the photos note the slow changes like, the increased erosion at the toe of bank, the exposed portions of undercut bank and exposed tree roots, and the small amounts of increased wood on the beach.

2.3 DYES INLET-BARKER CREEK – Bulkhead Removal (2014)

Waterbody: Dyes Inlet	Shoretype: Bluff backed beach	Net Shore drift cell: KS-18-19	Direction: North
Project Elements: Timber bulkhead removal, contaminated materials (creosote) removal, partial bank re-sloping, logs, planting, beach nourishment Construction date: August 2014		Objective: To remove bulkhead and install alternative erosion control measures (logs) where protection needed as part of the Kitsap Regional Shoreline Restoration Program	
Fetch: 3 miles Wave Energy: moderate Aspect: SSW	Land use: Private residential, unincorporated Kitsap County MHHW: 9.2' Toe Elevation: 9.2'	Structure: House and garage Setback: 62 feet	Performance assessment indicator for design: Benefit-Impact Index: 10

Project Background

Like many residential shoreline properties in Kitsap County with moderate wave energy, this project site was armored with a creosote-timber bulkhead sometime between the late 1970's to mid-1980's. The project site consists of two adjacent parcels located on the east shore of Dyes Inlet and immediately south of Barker Creek. The bulkhead was approximately 380 feet long and 15 feet tall, and in disrepair. Two locations within the bulkhead were breached and had been damaged by previous upland slides. The ordinary high water mark had been reestablished at the toe of the slope behind the bulkhead; as such the structure was not functioning to provide a high level of wave dissipation. The existing house, not including the deck, was set back 81 feet from the top of slope.

The beach site is backed by a steeply sloping to vertical bluff, and forms an accretion spit at the northwest end that is bounded by the south bank of Barker Creek. The highest portion of the vertical beach bluff is near the northwest end, about 29 feet tall. The upper bluff consists of silty sand and scattered gravel of Vashon advance outwash deposits. The lower bluff materials consist of hard silt with variable amounts of clay and medium dense sand with variable amounts of silt and gravel of the pre-Vashon, lacustrine and outwash deposits. Upland landslide activity is driven by groundwater seepage at this Vashon – Pre-Vashon contact (Cousins, 2013).

Existing research supports the significance of this project. The location of this project site was identified by the Sediment source analysis (Qwg Applied Geology et al. 2012) as within a priority restoration reach and a priority drift cell. The East Kitsap Nearshore Assessment recommends the management option, "Enhance, Create and Restore Site Processes" for the Nearshore Assessment Unit (NAU) in which the project is located.

Kitsap County staff approached the homeowner through the County's Regional Shoreline Restoration Program. The homeowner was supportive of the Program's goals to remove hard armoring and improve nearshore habitats on private properties, and wanted to participate. The Kitsap County Project Manager coordinated the project logistics and fully collaborated with the homeowner. The homeowner was included in all meetings and

decision points, and signed off on all design documents. It was expected that the homeowner take ownership of the project, and sign a Landowner Agreement which outlined mutual responsibilities.

The Watershed Company was hired to design the bulkhead removal project, which cost $31,500. Sealevel Bulkhead Builders won the bid to construct the project ($78,328) and completed the project in October 2014. All local, state and federal permit applications were prepared by the county project manager.

Design and Construction

The project objectives were to:

- To reconnect upland sediment sources to the nearshore by removing all or some degree of hard armoring at the shoreline, thereby reestablishing sediment transport processes
- To demonstrate how restoration can occur on private property through complete armor removal or through a combination of softer alternatives for shore protection

In its design, The Watershed Company also considered key desires from the homeowner, in addition to the project's overall nearshore habitat goals. Homeowner desires included beach access for residents, slope safety for young children and aesthetics.

The main elements of the design included:

- Removing the 380-foot bulkhead (approximately 150 cubic yards of creosoted timber and piles)
- Re-sloping and re-contouring part of the slope directly in front of the home to a 2:1 slope (removal of approximately 550 cubic yards)
- Planting the re-sloped area with native plants, shrubs and trees (900)
- Placing beach nourishment material (from native materials onsite and imported 'fish mix') as a colluvium to increase toe protection (250 cubic yards)
- Placing two log/boulder complexes for stabilization measures and to increase habitat diversity
- Citing the new stair access at the north side of the property adjacent to Barker Creek's south bank

The proposed project's site plan, grading details, and planting (revegetation) plan are shown in Figures 4, 5 and 6.

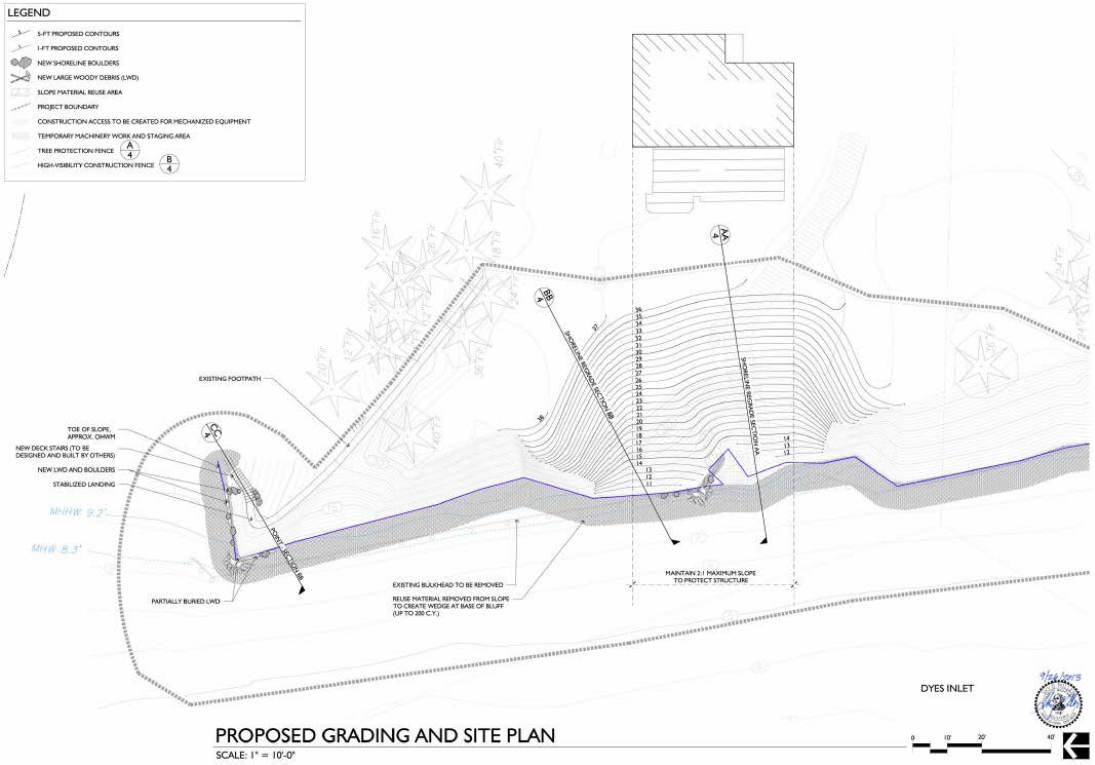


FIGURE 4. SITE PLAN SHOWING PROPOSED CONDITIONS WITH BULKHEAD REMOVAL, GRADING AND LARGE WOOD INSTALLATIONS.

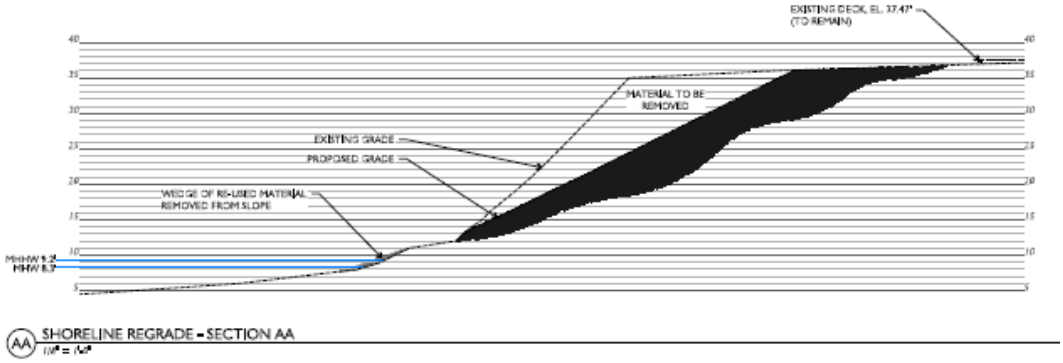


FIGURE 5. INSET SHOWS A CROSS-SECTION OF GRADED AREA AT SECTION AA OF SITE PLAN.

