

Residential Shoreline Loan Program Feasibility Study: Developing a New Shore Friendly Incentive to Help Puget Sound Homeowners Finance Beach Restoration and Sea Level Rise Adaptation



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EXECUTIVE SUMMARY

Several regional recovery plans and strategies seek to accelerate the removal of unnecessary hard armor from Puget Sound marine shorelines. The Shore Friendly program supports this priority by offering technical assistance and financial incentives to encourage voluntary armor removal projects on residential parcels. Since 2014, local Shore Friendly programs have engaged with hundreds of waterfront homeowners and facilitated restoration of roughly 4,000 linear feet of critical beach habitat. However, existing financial incentives are not sufficient to address the cost barrier associated with expensive marine construction projects. The 2018 Shoreline Armoring Implementation Strategy identified development of new financial incentives as a near-term priority. This feasibility study is a response to that recommendation. Establishment of a revolving loan fund to provide low-cost financing has been suggested as a promising incentive approach since Shore Friendly was first developed.

At the same time, homeowners are growing more concerned about hazards associated with climate change and resource managers recognize the extent to which sea level rise is expected to exacerbate the negative impacts of existing shoreline armor on Puget Sound beaches and the species dependent on them. Therefore, this feasibility study also explores raising homes to reduce coastal flooding risk and moving homes away from retreating bluffs as target activities that could be financed through a residential shoreline loan program.

This report assesses the feasibility of developing a Shore Friendly residential shoreline loan program and includes the following elements:

- An overview of research related to shoreline armoring and projected impacts of sea level rise in the Puget Sound region.
- Technical analyses to estimate market size, potential demand, expected project costs, and the amount of funding needed to establish a self-sustaining revolving loan fund.
- A review of model programs to inform design of a loan program.
- An evaluation of potential sources of seed money for a loan fund.
- A compilation of partner input and key considerations regarding program administration, including potential state/local partners and project eligibility criteria.

These assessments demonstrate that a loan program is a viable mechanism to advance residential shoreline projects and improve ecological outcomes. Since revolving loan funds are replenished as loans are repaid, a relatively low initial investment can have a large impact. Financial modeling indicates that \$4.5 million in seed money could fund \$9.7 million in projects over the first 15 years of a loan program. Seed money could be added over several years; \$600,000 should be enough to cover program start-up costs and initial fund capitalization in year one. Existing institutional authorities and expertise, as well as established local Shore Friendly programs, can be leveraged to administer a loan program.

Market, Cost, and Financial Analyses

The project team conducted three technical analyses to determine how much seed funding would be needed to make a Puget Sound residential shoreline revolving loan fund viable. Results of the market analysis indicate that there is demand for 6 to 8 loans per year over a 15-year analysis period. We expect demand to increase in the future as extreme high-water events become more frequent. Financial model simulations predicted annual loan disbursements ranging from \$396,000 to \$791,000. A total of \$4.5 million in capitalization funding would meet this demand and result in a self-sustaining (i.e., able to continue funding projects without addition of more capital) revolving fund after nine years. Methods are summarized below.

The project team developed 10 project scenarios to structure the technical analyses. Each scenario consists of a different combination of the 4 target activities: armor removal, soft shore protection, home elevation, and home relocation. We created these scenarios because one activity or a combination of activities may be suitable for a waterfront property depending on parcel characteristics and homeowner objectives. Since there are fixed costs associated with implementation (e.g., design, permitting, equipment mobilization), summing the cost of individual activities is not an accurate way to estimate the total cost of a project involving more than one activity.

The market analysis resulted in estimates of (1) the number of parcels where target activities could be appropriate and (2) the expected demand for loans to finance projects involving likely combinations of those activities. Market size was estimated using geospatial datasets created in 2014 during development of the Shore Friendly social marketing strategy and the Estuary and Salmon Restoration Program's recently updated Beach Strategies Geodatabase. The project team calculated the number of parcels that shared specific combinations of four physical characteristics: presence of a home, armor status, erosion potential, and shoretype (used as a proxy for potential hazard exposure), then assigned project scenarios to each group. A total of 21,953 parcels (62% of all residential parcels) were associated with a project scenario. Demand for loans was predicted by adjusting the market size estimates using results of surveys and focus groups conducted in 2013 during development of the Shore Friendly social marketing strategy. That market research data provided information about waterfront landowner interest in the target activities and in using loans to finance projects.

For the cost analysis, the project team compiled and analyzed cost data for the four target activities. Design, permitting, and construction costs for 46 projects constructed in ten Puget Sound counties between 2009 and 2019 was aggregated to provide low, average, and high values for each project scenario. All costs were adjusted to 2019 dollars using a Civil Works Construction Cost Index System method that also allowed inflation of future project costs, which is important because our financial analysis extends through 2035.

The financial analysis used results of the market analysis (number and mix of projects) and the cost analysis (size of loans needed to finance those projects) as inputs to a financial model that determined how much seed money would be needed to establish a revolving fund.

Three capitalization schedules were simulated in the model; the longer schedules would limit the number and/or value of loan disbursements in the fund's early years.

Model Loan Programs

The project team assessed six model loan programs in four states to develop recommendations for the structure of a Shore Friendly loan program. Program administration is envisioned to be similar to Washington's on-site sewage system replacement loan program. In this model, a lead state agency applies for funding, develops eligibility requirements and prioritization criteria, and oversees a contract with a financial institution to manage the fund and service the loans. Another state agency provides technical assistance, and local jurisdictions can opt-in to the program under a memorandum of understanding with the lead agency.

Potential Funding Sources

The project team evaluated multiple funding options to identify promising sources of seed money. A Shore Friendly loan program that incorporates home elevation and relocation activities would not be a straightforward match for any single existing source of grant funding. Common barriers to funding/financing climate adaptation—including narrow goals of many funding programs, bias towards planning large discrete projects on public land, and restrictive timing requirements—are likely when seeking grant funding for this proposal. Establishing the program with an initial focus on armor removal may make it more competitive for habitat-related grant funding that could be used to support program start-up and initial capitalization. Then, once demand for loans and interest in projects involving moving homes is firmly established, additional funding could be sought from other types of grant programs (e.g., hazard mitigation, community development, housing rehabilitation).