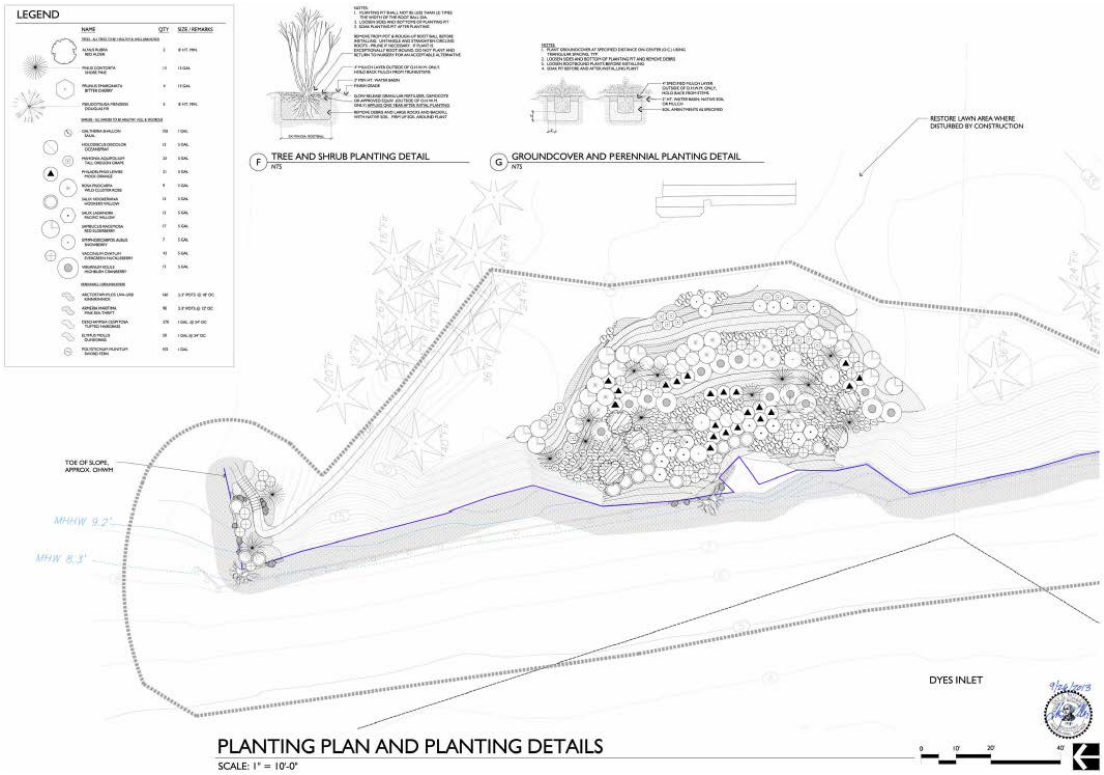


FIGURE 6. PROPOSED PLANTING PLAN FOR BULKHEAD REMOVAL PROJECT. MAJORITY OF PLANTING IS IN GRADED AREA.

Current Conditions

Technique condition

Small slides have occurred along entire project area where bulkhead was removed. The largest degree of sliding was observed after 2015 winter storms. The re-sloped and contoured area has experienced some toe-erosion and erosion along edges of the contour (namely the south side). After construction in 2014, the re-sloped toe was graded flush with the beach face. Since 2.5 years from completion the re-sloped area had a small vertical bank, dropping 5-15 feet. The site lost a considerable number of installed plants in this interface area. The re-contoured area no longer has its original shape as a bowl, but the shoreline has returned to more of a straight line (as it had originally).

In spring 2015 additional willow stakes were put installed in attempt to impede erosion. Many of these too have since been lost. The log-boulder complex in front of re-sloped area has remained in place. The top log that is bolted to the buried one is more exposed. At the northern point, the log structure (of three logs) is also still in place, but the logs on the Barker creek side are no longer buried. Scouring has occurred behind them. Also, in this area the plants installed directly behind this log complex were lost due to high tides and storms.

Upland threats

The house (not including deck) was located 81 feet from top of bank pre-construction. Now with the newly re-contoured area the house is located 45 feet from the top of re-contour bank. No movement of the newly established top of re-contour bank has occurred.

Beach characteristics

Substrate on the upper beach appears to have higher densities of finer sands and less exposed courser cobbles. At time of construction, the upper beach had areas with thinner beach materials and exposed bands of hard clay. These exposed areas are now less visible and covered up with finer sand materials. The accretion spit at the mouth of Barker Creek on the south bank has changed considerably, with a buildup of sandy beach material. The depth of sand appears deeper at the spit.

Adjacent shores

No significant changes occurred on properties immediately adjacent and north or south of the project site. However, it was observed that a property three parcels up-drift (south) of the project site experienced a slide in the winter of 2015.

Performance

TABLE 2. DESIGN-SPECIFIC BENEFITS AND NEGATIVE IMPACTS SCORING MATRIX FOR THE DYES INLET-BARKER CREEK BULKHEAD REMOVAL PROJECT. DESIGN-SPECIFIC PARAMETERS INCLUDE THOSE FOR BULKHEAD REMOVAL, LARGE WOOD, BEACH NOURISHMENT AND BANK-RESLOPE/REVEGETATION TECHNIQUES

Category	Parameter	Rating	Score	Rationale
Benefits	Removed structures restoring natural processes	Med-high	5	All of bulkhead removed, two soft-shore structures installed
	Sediment volume augmented	High	3	Feeder bluff input and nourishment
	Input/exchange of LWD, detritus	Med	2	Allows both alongshore and cross-shore
	Backshore vegetation enhanced	None	0	No backshore habitat on site
	Marine riparian vegetation enhanced	Med	2	Vegetation enhanced in along one 50 foot section
	Low cost and simple installation	Low	1	Approx. $206/LF
Impacts	Structures bury backshore and intertidal areas	None	0	No backshore area to bury
	Structures impound littoral sediment	None	0	No structures built
	Coarser/steeper beach profiles created	None	0	Finer sediments accumulating

Category	Parameter	Rating	Score	Rationale
	LWD/detritus recruitment reduced	None	0	No negative impact
	Adjacent end erosion	None	0	No negative impact
	Required maintenance level	Medium (questionable)	-2	1 LWD structure is becoming unburied. This could require attention in the future if decision is made to repair. Not actively protecting bank.
Design-specific benefits	Restored cross-shore connectivity	High	3	Major improvement in sediment/LWD
	Reclaimed or created backshore/upper intertidal substrate	None	0	No fill/no backshore area
	Vegetation reestablished without slope failure	Low	1	Native vegetation planted in re-sloped area but losing plantings due to erosion
	Surface and groundwater adequately managed	Medium	2	Surface water managed with plantings/ no collection
	Natural materials used (minimal hardware)	Medium	2	Only exposed hardware is the bolts attached logs together. No anchoring of logs.
	LWD facilitates fine sediment deposition	Low	1	Small amount of deposition, mostly behind LWD structure in front of re-slope area.
	Enhance potential forage fish spawning habitat	Medium	2	
	Sediment benefit down-drift beaches in process unit	Low	1	Moderate nourishment but close to drift cell terminus
Design-specific Impacts	Infrastructure threatened	None	0	Home not threatened
	Off-site erosion increased substantially	None	0	
	Slope failure within the project area	Medium	-2	50% of bank experiencing slope failures
	Nonnative/invasive vegetation	Low	-1	<15% invasive species (mostly blackberry which has been part of slope failures and now gone, and Scotch broom)

Category	Parameter	Rating	Score	Rationale
	Placement causes scour, disturbance	Medium	-2	Moderate scour around one LWD structure at point
	LWD can become detached or cause damage	Low	-1	Possible detachment
	Smothered eelgrass beds/other fauna	Low	-1	Minor amounts of sediment moved to lower intertidal area
	Loss of substrate heterogeneity	Low	-1	
Benefit Index			**25**	
Impact Index			**-10**	
Total BI Index			**15**	

The total BI index of 15 indicates that total benefits outweigh the negative impacts. Of all three completed armor removal/restoration projects this project scored the second highest. This score appears reasonable compared with the MSDG case study which documents index scores that range from 8-18 for 4 bulkhead removal projects (Table 5-3, pg. 5-5 in the MSDG). Additionally the other case studies, two other Reslope-Revegetation projects have an average BI index score of 8.5 and four other bulkhead removal projects have an average BI index score of 14.5, so the performance score of 15 seems acceptable.

Monitoring

The online story map *Nearshore Restoration Activities in Kitsap County*, presents a visual of changes at the beach and bank with monitoring photos taken over the years at photo stations. To view monitoring photos of the Dyes Inlet-Barker Creek project site up to two years after bulkhead removal, go to the 'Barker Creek Wooden Bulkhead' tab of the online story map. As you proceed through the photos note the changes like, the installed wood complexes, the increased erosion at the bank, the small slide areas and some loss of vegetation, and the accumulating fine sediments on the beach.

2.4 PRESIDENT POINT - Bulkhead Removal (2015)

Waterbody: Dyes Inlet	Shoretype: Bluff backed beach	Net Shore drift cell: KS-10-1	Direction: North
Project Elements: Basalt rock bulkhead removal, beach nourishment with native materials, wing-wall and concrete steps construction Construction date: September 2015		Objective: To remove bulkhead and install wing walls to protect adjacent properties (minimal amount of necessary) as part of the Kitsap Regional Shoreline Restoration Program	
Fetch: Large to NNE, 11 mi. Wave Energy: moderate-high energy Aspect: NE	Land use: Private residential, unincorporated Kitsap County MHHW: 10.95' Toe Elevation: 10'	Structure: House and garage Setback: 110 feet (closest point to top of slope)	Performance assessment indicator for design: Benefit-Impact Index: 11

Project Background

This project site is situated on a private, residential parcel southeast of Apple Tree Cove. The shoreline runs north-south and was armored with approximately 165 linear feet of combined basalt-rock bulkhead and boat ramp. At the north end of the bulkhead a concrete boat ramp extended +8 feet of the mean lower low water mark. The neighboring parcel to the north is unarmored, whereas the neighboring parcel to the south is armored with concrete. The house and deck is approximately 80 feet from top of slope at the closest point. If the distance is considered without the deck the distance from the house's closest point is 110 feet to the top of slope. (The garage is set back even farther). The bulkhead is mostly comprised of three and four man rock, and has been in place since the current homeowners have lived there (18 years). The bulkhead was in moderate condition without any major breaches or wall collapses, when it was originally assessed in 2014.