Options for non-grant funding are likely to evolve rapidly in the coming years. Two bills passed in the last Congress involved providing states with capitalization grants to create revolving loan funds for nature-based shore protection or hazard mitigation. Washington's Legislature created a Climate Resiliency Account via budget proviso in 2020, and funding may be provided after pandemic-related fiscal challenges end.

Next Steps

This feasibility report ends with an outline of the steps needed to develop a Shore Friendly loan program; description of options for its administration; and summary of partner input received on potential project eligibility criteria. The next step is to identify a state agency champion willing to either dedicate existing staff time, or apply for grants to hire a temporary position, to secure funding and engage potential partners to develop program guidelines. Ideally, this same entity will ultimately administer a loan program and establish a program manager position (0.5 - 0.75 FTE). Criteria are proposed for evaluating potential roles for lead and supporting agencies, and a qualitative evaluation of potential partners is provided.

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[Appendix 3. Cost Analysis Memo](#)

[Appendix 4. Financial Analysis Memo](#)

ACRONYMS AND ABBREVIATIONS

BFE	Base Flood Elevation
CD	Conservation District
CGS	Coastal Geologic Services
CDFI	Community Development Financial Institution
CFR	Code of Federal Regulations
Commerce	Washington State Department of Commerce
CWSRF	Clean Water State Revolving Fund
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
ESRP	Estuary and Salmon Restoration Program
FCZD	Flood Control Zone Districts
FEMA	Federal Emergency Management Agency
GSH	Green Shores for Homes
HUD	U.S. Department of Housing and Urban Development
MHHW	Mean Higher High Water
MSDG	Marine Shoreline Design Guidelines
NE	Northern Economics
NEP	National Estuary Program
NFIP	National Flood Insurance Program
NFWF	National Fish and Wildlife Foundation
NOAA	National Oceanic and Atmospheric Administration
NTA	Near Term Action
PACE	Property Assessed Clean Energy
PACER	Property Assessed Clean Energy and Resilience
PSI	Puget Sound Institute
PSP	Puget Sound Partnership
RAE	Restore America's Estuaries
RCO	Washington State Recreation and Conservation Office

RCW	Revised Code of Washington
RFP	Request for Proposals
RLF	Revolving Loan Fund
SFHA	Special Flood Hazard Area
SLR	Sea Level Rise
SMA	Shoreline Management Act
SMP	Shoreline Master Program
UW	University of Washington
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOH	Washington Department of Health
WEMD	Washington Emergency Management Division
WSCC	Washington State Conservation Commission
WSG	Washington Sea Grant

1. INTRODUCTION

Puget Sound’s shores have experienced significant anthropogenic alterations since the 1850s and these changes in physical structure have contributed to subsequent declines in biological diversity and productivity (Fresh et al. 2011). Shoreline armoring, the practice of constructing rigid structures to stabilize shorelines and manage erosion, is the dominant stressor to Puget Sound beaches (Simenstad et al. 2011). The “hardening” of a shoreline with a seawall, bulkhead, or revetment disrupts the sediment delivery and transport processes needed to maintain Puget Sound beaches and increases reflected wave energy (Johannessen and MacLennan 2007, Shipman 2010). Armor impacts the nearshore food web by modifying inputs of terrestrial organic matter to the intertidal zone, reducing the abundance of invertebrate taxa, and burying or degrading priority habitat for beach-spawning forage fishes¹ (Penttila 2007, Dethier et al. 2016a).

Yet hard armor may not be the best way to manage erosion in many parts of Puget Sound (Johannessen et al. 2014). In sheltered areas with low to moderate erosion potential, armor is often not necessary to protect landward infrastructure. Likewise, armor is not effective at preventing landslides where runoff or poor vegetation management are contributing to bluff retreat (Johannessen and MacLennan 2007, Shipman 2010, Johannessen et al. 2014, Kaminsky et al. 2014). Many existing Puget Sound bulkheads, particularly those along residential properties, are overengineered for actual erosion risk (Johannessen et al. 2014).



Armor doesn’t always prevent landslides
Photo by Coastal Geologic Services

Several regional plans and strategies, including the Action Agenda for Puget Sound (Puget Sound Partnership 2018) and *gʷəḏadad* Tribal Habitat Strategy (Northwest Treaty Tribes 2018), seek to accelerate the removal of unnecessary hard armor. Shoreline Management Act and Hydraulic Code regulations likewise encourage removal of bank protection structures and identify non-structural measures, like increasing building setbacks and relocating buildings, as the most preferred the shoreline management approach.² When some type of stabilization is needed, “soft” shore protection techniques that utilize less rigid materials like sand, gravel, large wood, and native plants are considered a less damaging alternative to hard armor. Since the configuration and placement of shoreline structures can significantly affect their relative impacts, soft shore is preferred over hard armor because the use of natural materials and

¹ **Forage fishes** are “small, schooling fishes that form critical links between the marine zooplankton community and larger predatory fish and wildlife in a marine food web” (Penttila 2007).

² [WAC 173-26-231\(3\)\(a\)\(ii\)](#) and [WAC 220-660-370\(3\)\(b\)](#)

capacity to adjust over time minimizes relative impacts to physical and ecological processes (Williams and Thom 2001, Coyle and Dethier 2010, Dethier et al. 2016b).

Puget Sound National Estuary Program (NEP) partners have utilized a variety of approaches to protect and restore Puget Sound beaches (Kinney et al. 2016, Habitat Strategic Initiative 2018, Kinney and Francis 2019). In addition to funding large-scale armor removal projects on public lands, NEP partners recognized that there was an opportunity to accelerate the softening of Puget Sound shores with small projects adjacent to single-family homes. Residential parcels comprise roughly 57% of the Puget Sound shoreline and almost 50% of them are armored (Colehour + Cohen et al. 2014a). A significant number of those structures have been in place for decades and are losing their structural integrity (Johannessen et al. 2014). This trend is reflected in permit data, which show repair and replacement of existing shoreline armor to be the most common types of armor project in the region. Between 2011 and 2018, 15 miles of shoreline armor was replaced in Puget Sound (WDFW 2019).

The period of time when a homeowner is considering what to do about a deteriorating bulkhead is a window when they can be encouraged to remove damaging structures and implement less harmful shoreline management measures. The cumulative benefits of such actions are particularly meaningful when certain types of structures and key geographic areas are prioritized. Some older bulkheads installed before implementation of modern environmental laws were constructed below ordinary high water and resulted in substantial loss of upper beach area and function (Carmen et al. 2010). The removal or relocation of structures that encroach on lower beach elevations (as shown below), as well as removal of bulkheads that impound sediments along feeder bluffs (see box on next page), are high priority actions for restoration of beaches in the region (Dethier et al. 2016b).



Armor placed below ordinary high water
Photo by Windermere Real Estate

A **feeder bluff** is an “eroding coastal bluff that delivers a significant amount of sediment to the beach over an extended period of time and contributes to the local littoral sediment budget” (Shipman et al. 2014). Due to widespread armoring for erosion control, the current extent of feeder bluffs in Puget Sound is significantly reduced from historical levels (Simenstad et al. 2011). The resulting reduction in sediment supply has implications for long-term maintenance of beach ecosystems (Fresh et al. 2011, Shipman et al. 2014).



Photo by Hugh Shipman



Photo by Department of Ecology

In 2012 the Puget Sound Marine and Nearshore Lead Organization, a partnership between the Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Natural Resources (WDNR) funded by the Environmental Protection Agency (EPA), recognized this opportunity and supported the development of a social marketing³ strategy focused on residential armoring behaviors. This innovative effort used the systematic framework provided by social marketing to define target behaviors and audiences; conduct surveys and focus groups to identify barriers and motivators for engaging the in the target behaviors; develop a portfolio of incentives to overcome those barriers; and design audience-tested messages and graphics. The resulting [Shore Friendly](#) strategy created by Colehour + Cohen et al. (2014 a-e) focused on encouraging homeowners to either remove armor and/or choose alternatives to armor.

Beginning in 2014, Shore Friendly campaigns were piloted by five local partners with grant funding from the Marine and Nearshore Lead Organization. By 2018 these local programs had engaged with more than 700 homeowners; provided individualized erosion assessments for 284 properties; provided assistance with engineering design and permitting for 23 projects; and supplied mini grants for 49 projects (Kinney and Francis 2019). These early successes led to the

³ **Social marketing** applies traditional marketing principles to influence behavior change in target audiences. It is a rigorous, evidence-based approach that has been used for decades to improve public health. Social marketing differs from traditional community outreach and education programs in that it focuses on identifying and addressing specific barriers to action (PSP 2015).

inclusion of homeowner incentives as a major element in a formal regional recovery plan, the [Shoreline Armoring Implementation Strategy](#) (Habitat Strategic Initiative 2018).⁴ In 2019, the Washington State Legislature appropriated funding from the state capital budget to the Estuary and Salmon Restoration Program (ESRP) at WDFW to provide continued financial support for existing Shore Friendly programs and to expand the program to all Puget Sound counties.

A major lesson from the Shore Friendly pilots was that financial incentives are crucial for getting projects completed (Kinney 2018, Habitat Strategic Initiative 2018, Kinney and Francis 2019). Local programs identified several property owners willing to consider removal of failing bulkheads but were unable or unwilling to pay for all necessary project elements (engineering design, permitting, and construction) out of pocket. This was anticipated by Colehour + Cohen (2014e), who identified project cost as a determining variable for armor removal. It is now clear that existing financial incentives are not sufficient to meet demand and additional financial assistance will be critical to increase the number of completed armor removal projects.

Developing new options to provide financial support for incentive programs was identified as a near-term priority in the Shoreline Armoring Implementation Strategy. Low-cost loans were a common recommendation for a new incentive, and creation of a revolving loan fund has been suggested as a mechanism to develop a sustainable loan program (Futurewise 2014, Colehour + Cohen 2014e, Faghin and von Reis Crooks 2015). This feasibility study builds upon almost a decade of previous work by NEP partners and is intended to help move these recommendations from idea to reality.

1.1 Revolving Loan Funds

A revolving loan fund (RLF) uses seed money to capitalize, or establish, a managed fund that is used to make loans. As shown in Figure 1, the fund is replenished as loans are repaid, resulting ongoing financing for new loans and program administration. RLFs are a common way to leverage public investment to promote larger private investments in public goods like water quality, energy efficiency, and community development. When publicly funded, this type of financing is generally more accessible and has more favorable terms for borrowers as compared to products offered by private lenders (Otts and Bowling 2013).