The beach is backed by a 25-35 foot bluff that had had a buttress of talus which sloped downwards towards the bulkhead. The upper bluff sediments are glacial till deposits (dense silt and clay and stone inclusions), and the lower bluff sediments are of non-glacial origin (also dense sand, silt and organics) (Gerstel 2013). Due to the low permeability of these sediments, the local water table is high. Seeps and discharges have been observed discharging along the shoreline. The beach was characterized by a mix of predominantly cobble and sand in the upper intertidal, and an accretion area of sand is immediately off-shore of the site.

The project site falls within a priority drift cell for sediment source importance mapped by Qwg Applied Geology et al. 2012. No forage fish spawning has been documented within the drift cell. Some patchy beds of eel grass occur in the lower intertidal area.

The homeowners made the first contact with the Program through an online survey that asked questions regarding the homeowner's willingness to consider restoration options on their shoreline, and their general interest in nearshore educational materials and resources. The homeowner was supportive of the Program's

goals to remove hard armoring and improve nearshore habitats on private properties. Several on-site visits and meetings were held prior to the homeowners' decision to move forward and participate in the Program. The Kitsap County Project Manager coordinated the project logistics and fully collaborated with the homeowner. The homeowner was included in all meetings and decision points, and signed off on all design documents. It was expected that the homeowner take full ownership of the project, and sign a Landowner Agreement which outlined their responsibilities.

Coastal Geologic Services was hired to design the bulkhead removal project, which cost $35,499. Sealevel Bulkhead Builders won the bid to construct the project ($81,407) and completed the project in October 2015.

Design and Construction

The project objectives were to:

- To reconnect upland sediment sources to the nearshore by removing all or some degree of hard armoring at the shoreline, thereby reestablishing sediment transport processes
- To demonstrate how restoration can occur on private property through complete armor removal or through a combination of softer alternatives for shore protection

In working with the homeowner to produce the design, Coastal Geologic Services addressed their specific desires:

- To have a healthy, natural beach
- To reduce amount of lawn and increase native, water-wise plantings
- To create walkable access to beach
- To provide beach access for wildlife (deer, raccoon, otter)

The main elements of the design included:

- Removing a 165 feet of bulkhead (approximately 180 cubic yards of rock) and 600 square feet of concrete boat ramp
- Replacing 55 feet of bulkhead with a return wall and revetment to protect adjacent neighboring bulkhead and property, and leaving approximately 110 feet unarmored.
- Planting the existing lawn top of slope buffer with native plants and trees for stabilization and habitat diversity

Figures 7 and 8 show the site plan for the proposed bulkhead removal and demolition plan for the beach, respectively. Figure 9 shows the site's native planting plan.

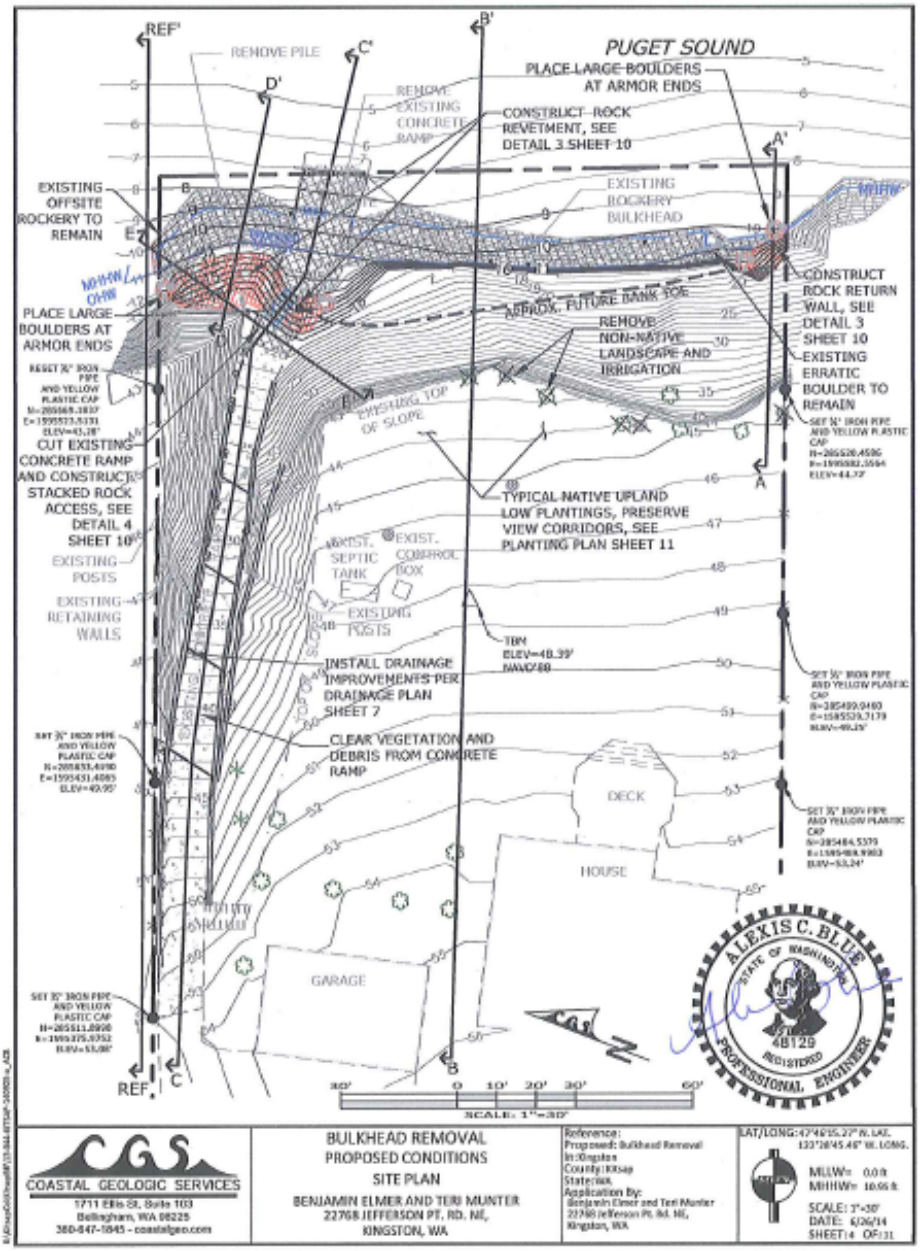


FIGURE 7. OVERALL SITE PLAN FOR BULKHEAD REMOVAL.

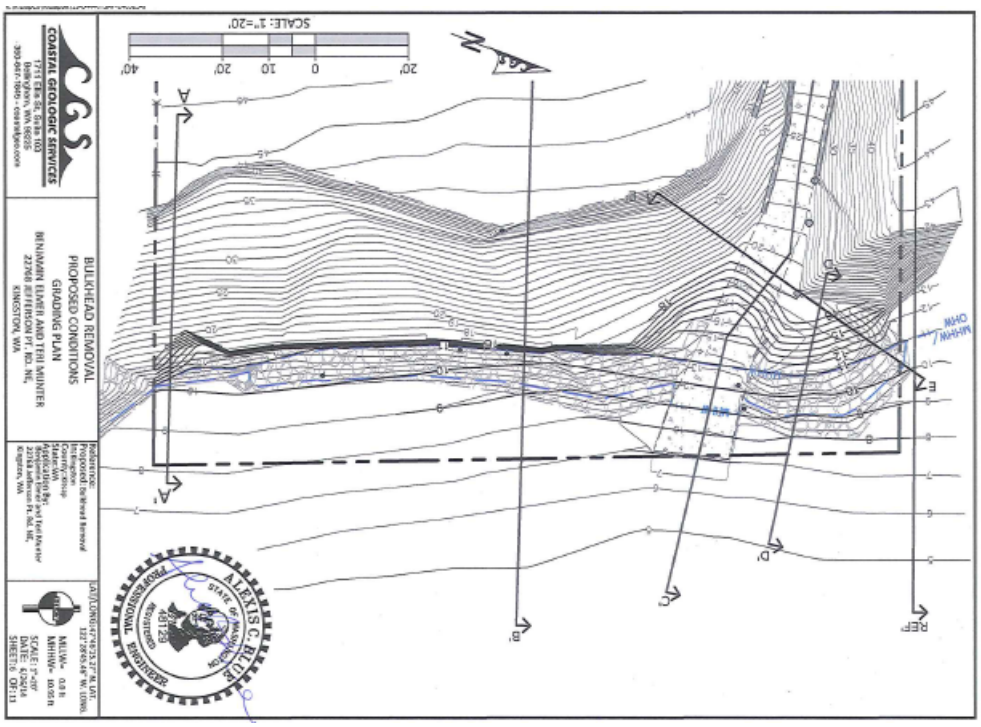


FIGURE 8. CLOSE-UP OF BULKHEAD TO BE REMOVED. SITE PLAN SHOWS ANTICIPATED NEW OHWM.