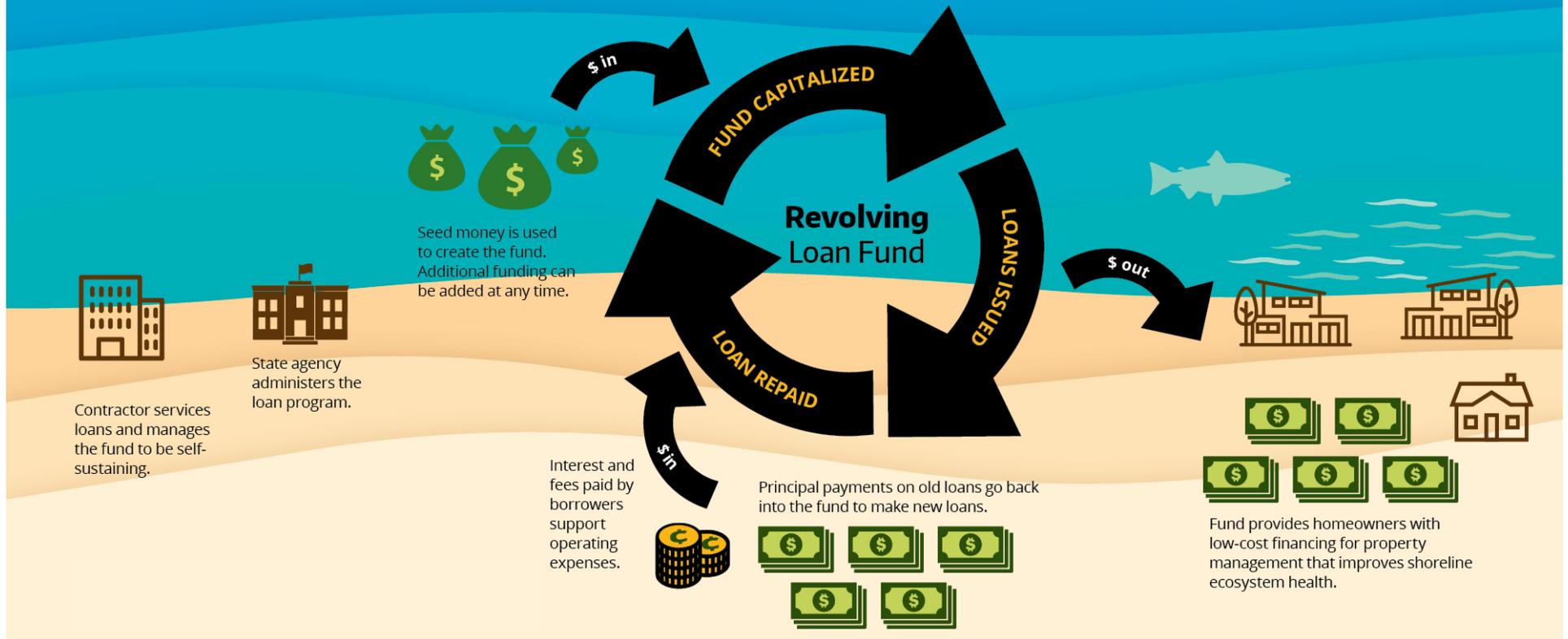
Section 3 of this report describes several existing revolving loan programs that provide a model for a residential shoreline loan program. For the remainder of this section, we discuss the types of activities that would be eligible for financing. In addition to armor removal and soft shore replacement activities, the project team has added climate change adaptation measures to the scope of this feasibility study.

⁴ The Habitat Strategic Initiative is the successor to the Marine and Nearshore Lead Organization. It is one of three [Strategic Initiative Lead Teams](#) created under EPA's Puget Sound NEP [funding model](#).

Figure 1. Revolving loan fund infographic

How a Revolving Loan Fund Works

A Revolving Loan Fund uses seed money from a grant or legislative appropriation to make loans for eligible projects. The fund is replenished as loans are repaid, which provides capital to finance new projects. The initial investment gets recycled again and again, becoming a long-term source of project funding.



Graphic design by John Linse, UW Creative Communications

1.2 Projected Impacts of Climate Change and Sea Level Rise

During early scoping for this study, regional partners that regularly interact with waterfront homeowners indicated that they were hearing growing concern about coastal flooding and bluff retreat hazards associated with climate change. These partners encouraged the project team to include adaptation measures like elevating and relocating homes landward as activities that could be financed by the proposed loan program.

This approach for accommodating higher water levels is strongly supported in the literature. The coastal effects chapter of the Fourth National Climate Assessment recognized that taking action to adapt to more frequent, widespread, and severe coastal flooding would significantly reduce cumulative damages to coastal properties and decrease cascading economic impacts for coastal communities (Fleming et al. 2018). There is wide recognition that investing in flood damage reduction provides economic and social benefits that exceed costs both in the near-term and over the long term (Lempert et al. 2018). Retrofitting buildings to mitigate flood risk results in more affordable flood insurance and reduced disaster recovery costs (French et al. 2017, Multihazard Mitigation Council 2017).

The many meanings of “mitigation”

In the context of emergency management, mitigation refers to actions taken to reduce or eliminate structural vulnerabilities and other risks associated with natural and other hazards. This usage is employed herein.

In the context of climate policy, mitigation refers to measures to reduce the amount and speed of future climate change by reducing emissions of heat-trapping gases or removing carbon dioxide from the atmosphere.

In the context of permitting programs, mitigation refers to measures taken to avoid, minimize, or compensate for adverse effects of a proposed action.

Related jargon used in this report defined

Adaption – Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.

Resilience – A capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.

Source: U.S. Global Change Research Program [Glossary](#)

“Absent strict, enforceable regulations mandating retrofitting of existing homes or major changes in homeowner insurance requirements, coastal resilience in a changing climate will largely reflect private, voluntary decisions of millions of individuals.” (Javeline and Kijewski-Correa 2019)

Yet, individual property owners are often uninformed about their vulnerability to flooding and the costly up-front investment required is beyond the means of many (Javeline and Kijewski-Correa 2019). Access to capital and insurance are thought to be key factors that influence property owner choices to modify their homes to withstand current and projected impacts (Fleming et al. 2018). Given climate change’s potential to disrupt mortgage and property markets, the creation of new products to finance installation of flood mitigation features has been encouraged (Berman 2019).

In the Puget Sound region, the impact of sea level rise (SLR) will first be experienced as episodic coastal flooding during extreme water level events—times when the height of sea surface is unusually high because high tides, storm surge, and/or wind-generated waves occur simultaneously (Miller et al. 2019). Even small increases in sea level can dramatically increase the frequency and severity of coastal flooding; areas already exposed to coastal flooding will be impacted more often, and new areas will be flooded (Vitousek et al. 2017).

Miller et al. (2019) provides the best available science on how the frequency of extreme water level events is expected to change in Washington as sea level rises. In Puget Sound, the extreme still water level⁵ with a 100-year return frequency (i.e., a 1% chance of exceedance in a given year) is currently 3.2 feet above mean higher high water (MHHW).⁶ With 1 foot of sea level rise, water levels are expected to reach that same elevation every 2 years (i.e., 50% annual chance the still water level will exceed this height).

The 100-year event is significant from a policy perspective because it represents the Federal Emergency Management Agency (FEMA) Base Flood Elevation (BFE). The relationship between the BFE and a building’s elevation determines flood insurance premiums, and floodplain management criteria pertaining to structural safety for flood damage reduction recommend elevating buildings to or above the BFE.⁷ The 100-year extreme still water height is expected to

⁵ The **still water level** includes the astronomical tide and storm surge, but not wave run-up. High wind events, which can generate waves in that push water up the shoreline, can lead to even higher water levels.