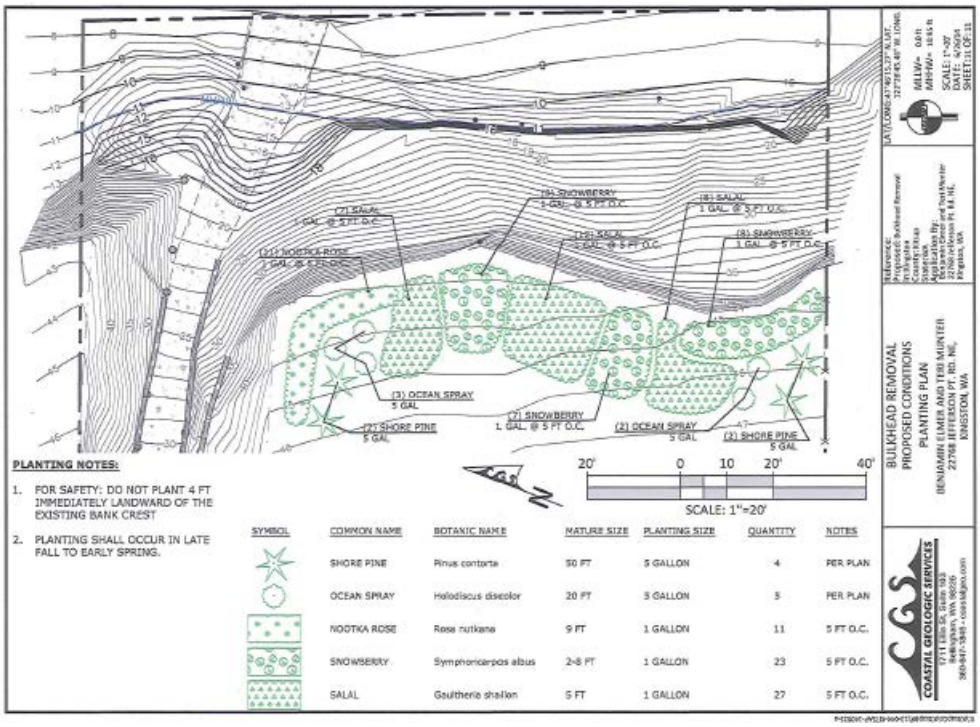


FIGURE 9. PLANTING PLAN FOR THE TOP OF SLOPE BUFFER AREA.

Current Conditions

Technique Condition

Shortly after project construction, during the first fall and winter storms of 2015, the site experienced small slope failures along the length of the bank face between the return walls. Most of the material that slid in the landslides appeared to be colluvium (old slide debris) that had accumulated over years behind the bulkhead wall. Once the bulkhead was removed and the site received heavy rains, the colluvium slid because the support of the wall was gone. Some mature alders on the bank face slumped to the beach, and over the course of the next months migrated water wards. The bank crest appeared in tact with the exception of one small portion in the center. In December 2015, it was also observed that drainage pipes were exiting the uplands south of the subject property. These pipes delivered stormwater from the adjacent neighbor's house and property to the bank. It was recommended by the project's licensed engineering geologist that this water be tight-lined down the slope with high-density polyethylene pipe. The project communicated with the neighbor regarding this issue, however after many conversations they weren't interested in pursuing the project.

Another observation made shortly after construction was the lowering the beach in the vicinity of the north revetment and stairs. Examining photos and conditions at the time (Dec 2015) showed that the beach dropped about 0.8 feet.

Upland threats

There has been no damage or changes to any structures. Houses and septic tanks and drain fields are located far enough away from the crest to have not been impacted. The stormwater pipe and open discharge of water on the bank face continues to be an additional source of erosion. The planted area is doing well and the plants are thriving. One large alder at the top of bank on the south end did slump a couple of feet down the slope. The degree of erosion seems to be acceptable to the homeowners, and in a filmed interview in 2016, they said they would do the project again.

Beach characteristics

Photo documentation and site visits have shown that the beach has lowered about 0.8- 1 foot. This effect is especially noticeable near the return wall and revetment, with larger proportions of the base rocks exposed. Another observation of the beach in the upper intertidal and close to the toe of bank is larger amounts of finer grained beach material and sand. From a distance, one can see a visible band of this lighter colored material at the bank toe. Also apparent is the greater input of wood (from downed alder trees) to the beach interface. At least one log that had been cemented into the bank became exposed and freed into the shore area, after the first year. The large erratic bolder which once stood at the toe of bank is now situated in the upper beach area, due to the toe position receding.

Adjacent Shores

No severe end-effects have been documented to northern neighbor. Actually, the property to the north has received more beach material (sand) than prior to the project because the drift cell direction is northwards. The beach to the south has remained the same.

Performance

TABLE 3. DESIGN-SPECIFIC BENEFITS AND NEGATIVE IMPACTS SCORING MATRIX FOR THE PRESIDENT POINT BULKHEAD REMOVAL PROJECT. DESIGN-SPECIFIC PARAMETERS INCLUDE THOSE FOR BULKHEAD REMOVAL AND REVETMENT TECHNIQUES.

Category	Parameter	Rating	Score	Rationale
Benefits	Effectively stopped or slowed landward erosion	Low	2	Replacement of the return walls needed for protecting neighboring structures; minimal landward progression
	Removed structures restoring natural processes	Med	4	The majority of the structure was removed
	Sediment volume augmented	Med	2	Input from feeder bluff allowed along 105 feet
	Input/exchange of LWD, detritus	High	3	In removal area, alongshore and cross-shore exchange occurs
	Backshore vegetation enhanced	None	0	Did not include backshore planting. There was no area to establish a backshore vegetation community.
	Marine riparian vegetation enhanced	None	0	Planting was limited on newly exposed bank/bluff. Native planting was installed beyond top of slope.
	Low cost and simple installation	None	0	$493/ linear foot, high cost
Impacts	Structures bury backshore and intertidal areas	Med	-2	The replacements return walls buried less intertidal area than the original bulkhead. At the widest section the return wall buried less than 7 feet width
	Structures impound littoral sediment	Low	-1	Bank +30 feet but replacement structures only impound 30% of shoreline length on parcel
	Coarser/steeper beach profiles created	None	0	None noted
	LWD/detritus recruitment reduced	None	0	Log width area actually increased
	Adjacent end erosion	None	0	Improvement to prior conditions
	Required maintenance level	Med	-2	Repair may be needed for return walls
Design-specific benefits	Restored cross-shore connectivity	Med	2	Med-high bank and moderate sediment available for transport
	Reclaimed or created backshore/upper intertidal substrate	High	3	Upper intertidal substrate and area enhanced because of the amount of bank erosion. New OHW mark is at higher elevation of estimated 11 ft.
	Structural integrity and function maintained	Med	2	

	Cross-shore location of exposed structure toe	Med	2	Toe between MHHW and OHWM
Design-specific Impacts	Infrastructure threatened	Low	0	Structures are not threatened
	Off-site erosion increased substantially	Low	-1	
	Scour at structure	High	-3	Greater than 0.5 foot beach drop at stairs
	Debris (rock, concrete, other) on beach from structure	None	0	Not very much residual rock left behind
Benefit Index			20	
Impact Index			-9	
Total BI Index			11	

The total BI index of 11 indicates that total benefits outweigh the negative impacts. Of all three completed armor removal/restoration projects this project scored the lowest. This score appears reasonable when compared with the MSDG case study which documents index scores that range from 8-18 for 4 bulkhead removal projects (Table 5-3, pg. 5-5 in the MSDG).

Monitoring

The online story map *Nearshore Restoration Activities in Kitsap County*, presents a visual of changes at the beach and bank with monitoring photos taken over the years at photo stations. To view monitoring photos of the President Point project site up to eight months after bulkhead removal, go to the 'President Point Rock Wall Bulkhead' tab of the online story map. As you proceed through the photos note the changes like, the increased erosion at the bank, the slide areas and loss of alders on the bank, and the accumulating fine sediments on the beach, as well as to the beach to the north.

2.5 DYES INLET-MOSHER CREEK – Bulkhead Removal

Project Background

The project site is a residential property on the east side of Dyes Inlet. The creosoted timber bulkhead spans the parcel's shore of 90 feet, and makes up a part of a larger structure which spans another 290 feet on three adjacent parcels to the north. The creosoted logs are stacked to comprise a vertical wall, ranging in height from 4-6 feet tall. Much of the fill around the base of the pilings has been eroding over the years. The bulkhead was built in the 1960's by the owner's father.

The bulkhead is located at the toe of a bench assumed to be comprised mostly of fill material. From the bench, the property slopes upland at 40%. County critical area mapping shows this parcel to be within a moderate hazard area. Geologic and geomorphic observations suggest that any slope instability would occur as shallow debris slide (Gerstel 2016). The parcel is within an area mapped as glacial till, overlying advance glacial outwash sands with a veneer of loose recessional outwash (Gerstel 2016).

The parcel reach is within a drift cell designated as a priority for restoration (Qwg Applied Geology et al. 2012), and the net shore drift is northwards. The outlet of Mosher Creek is approximately 1000 feet to the south, and acts a potential sediment source to the beach. The beach substrate is made up of cobble, gravel and course sand.

The homeowner first made contact with the Program through a general inquiry to the County about building a beach stairs or access. This project was the first to be supported by multiple programs: Shore friendly Kitsap provided geotechnical assistance and support, and the Regional Restoration Program supported the design and permitting costs. The homeowner made a diligent effort to include her three neighbors to the north (who share the entirety of the structure) in the project opportunity. At the time however, they were not ready to support the project and were unwilling to participate.

The homeowner hired Wnek Engineering to design the removal project. The design costs were $6,275. The homeowner was beginning construction at the time of writing this report (June 2017).

Design

The project objectives were to:

- To reconnect upland sediment sources to the nearshore by removing all or some degree of hard armoring at the shoreline, thereby reestablishing sediment transport processes
- To demonstrate how restoration can occur on private property through complete armor removal or through a combination of softer alternatives for shore protection

In working with the homeowner to produce the design, Wnek Engineering addressed their specific desires:

- To have a healthy, natural beach free of toxic materials
- To create walkable access to beach

The main elements of the design included:

- Removing approximately 90 feet of creosoted timber bulkhead
- Grading the toe of bank, after bulkhead removal to a 3:1 slope.
- Building two wing walls (approx. 10 feet long) to tie into the neighboring parcel's armored shoreline.
- Placing a log in front of each wing wall for a natural aesthetic.

Figure 10 shows the proposed conditions of the overall project site, grading plan and wing wall construction. Figure 11 shows a close- up of the site plan inset.