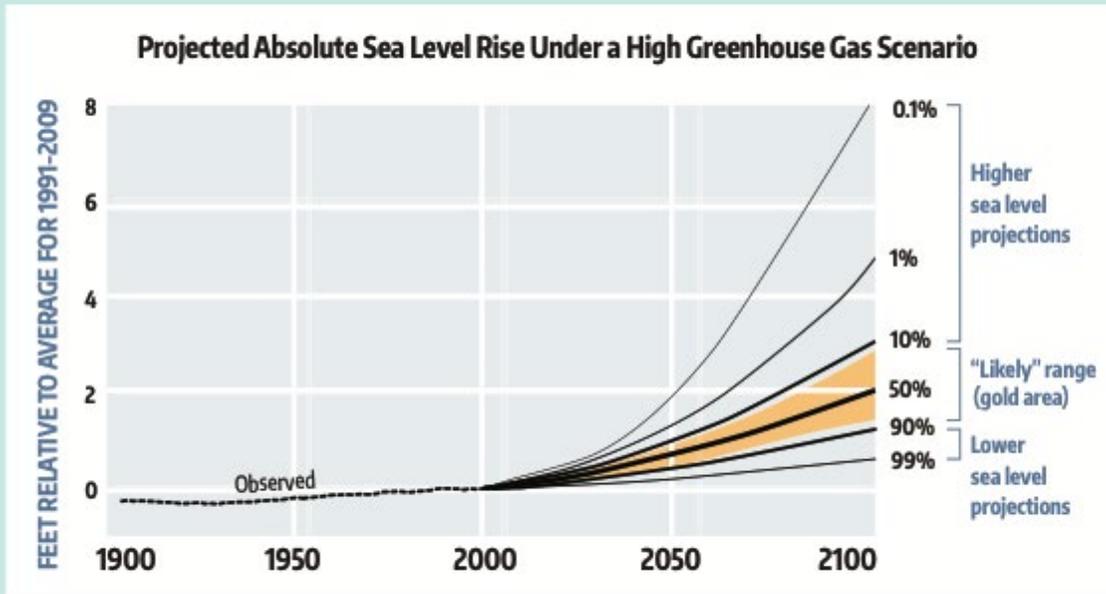
⁶ **Mean Higher High Water** is average of the higher high water height of each tidal day observed over a 19-year long National Tidal Datum Epoch determined by the National Ocean Service. Numerical values vary by location within Puget Sound, generally increasing to the south.

⁷ [44 CFR 60.3](#)

increase proportionally with changes in sea level; for example, in Puget Sound, one foot of SLR would increase the height of a 100-year event to 4.2 feet above MHHW and 10 feet of SLR would increase it to 13.2 feet (Miller et al. 2019).

When is one foot of sea level rise likely?

This figure from Miller et al. (2018) shows probabilistic sea level rise projections for Washington State through 2100. The percentages on the right show the likelihood that sea level will rise by at least the elevation shown on the left.

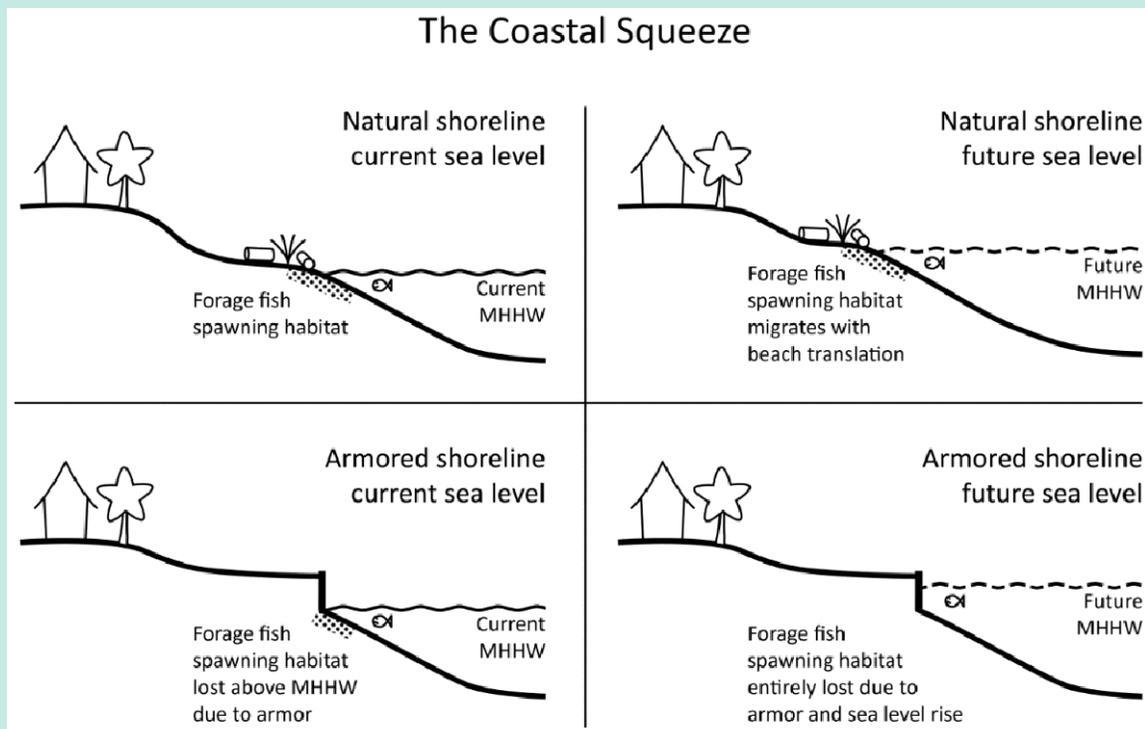


These absolute sea level rise projections do not include the impact of vertical land movement. An interactive sea level rise data visualization tool that provides locally specific projections accounting for geographic variability in vertical land movement can be accessed at: <https://cig.uw.edu/our-work/applied-research/wcrp/sea-level-rise-data-visualization/#dataviz1>

Climate change is also expected to accelerate the recession of Puget Sound coastal bluffs (Johannessen and MacLennan 2007, MacLennan et al. 2013, Shipman et al. 2014, Kaminsky et al. 2014). The crests of these bluffs migrate landward as the combined result of wave-induced undercutting (toe erosion); landslides associated with heavy precipitation; vegetation removal; and water additions from poorly designed drainage, lawn watering, and septic tank leach lines (Johannessen and MacLennan 2007). High water levels associated with SLR are anticipated to exacerbate toe erosion while predicted increases in the frequency and intensity of heavy rain events will likely trigger additional landslides (Mauger et al. 2015).

The proposed loan program aims to link implementation of climate adaptation measures and beach restoration via armor removal because the adverse impacts of conventional shore stabilization structures are expected to grow as sea level rises. Coastal squeeze (see box) will cause critical nearshore habitats to narrow or disappear where shoreline armoring blocks their landward migration. Unarmored beaches may also experience narrowing where stabilization of up-drift feeder bluffs has impounded the sediment needed to build beach profiles higher as water levels rise (Shipman et al. 2014). These impacts are likely to cause substantial loss of beach-spawning forage fish habitat (Krueger et al. 2010) and amplify wave run-up, resulting in a higher probability of damage to homes and associated structures (Johannessen and MacLennan 2007). This could motivate property owners to build new or more robust stabilization structures that end up exacerbating erosion and further accelerating beach loss (Shipman et al. 2014).

Coastal squeeze is “intertidal habitat loss caused when the high water mark is fixed by a defense and the low water mark migrates landward in response to sea level rise” (Pontee 2013).



Graphic by Coastal Geologic Services

The technical assistance provided by local Shore Friendly programs helps homeowners identify actions to protect their property in a way that minimizes damage to Puget Sound, but meaningful financial incentives are needed to encourage implementation. Expense is likely to be even more of a barrier for high-cost projects involving moving homes up and/or inland. We can expect future storms to act as catalytic events that accelerate adaptation (Lempert 2018). Homeowner motivation to reduce risk is high immediately after such incidents (French et al. 2017, Aerts et al. 2018), so ideally a program to finance projects is in place before coastal flooding becomes more common. Adding accessible low-cost loans to the Shore Friendly toolbox would reduce damage from natural hazards and deliver environmental benefits, improving the resilience of both human and ecological communities.



“Shoreline armoring is a classic example of an environmental problem involving cumulative impacts. Individual structures may have a relatively small effect on the sediment budget of an entire drift cell and their effects may take years to materialize. At the same time, the aggregate impact of many small structures can become significant, particularly over longer time frames.” (Shipman et al. 2014)

1.3 Activities Evaluated for this Feasibility Study

This study considers a loan program that would finance four target activities on Puget Sound waterfront residential properties:

- Removing shoreline armor
- Installing soft shore protection to replace a hard structure (where needed)⁸
- Elevating a home to protect from coastal flooding damage
- Relocating a home to another portion of its parcel to protect from bluff recession

Activities one and two broadly include several of the techniques described in the *Marine Shoreline Design Guidelines* or “MSDG” (Johannessen et al. 2014). Local [Shore Friendly](#) programs currently help residential property owners evaluate existing conditions, select a MSDG technique or techniques appropriate for their parcel, and assist with project implementation. What we refer to as soft shore protection may include one or more of the following MSDG techniques: beach nourishment, large wood, and reslope-revegetation.

Activities three and four, called relocation and vertical relocation in the MSDG, are hazard mitigation measures intended to reduce potential damage to homes from bluff retreat and coastal flooding while maintaining or restoring natural shoreline processes.

Administration is envisioned to be similar to Washington’s on-site sewage system replacement loan program (described in Section 3.1), where a state agency applies for funding, develops eligibility requirements and prioritization criteria, and oversees a contract with a financial institution to manage the fund and service the loans.

This feasibility study includes the following elements:

- Three technical analyses to gauge homeowner demand for target activities and capitalization needs for a viable revolving fund. They are a market analysis (how many and what mix of projects do we expect?), a cost analysis (how much will these projects cost?), and a financial analysis (how much seed funding is needed?).
- Descriptions of six model loan programs to inform the design of this new incentive.
- An evaluation of potential sources of funding needed to start a loan program.
- Considerations for program administration, including options for the state agency lead.
- Recommendations and next steps.

⁸ Although soft shore protection has less of an impact than hard armor, stabilizing an unmodified shore still has a net negative effect even if a nature-based technique is employed. Regional partners do not want to incentivize construction where no structures stabilization structures currently exist. Therefore, the project team has included soft shore protection as an eligible activity for the purposes of this study but, as explained in Section 2.1, our analysis limits this activity to projects where soft shore is needed after a hard structure is removed.

Armor removal



Photo by Coastal Geologic Services

Soft shore protection



Photo by Coastal Geologic Services

Home elevation



Photo by DB Davis LLC

Home relocation



Photo by DB Davis LLC

2. TECHNICAL ANALYSES

The project team conducted three analyses to determine how much seed funding would be needed to make a Puget Sound residential shoreline revolving loan fund viable.

1. A **market analysis** to estimate the number of parcels where eligible activities could be appropriate and the expected demand for loans to finance projects involving likely combinations of those activities.
2. A **cost analysis** to quantify the likely range of loan amounts based on the cost of local projects constructed over the past decade.
3. A **financial analysis** to simulate revolving fund performance over a 15-year period using a hypothetical loan portfolio derived from results of the market and cost analyses.

Ten **project scenarios** were developed to structure these analyses. We did this because one activity or a combination of activities may be suitable for a waterfront property depending on parcel characteristics and homeowner objectives. Since there are fixed costs associated with implementation (e.g., design, permitting, equipment mobilization), summing the cost of individual activities is not an accurate way to estimate the total cost of a project involving more than one activity.

The project scenarios are: remove armor; remove armor + install soft shore; remove armor + install soft shore + relocate home; remove armor + install soft shore + elevate home; remove armor + relocate home; remove armor + elevate home; install soft shore; install soft shore + relocate home; install soft shore + elevate home; and elevate home. On some properties, it may be appropriate to both relocate and elevate a home. This was not considered as another project scenario due to the cost efficiencies of taking both actions at the same time (i.e., we would not expect it to cost much more than only relocating a home).