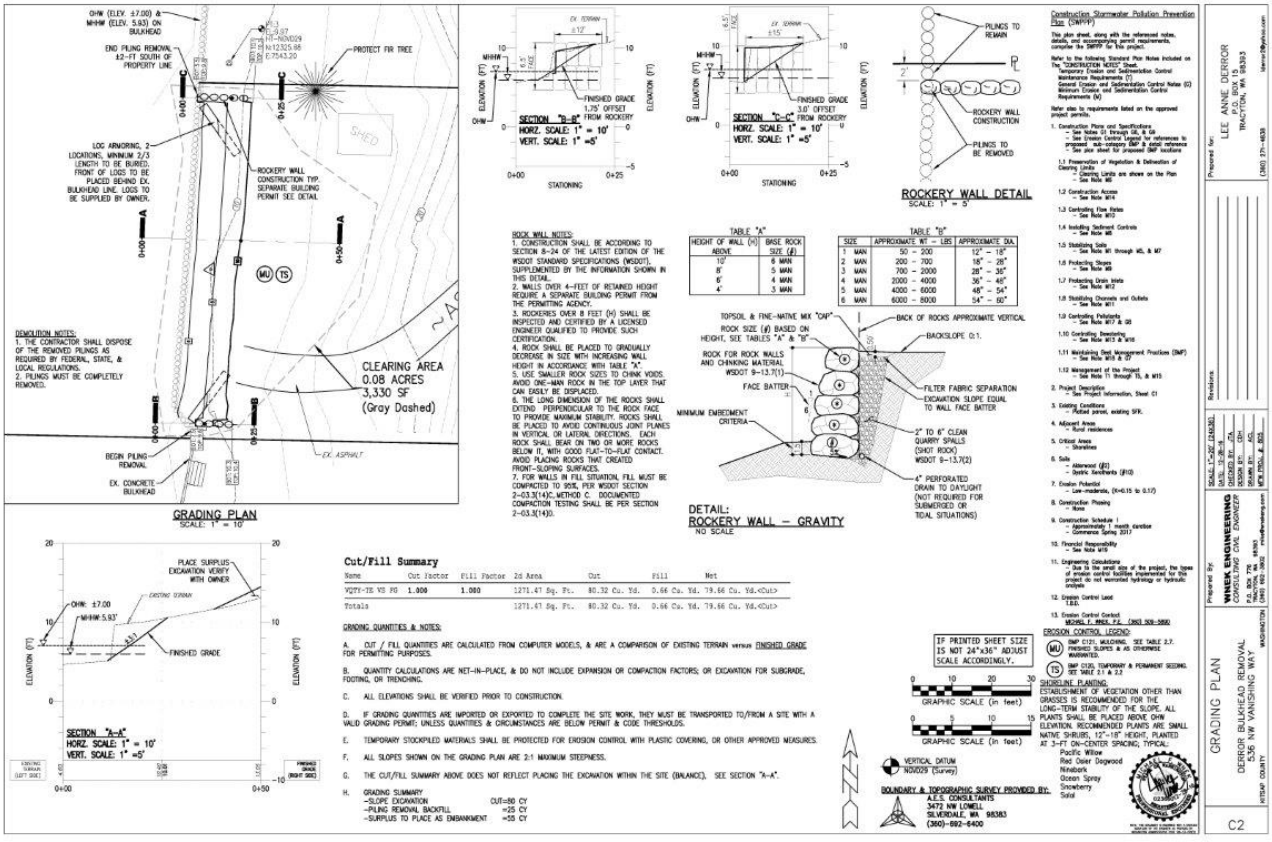


FIGURE 10. PROPOSED CONDITIONS FOR THE OVERALL PROJECT SITE, INCLUDING GRADING PLAN AND WING WALL CONSTRUCTION.

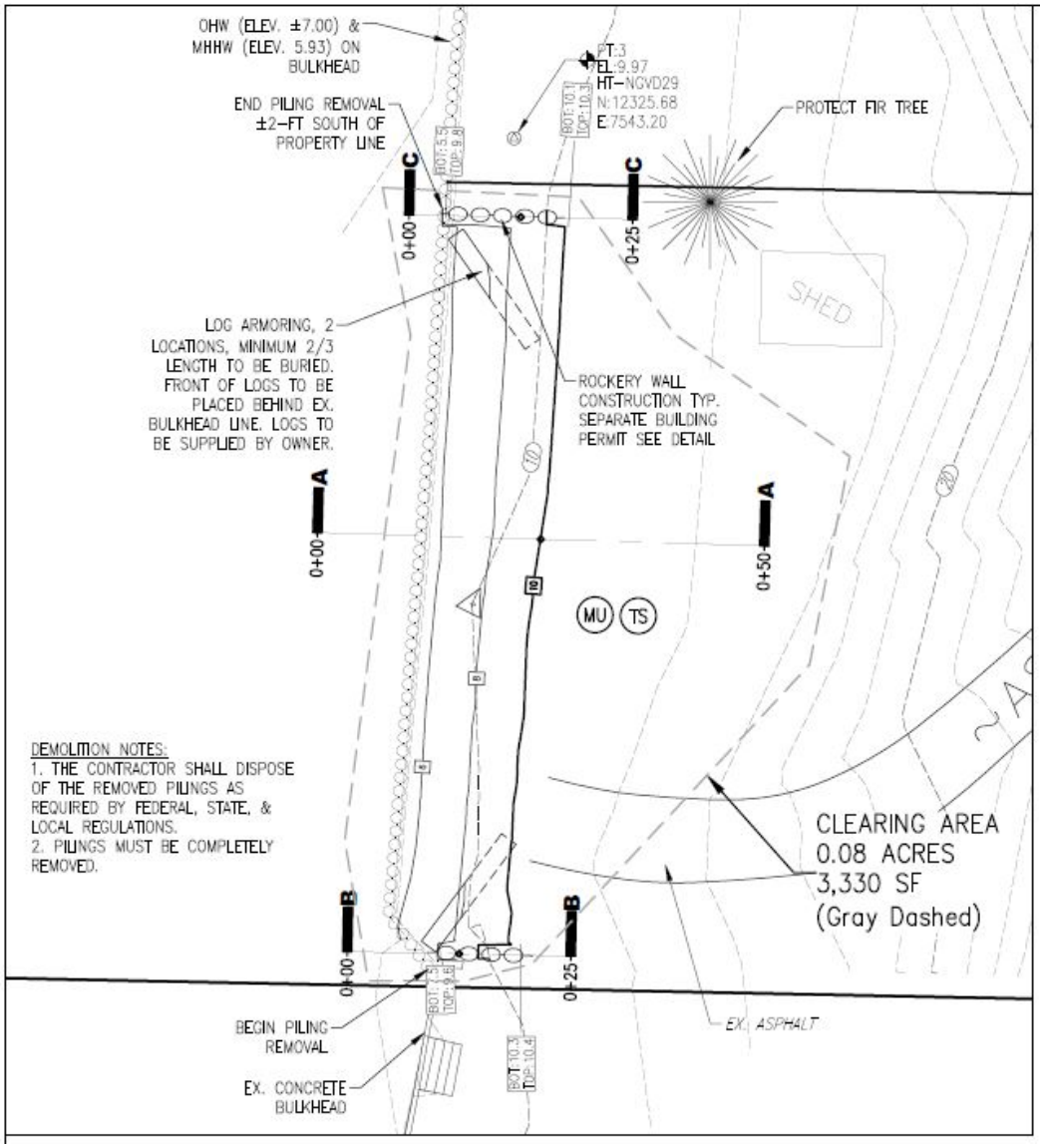


FIGURE 11. ENLARGED INSET OF SITE PLAN

2.6 SUQUAMISH–PEBBLE BEACH – Bulkhead Removal

Project Background

The project site is located on the eastern shore of Port Madison, south of the Indianola Spit. The site is located near the end of its drift cell, and bluffs to the south supply sediment to this beach. The site is located within a priority reach for restoration (Qwg Applied Geology et al. 2012), and has continuous eelgrass (mapped) and documented spawning areas for pacific herring. The subject beach has a substantial maximum fetch of 7.8 miles to the southeast. The vertical bulkhead is comprised of 3-4 foot tall creosoted piles connected by horizontal timbers, and extends approximately 95 feet of the shoreline. A set of concrete stairs abut the southern property line and the neighbor's rock bulkhead. Much of the bulkhead is in disrepair, with toppling piles and timbers. Both adjacent, neighboring beaches are armored: the southern neighbor with a low rockery and the northern neighbor with a concrete vertical bulkhead that terminates in a short groin. Overtopping of the bulkhead by waves occurs during winter storms, and sediments behind the bulkhead are eroding. Conversely, sediments are accumulating at the beach's north end next to the neighbor's groin, as a result of the northerly drift direction.

The distance from the shore to the house slopes gently. The house is located about 66 feet from the bulkhead face and the septic system is about 45 feet from the existing ordinary high water. The geology of the site is dominated by advance outwash deposits consisting of interbedded layers of sand and silty sand. This outwash material is susceptible to erosion by wave action (Cousins et al. 2017). The area is also mapped as unstable by the Coastal Zone Atlas of Washington for Kitsap County (Washington Department of Ecology, 1979).

The homeowner initially contacted the Shore Friendly Kitsap Program, and received a geological site erosion assessment and recommendations from their contracted coastal geologist. The cross-over between programs, put the interested homeowner in contact with the Kitsap Regional Shoreline Restoration Program. The Program supported the geotechnical report and design for a bulkhead removal and shoreline restoration. The homeowner actively managed his own project and took responsibility for ensuring that all the necessary pieces came together, including the septic design, property survey, geotechnical report and design. The homeowner hired Coastal Geologic Services, Inc. to complete the restoration design. The design costs were $6996.