The following sections summarize the market, cost, and financial analyses. The complete analyses are provided as technical appendices available at the links provided in the table of contents.

2.1 Market Analysis

The project team estimated the **market size** of each project scenario by querying existing geodatabases (CGS 2017, CGS 2020) to calculate the number of parcels with specific combinations of four physical characteristics: presence of a home, armor status, erosion potential, and shoretype. This analysis was based on the parcel segmentation developed by Colehour + Cohen (2014a) during development of the Shore Friendly social marketing strategy.

We built on the Shore Friendly segmentation framework by identifying shores potentially exposed to flooding and bluff retreat to link groups of parcels with project scenarios that include home elevation or relocation. This was done using shoretype as a proxy for hazard

exposure. Coastal flooding risk was associated with low elevation shoretypes (accretion shoreforms, inner lagoon, and estuarine embayment shores) and retreat risk with bluff shoretypes. This very coarse analysis was used because parcel-scale data on current and future hazards was not readily available. A Washington Sea Grant project ([NTA 2018-0685](#)) to assess Puget Sound land elevation data and rank sea level rise related hazard exposure which began in May 2020 will begin to fill this data gap.

Results are summarized in Table 1. Step-by-step descriptions of the methods employed, and more detailed results are provided in Appendix 1 and Appendix 2.

Table 1. Market size estimates for each project scenario

Project scenario	Activities	Number of parcels	Percent of residential parcels	Cumulative length (feet)
1	elevate	1,787	4%	361,985
2	relocate + soft	5,965	13%	954,756
3	soft	4,924	11%	1,041,098
4	soft + elevate	3,959	9%	680,230
5	remove + elevate	1,044	2%	151,552
6	remove	84	0.2%	14,013
7	remove + soft + relocate	4,324	10%	503,652
8	remove + soft	771	2%	144,225
9	remove + soft + elevate	4,420	10%	595,758
10	remove + relocate	675	2%	109,323
TOTAL		27,953	62%	863 miles

The next step was to estimate the **loan demand** for each project scenario. This was done by adjusting the market size estimates developed in Table 1 using market research data obtained during Shore Friendly program development. Results of an online/telephone survey (Colehour + Cohen et al. 2014b) and focus groups (Colehour + Cohen et al. 2014c) provided information about waterfront landowner interest in the target activities and in using loans to finance projects. Specific survey and focus group questions, and corresponding responses, used in the demand analysis are provided in Appendix 2.

Figure 2 and Table 2 describe the methods used to calculate demand; the input source for each step; and, since the quality of the inputs varies, our confidence level for the estimates. Demand analysis calculations are provided in Table 3.

Figure 2. Calculation flow to estimate demand

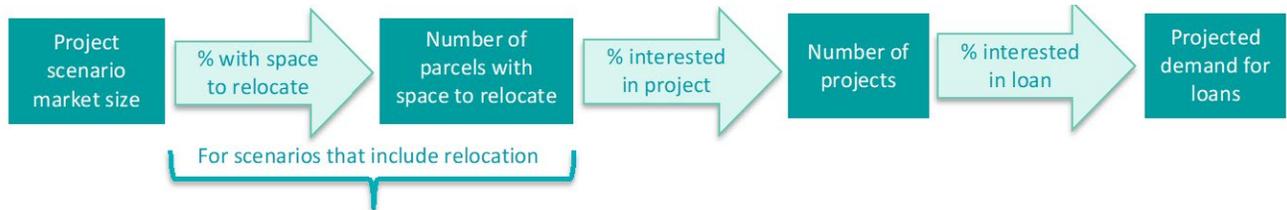


Table 2. Sources for demand analysis inputs

Input	Source	Confidence
Market size	Shore Friendly parcel segmentation (2020 update) and Beach Strategies Geodatabase queries by CGS as described in Appendix 1 and summarized in Table 2	High (shoreline activities): recent Beach Strategies Geodatabase updates and revised parcel segmentation analysis Very low (hazard mitigation activities): shoretype was used as proxy for hazard exposure
Space to relocate	Colehour + Cohen et al. (2014b): 34% of survey respondents said their property was not large enough to allow for moving the house further from shore	Low: data was self-reported, and respondents were not separated by shoretype
Interest in projects	Colehour + Cohen et al. (2014b): “very likely” and “somewhat likely” survey responses	Medium (shoreline activities): survey data was broken down by type of project but is several years old Low (hazard mitigation activities): survey results were not separated by shoretype; we assumed self-reported concerns about sea level rise correlate with interest in projects; and data is several years old
Interest in loans	Colehour + Cohen et al. (2014c): “very useful” focus group responses	Low (shoreline activities): very small number of focus group participants; data is several years old Very low (hazard mitigation activities): same percentage used for scenarios with hazard mitigation activities that would cost much more

Table 3. Demand analysis calculations

Project scenario	Activities	Market size	x	Space to relocate	=	Number parcels	x	Interest in project	=	Likely projects	x	Interest in loan	=	Projected demand
1	elevate	1,787		—		—		0.03		54		0.17		9
2	relocate + soft	5,965		0.66		3,937		0.01		9		0.17		7
3	soft	4,924		—		—		0.39		1,920		0.17		326
4	soft + elevate	3,959		—		—		0.03		119		0.17		20
5	remove + elevate	1,044		—		—		0.03		31		0.17		5
6	remove	84		—		—		0.14		12		0.17		2
7	remove + soft + relocate	4,324		0.66		2,854		0.01		29		0.17		5
8	remove + soft	771		—		—		0.18		139		0.17		24
9	remove + soft + elevate	4,420		—		—		0.03		133		0.17		23
10	remove + relocate	675		0.66		446		0.01		4		0.17		1

Although these demand estimates would be significantly improved with newer market research data and more refined geospatial data on hazard exposure, the project team determined that data quality is sufficient for the purpose of quantifying loan fund capitalization needs. The purpose of this exercise is to develop a hypothetical loan portfolio for which inputs and outputs can modeled over a period of 15 years. This will inform the level of funding that should be sought by regional partners to capitalize a revolving loan fund.