Design

The project objectives were to:

- To reconnect upland sediment sources to the nearshore by removing all or some degree of hard armoring at the shoreline, thereby reestablishing sediment transport processes
- To demonstrate how restoration can occur on private property through complete armor removal or through a combination of softer alternatives for shore protection

In working with the homeowner to produce the design, Coastal Geologic Services addressed their specific desires:

- To have a healthy, natural beach free of toxic materials
- To enhance nearshore habitat
- To uncover/increase upper beach habitat and backshore areas

- To restore cross-shore connectivity that will increase exchange of terrestrial and aquatic insects, invertebrates and organic material
- To more effectively protect from marine inundation and erosion than the current failed bulkhead is affording

The main elements of the design included:

- To remove approximately 95 feet of creosoted timber bulkhead and concrete stairs (entire length of parcel).
- To install a storm berm as alternative erosion protection. This berm will use on-site native sediment (50 CY) and imported beach nourishment (90 CY).
- A soft shore protection installation using imported large wood will be installed at the property corners upland of the OHWM. These logs will be buried (at minimum 1/3 of their cross-sections), anchored with ecology blocks and pinned with large boulders on the surface. Once piece of large wood will be placed at each property corner. The wood will be at least 24”in diameter and 20 feet long in size.
- The backshore area will be planted with native dune grass and riparian plants.

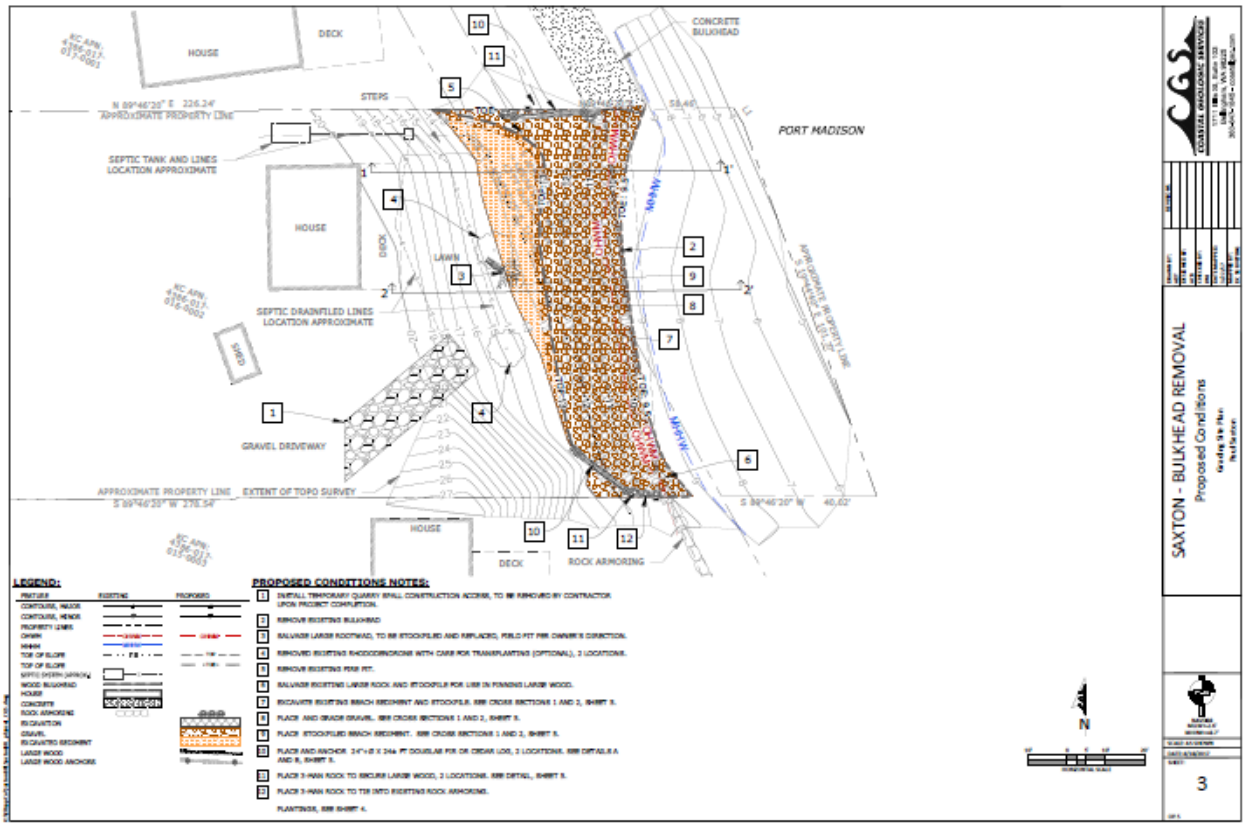


FIGURE 12. SITE PLAN SHOWING PROPOSED CONDITIONS WITH BULKHEAD REMOVED AND INSTALLATION OF STORM BERM AND LARGE WOOD SOFT SHORE PROTECTION.

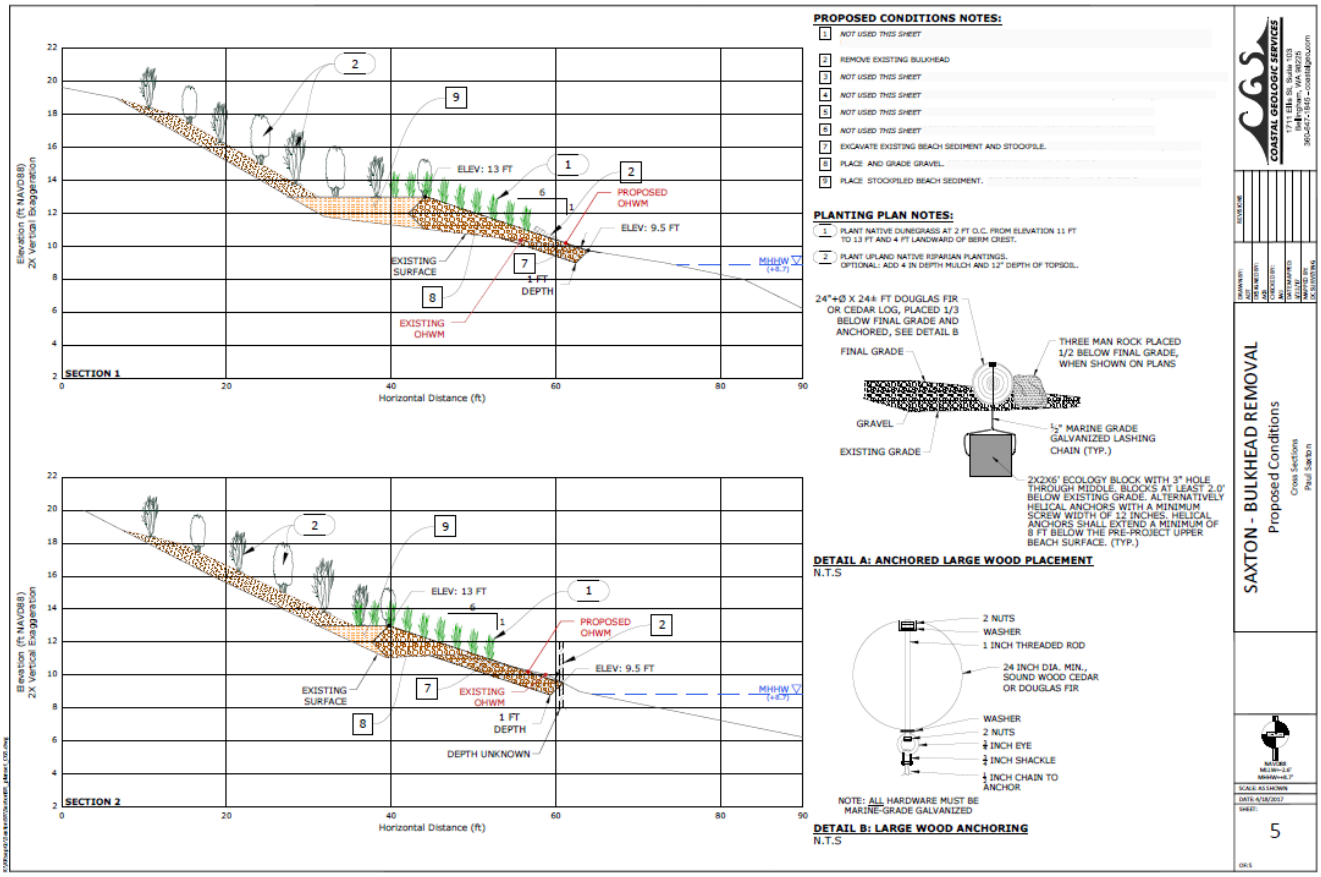


FIGURE 13. PROPOSED CONDITIONS SHOWING CROSS SECTIONS

3.0 LESSONS LEARNED

Since this program took place over many years, it gave us a larger window of time to reflect on how the program was working, as well as the opportunity to 'adaptively manage'. Small program changes were made in response to the lessons we learned along the way. The list below summarizes the most significant takeaways.

Public outreach challenges

The Program faced some challenges in sustaining its outreach message to the public about potential financial and technical opportunities for landowners considering bulkhead removal projects. Using the approach of workshops and websites it was difficult to maintain interest from public. For both the public educational workshop and demonstration restoration tour we did not have the highest turnout (both under 30 people). Using the post card mailing to encourage people to respond to an online survey worked, however to get people to take the next step and build off their interest we found it more effective to offer a personalized site visit to their property (instead of a general workshop). From a total of eight site visits, we had four very interested candidates who considered moving forward with a private restoration project. In hindsight it is clear that to sustain the educational and programmatic message, the program needed to have more consistent exposure. For future efforts we would recommend a pointed outreach strategy with a well-crafted message, and various tactics for advertising (like Shore Friendly employs).

Coordinating with other agencies and utilizing their expertise is critical.

It can be highly beneficial to coordinate with other agencies for the sake of streamlining permitting, and to leverage other existing programs for more effective implementation of restoration projects. For example, by meeting with Washington Department of Fish and Wildlife (WDFW) in early project stages, suggestions were given on effective restoration practices and those marine shoreline design guidelines (MSDG) most appropriate for the site. The project was also given input on how its design could meet the Hydraulic Code and restoration criteria, which helped to later avoid potential permitting difficulties. It also became clear that when there is opportunity to coordinate with other agency programs, like Washington's Department of Natural Resources (WDNR), *Marine Debris and Creosote Removal Program*, it can be a great cost-savings and mutually benefit both parties. At the Anna Smith Park project site, one year after removal as natural erosion processes were establishing, we noticed relic wooden bulkhead supports becoming exposed on the beach. We coordinated with WDNR to remove this wood debris through their program, which resulted in a better overall project and more likely positive outcomes. Also, during one of the private homeowner projects, we leveraged the WDNR's creosote removal program. The private homeowner's project was adjacent to a WDNR Shorelands property that had a non-functioning, creosoted timber bulkhead and it was logical to take advantage of construction machinery while working next door. As such, the relic WDNR bulkhead was removed by Kitsap County's contractor, and WDNR reimbursed County though the creosote removal program.

More incentives are needed to help neighbors work together on armor removal projects that span properties and include larger portions of reaches and drift cells.

The Program found that for homeowners, working together on larger bulkhead removal projects that span multiple adjacent properties, continues to present difficulties and barriers. It is a real challenge for homeowners to coordinate effectively when they may share different share visions for their beach, as well as other

disparities. Differences in stewardship ethic, financial resources or desire can hinder cooperation. The Program experienced these difficulties when one motivated homeowner tried to coordinate the removal of a common bulkhead shared with her neighbors without success. Some ideas brainstormed to encourage coordination and cooperation include: increasing financial incentives through grant programs scaled according to numbers of homeowners working across property lines and length of reach restored, making technical resources (more so for groups) and coordination assistance available from non-regulatory and neutral points of contact, like WSU Kitsap Watershed Stewardship group. The Program had some feedback that the County was perceived as not to be trusted; neutral points of contact can help to dispel distrust of regulatory agencies, and potentially build more open lines of communication.

Educating homeowner's expectations for project outcomes.

By working with homeowners from the beginning to the end of a bulkhead removal project, we learned that it is very important to educate the homeowner on what to expect immediately after removal. The first couple of years after a bulkhead removal project has been constructed, the shoreline can experience more bank erosion because sediment materials that had been retained for so long now have the ability to move. Often, immediately after removal the shoreline experiences a large pulse(s) of erosion, and then these erosion processes moderate as they reach a more natural regime. Through discussion and using examples of previous projects it's important to be transparent that the beach may look messy during the first years, and to emphasize that restoration's goal is not a landscaped product but a natural, functioning beach. It is also important to help the homeowner see that there is a degree of uncertainty even in the experts' predictions (of coastal geomorphologists and geologists) for erosion rates post-project. A homeowner should take time to reflect on how much erosion or bank loss (and beach gain) would be acceptable to them, and relay their concerns to the expert for further considerations.

Pragmatic takeaways from implementing bulkhead removal techniques.

After constructing three bulkhead removal projects, all somewhat different in beach conditions and project needs we learned some obvious lessons. Using design techniques that are simpler are often more effective. For example, if a built structure (like a large wood soft shore protection structure) is truly not needed it is better to avoid this costly measure. Another lesson learned was to postpone major plantings until after the first year, after the initial large pulses of sediments and erosion events to avoid losing plants to erosion. Alternatively, planting could be considered in stages: immediately after bulkhead removal, areas with low probabilities of erosion could be planted along with areas that required plants for immediate erosion control, and then the following year the remaining areas could be assessed to see if they were stable enough to plant. This way losing plants and project investment can be avoided.

Empowering homeowners to take the stewardship lead.

Despite some homeowners having the common goal of wanting to participate in the restoration of their own private beaches, they may not all have the similar capacity to 'do' these projects. In working with four sets of different homeowner (of four different properties) we found their capacity with respect to restoration knowledge, contracting savviness and financial resources to all differ, and thus so did their needs. We worked with one homeowner in particular who said they didn't think they would have been able to get their project done without the guidance of the Program. On the other hand, we also worked with two homeowners who had

the ability to act as their own project manager, and hire the necessary consultants and direct their work to complete final designs for their bulkhead removal projects.

In an effort to be more efficient with the Program budget and to piggy-back off success from the coinciding *Shore Friendly Kitsap Program*, we tweaked the Program model for the last two participating projects to have the homeowner take the project lead. This meant the homeowner acted as the project manager and the County Program provided a financial reimbursement, and adequate guidance to support homeowners' private bulkhead removal or soft-shore projects. In general, we found that the two designs solicited by the homeowners themselves cost less than the two designs procured by the County. It was also evident that despite the difficulties homeowners faced, that being their own project manager was effective at cultivating project ownership and pride. This model also has potential to be more sustainable in the long-term for the County.

4.0 LONG-TERM OUTCOMES FOR THE NEARSHORE

Through the use of Table 4 below, a discussion is presented that examines the outcomes realized at the end of this grant in relation to anticipated outcomes as stated in the logic model of the original proposal. Also, discussed are long-term outcomes that are needed, as well as those currently being worked on, to achieve a healthier functioning nearshore: a strategic direction of restoration and protection efforts for nearshore habitat and an engaged community that is able to participate in private restoration opportunities (when willing). The discussion of long-term outcomes pulls in a broader perspective, and speaks to how this Shoreline Restoration Program funded by the EPA has built a foundation for many other important grants/programs sponsored by Kitsap County. For example, this EPA grant has helped to spur or played a part in the *Nearshore Permitting Effectiveness through Trouble Shooting, Action Planning, Course Correction and Tracking and Monitoring* (TACT), *Shore Friendly Kitsap*, and *West Sound Nearshore Integration and Synthesis of Chinook Salmon Recovery Priorities* grant projects.

TABLE 4. REALIZED AND LONG-TERM OUTCOMES FOR THE NEARSHORE.

Anticipated Outcomes for End of Grant	Realized Outcomes at End of Grant	Achieving Long-Term Outcomes (What still needs to be done)
Increased regional understanding of impacts of bulkheads on Puget Sound Shorelines and restoration priority schemes.	**Regional understanding of impacts of bulkheads on shorelines increased.** Community outreach was done through various methods and on varying scales: The program connected to the public through workshops, online surveys, the program webpage, and homeowner site visits. **Regional understanding of priority areas for restoring sediment sources (feeder bluffs) increased.** The *Sediment Source Analysis* completed an inventory and characterization of sediment inputs (i.e. feeder bluffs) along County shorelines. It also identified and mapped the locations of priority reaches and drift cells for restoring and protecting sediment inputs. These mapped reaches are priority areas for potential armor removal and feeder bluff protection opportunities.	Lessons learned from this grant were used to build other successful grant programs: *Nearshore permitting Effectiveness through Trouble shooting, Action planning, Course correction and Tracking and Monitoring* (TACT) and *Shore Friendly Kitsap*. TACT focused on improving the effectiveness of local shoreline permitting and *Shore Friendly Kitsap* focuses on helping homeowners to be successful in executing their own shoreline restoration and bulkhead removal projects by providing incentives. **The need still exists to find sustainable ways to institutionalize assistance to homeowners who wish to participate in armor removal projects. There is also the need to find secure funding sources for priority armor removal projects on both public and private lands.**

Anticipated Outcomes for End of Grant	Realized Outcomes at End of Grant	Achieving Long-Term Outcomes (What still needs to be done)
Increased understanding of where areas that provide the maximum environmental benefits are located.	**The Sediment Source Analysis filled a major data gap regarding Kitsap County feeder bluffs.** The *Sediment Source Analysis* was one of the first assessments for Kitsap County shorelines to specifically consider the nearshore process of sediment supply/inputs to beaches. The study quantified and characterized important areas for protection and restoration on varying scales. This study provides a general road map to direct restoration or protection actions that result in greater environmental benefits.	Data from the *Sediment Source Analysis* was integrated in a separate, larger effort to identify all nearshore restoration and protection project opportunities (public and private) on a parcel scale (including armor removal), and develop a prioritization framework to score and rank projects for benefits to juvenile Chinook salmon for eastern Kitsap County shorelines. (This project, the *"West Sound Nearshore Integration and Synthesis of Chinook Salmon Recovery Priorities*") was funded by the Salmon Recovery Funding Board). This comprehensive framework compared all nearshore project types (i.e. armor removal projects versus culvert removal/modification). Continuing to use the sediment source data shows the very important crosswalk between different grant programs, and how one study integrated information from another to take our understanding of regional priorities a step further. **Next steps are to continue this type of prioritization effort and integrate the sediment source data for the western portion of Kitsap County (i.e. Hood Canal shorelines). The West Sound Watersheds Lead Entity Four year work plan should be updated to include high priority armor removal project opportunities. The next update of the Shoreline Master Program in 2020 should also incorporate high priority armor removal projects in its Restoration Plan, which have been identified by nearshore prioritization efforts (that have utilized the sediment source data).**

Anticipated Outcomes for End of Grant	Realized Outcomes at End of Grant	Achieving Long-Term Outcomes (What still needs to be done)
Increased understanding among staff and volunteers of effective ways to garner support of homeowners.	**The Program learned that an effective way to garner homeowner support was to provide very personalized attention.** We shifted away from larger workshops and supported homeowners' needs with site visits, phone calls, technical assistance which more actively engaged homeowners.	Through the *Shore Friendly Kitsap Program*, the County and partners (Washington State University Extension and Washington Sea Grant) are continuing outreach to homeowners to garner their voluntary support and interest for armor removal. *Shore Friendly Kitsap Program* continues to learn new things about gaining homeowner support, like using social marketing messaging and using multiple outlets to advertise this message. **The need continues to exist to sustain public outreach and find ways to institutionalize support for private armor removal beyond grant end dates (for example, just as the Kitsap Conservation District has an established Raingarden Program).**
Increased understanding among shoreline homeowners of how to be a better steward of their shore property (and minimize their environmental impacts).	It is difficult to gauge if there is an increased understanding among shoreline homeowners of better stewardship. **The program worked closely with four sets of homeowners on bulkhead removal projects on four private properties**. Through the process these homeowners were given materials and information on how to minimize their environmental impacts, participated in discussions with the County project manager, consulting geologists and engineers on best management practices.	**The need continues to exist to sustain public outreach and education for best management and stewardship practices on shoreline properties beyond grant end dates.** *The Shore Friendly Kitsap Program* has continued outreach with a webpage, informational brochures and planting guides (this grant ends in fall 2018).
Increased understanding among staff of how to effectively to manage successful restoration projects.	**Staff managed the design and construction of one public bulkhead removal project and two homeowner bulkhead removal projects.** This experience helped to strengthen County relationships across particular agencies like WDFW, WDNR; provided more insight into barriers or inefficiencies with respect to local permitting; provided more insight into homeowners' needs for completing their own restoration projects.	Next steps are to continue streamlining of local shoreline permitting for restoration permits by improving coordination within the Department and providing permitting assistance to homeowners (through *Shore Friendly Kitsap Program).* **The need exists to a secure long-term funding mechanism to support incentives, such as permitting assistance to homeowners.**

Anticipated Outcomes for End of Grant	Realized Outcomes at End of Grant	Achieving Long-Term Outcomes (What still needs to be done)
Enhanced functionality of nearshore processes at the site and drift cell scale.	**Through this Program, a total of 1236 linear feet of hard armor was permanently removed (rock and creosoted timber), resulting in 1236 feet of naturalized beach.** These restoration actions positively impacted 2 restoration reaches and 2 priority drift cells. Qualitative monitoring shows indicators of the sediment input and transport processes and functions returning to the beaches, such as increased upper beach/intertidal area, increased erosion events, increase of large wood.	To continue enhancing the functionality of nearshore processes, bulkhead removal projects on private and public shores need continuous support. **An incentive system that specifically encourages restoration work in priority areas and/or encourages neighboring homeowners to work together to restore larger portions of drift cells is needed.** (The nearshore prioritization framework now provides the rationale to support higher priority projects when landowner willingness is present.)

5.0 CONCLUSIONS

The **Kitsap Regional Shoreline Restoration Program** began seven years ago, and is now seen as the critical foundation for a robust suite of programs that Kitsap County, and the region, are using to improve the health of Puget Sound shorelines. Regionally, Kitsap County is viewed as one of the leaders making on-the-ground headway towards improvement in the Puget Sound Partnership Shoreline Armoring Vital Sign target (i.e. a net reduction in the amount of shoreline armor).

The Sediment Source Analysis work (a key deliverable of this grant), not only informed project development for this program, but has since been utilized by public and private entities for prioritizing projects for salmon recovery, forage fish, and of course nearshore processes improvements. This work has been integrated into larger recovery efforts, including recent County efforts to prioritize nearshore restoration and protection opportunities on a parcel scale (called the *West Sound Nearshore Integration and Synthesis of Chinook Salmon Recovery Priorities* project).

Working with homeowners for this EPA-funded Program, County staff quickly recognized gaps in both homeowner education and willingness, but also in the local permit process itself for these restoration projects. These lessons drove the County to seek and receive funding for a program to identify and correct internal permitting barriers to bulkhead removal (TACT), which have led to state-wide discussions and changes. The success and lessons also poised the County to become a pilot for the state's *Shore Friendly Program*, which takes a social marketing approach to assisting private homeowners with bulkhead removal efforts, similar to early programs used to encourage recycling.

Small, steady successes implementing bulkhead removal projects on private shores (through this Program and *Shore Friendly Kitsap*) have shown the West Central Local Integrating Organization (LIO), of which Kitsap County is a part of, that there is a willingness by homeowners to be environmental stewards of their properties. Homeowners have a real desire to "do" shoreline restoration on their private properties, and there is a need for financial support. One bulkhead removal project on a small parcel may have a relatively small ecological lift, however the cumulative impacts of numerous small restoration projects can have positive effects on the Puget

Sound region as a whole. These successes have given the LIO confidence to continue support to Kitsap County programs for assisting armor removal on private properties through allocation of EPA's National Estuary Program funds (via the Puget Sound Partnership). Supporting these restoration actions is also directly aligned with the West Central's Ecosystem Recovery Plan's Near-term Action (NTA) for reducing shoreline armor.

Puget Sound Partnership's (PSP) strategic initiative teams are using lessons learned from local experience to craft a comprehensive implementation strategy to accelerate progress towards the Puget Sound Shoreline Armoring Vital Sign target. As a result of experience gained through the **Kitsap Regional Shoreline Restoration Program** and implementing nearshore restoration projects, Kitsap County is now poised to play an important role within these regional strategies, and to continue the hard work to institutionalize programs that support homeowners in their nearshore restoration actions.

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7.0 APPENDIX

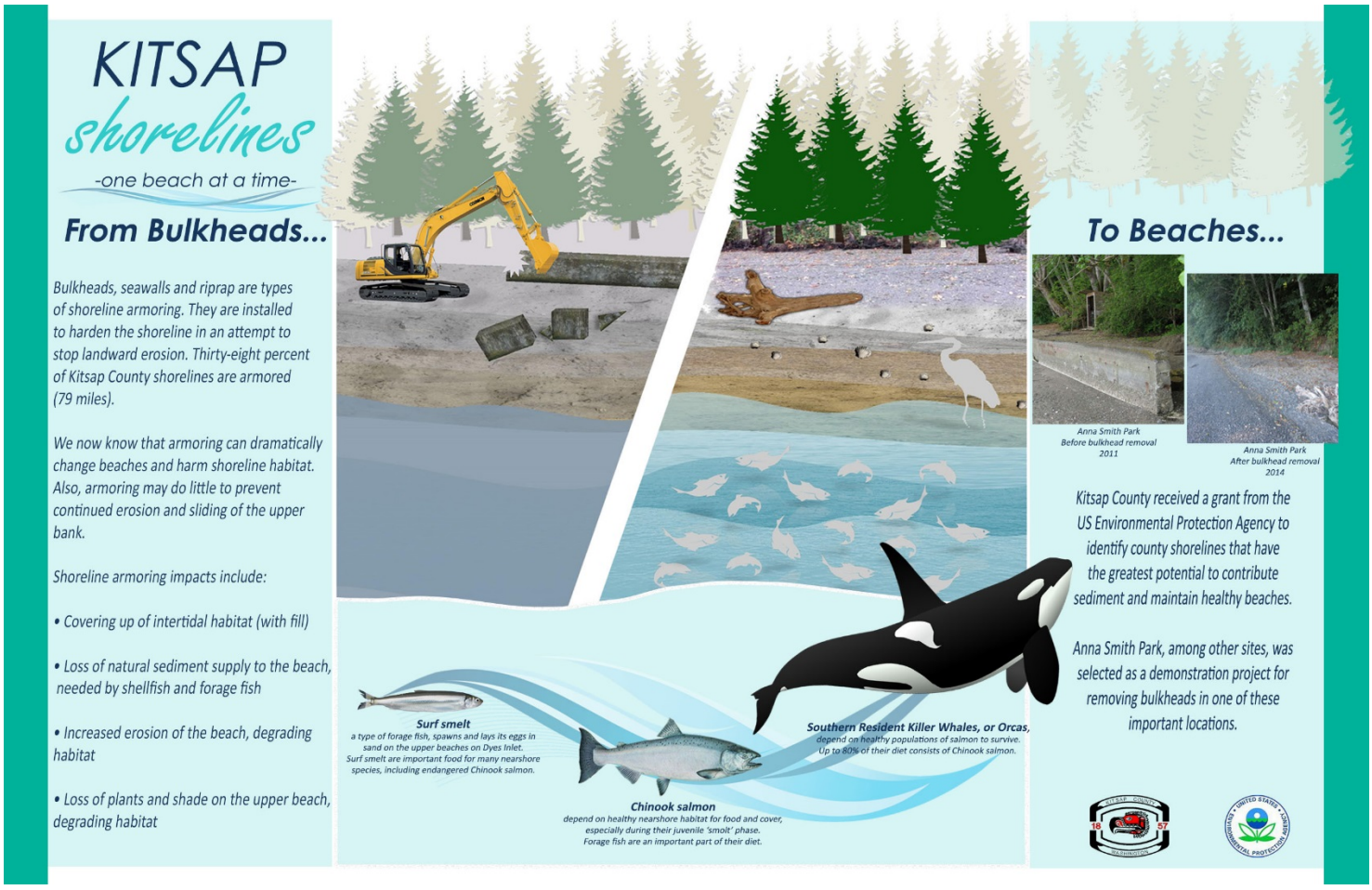

FIGURE 14. INTERPRETIVE SIGN DESIGN FOR ANNA SMITH PARK RESTORATION