Some sources of error identified in Table 2 would overstate, and others would understate, potential demand for loans. For example, the number of parcels exposed to coastal flooding and bluff retreat hazards is likely lower than we estimated using shoretype. But anecdotal reports from Shore Friendly staff/contractors that regularly interact with waterfront homeowners indicate that concern about hazards and interest in taking action to protect property is higher now compared to 2013 when the surveys were conducted.

The project team coordinated preliminary demand analysis results with Shore Friendly program partners in order to “ground truth” our estimates of loan demand. The group raised concerns about the very large market share of Project Scenario 3, which involves installing soft shore protection on unarmored parcels. These types of projects are not an emphasis of Shore Friendly programs because of the programs’ strategic focus on projects that incorporate armor removal to increase ecological lift. Although installing soft shore protection on an unarmored beach has lower impacts than hard armor, it does have impacts and therefore should not necessarily be supported with loans. In response to this input, we presented a few options for Scenario 3 (50%, 25%, 10%, 5% of the calculated loan demand) to Shore Friendly partners so they could participate in selection of the most appropriate input into the financial model. After discussion, the project team decided to use the 5% option for Project Scenario 3 (13 loans versus 326).

Total demand is predicted to be 112 loans, or 6 to 8 loans a year over the 15-year model period.

2.2 Cost Analysis

The project team then compiled and analyzed cost data for the four target activities in order to predict the likely range of loan size for the ten project scenarios. Along with the demand estimates described in the previous section, these are key inputs for the financial analysis described in the next section.

As described in Appendix 3, the project team gathered data about projects constructed between 2009 and 2019 in Puget Sound counties. Information was provided by local Shore Friendly programs, property owners, public project sponsors, contractors, and consultants. CGS project files, case studies from Johannessen et al. (2014), and data compiled for an Island County Shore Friendly cost benefit analysis (Côté and Domanski 2019) were additional sources of project information.

A total of 46 projects in 10 counties had records detailed enough to meet the data requirements of this analysis. Costs were broken down into design, permitting, and

implementation for shoreline projects and construction, disposal, utilities, and foundation for relocation/elevation projects. Information about shoretype and construction access (land versus barge) was also compiled.

Since construction labor and material prices have risen since 2009, the project team adjusted costs to a base year of 2019 using the U.S. Army Corps of Engineers (USACE) Civil Works Construction Cost Index System.⁹ This system provides inflation factors for various civil works projects, including bank stabilization, which allowed us to adjust 2009-2018 costs to 2019 dollars. A benefit of using this method is that it provides cost escalation factors through 2055, so we can also use the bank stabilization index to adjust future costs when modeling loan fund performance through 2035 for the financial analysis.

Results of the cost analysis are summarized in Table 4. Details about the projects included and additional results, such as cost per linear foot for shoreline activities, are provided in Appendix 3. Project characteristics that affected the cost of shoreline projects included the type and size of bulkhead, wave exposure, and the shoretype. Considerable cost variability was observed given the diversity of Puget Sound properties and projects. For relocation and elevation projects, pricing reflects the size of the structure, distance to be moved/elevated, safety factors, access (narrow roads, lot slope, utilities overhead), foundation construction method (slabs or basement), and the number of needed permits.

Table 4. Cost analysis results

Activity	Number of projects ¹	Low	Average	High
remove ²	22	\$33,300	\$71,000	\$138,100
soft	11	\$20,800	\$51,100	\$143,800
elevate	9	\$60,000	\$100,000	\$140,000 ³
relocate	9	\$43,800	\$135,000	\$234,200

¹Total is >46 because for some “bulkhead removal + soft shore protection” projects, cost data was detailed enough to break down the cost by individual activity.

² For residential-scale projects <400 feet in length. Information about some larger projects is provided in Appendix 3.

³ Data on elevation projects was sparse and, where home square footage information was provided, the values were relatively low (<1,600 ft²). This high value is based on NW Structural Moving advertised rates for “turnkey service” to elevate a 3,000 to 5,000 ft² home in the Whidbey Island service area rather than actual project data.

⁹ <https://www.usace.army.mil/Cost-Engineering/cwccis/>

2.3 Financial Analysis

The project team then used the results of the market analysis (number and mix of projects) and the cost analysis (size of loans needed to finance those projects) to develop a financial model to inform decisions about the initial size of a residential shoreline loan program and how much seed funding regional partners should seek.

Table 5 summarizes the demand and cost variables used as inputs to the financial model. This represents a *hypothetical* loan portfolio. The project team recognizes that it is impossible to precisely predict future human behavior—especially given the uncertainty associated with climate change. A revolving loan fund would be able to finance a larger number of less expensive projects or a smaller number of more expensive projects. Decisions to finance projects would be based on the applications received and eligibility/prioritization criteria to be developed by program partners.

Table 5. Financial model loan portfolio inputs

Project scenario	Activities	Number of loans	Low	Average	High
1	elevate	9	\$60,000	\$100,000	\$140,000
2	relocate + soft	7	\$54,910	\$158,185	\$321,300
3	soft	16	\$20,800	\$51,100	\$143,800
4	soft + elevate	20	\$68,680	\$128,435	\$241,230
5	remove + elevate	5	\$79,305	\$145,350	\$236,385
6	remove	2	\$33,300	\$71,000	\$138,100
7	remove + soft + relocate	5	\$84,150	\$198,730	\$324,445
8	remove + soft	24	\$55,200	\$98,800	\$147,500
9	remove + soft + elevate	23	\$97,920	\$168,980	\$244,375
10	remove + relocate	1	\$65,635	\$175,100	\$316,455
TOTAL		112	\$7.2 million	\$13.7 million	\$23.2 million

The number of loans were taken from Table 3, with the exception of Project Scenario 3 where 5% of the calculated value was used. The prices were taken directly from Table 4 or, for projects scenarios with multiple activities, were calculated by adding the individual activity costs then applying a 15% discount. This discount, based on the professional judgement of CGS, reflects efficiencies that occur when project elements like permits and equipment mobilization are

combined when multiple activities occur as part of the same project. An example calculation is: low value for Project Scenario 2 = [low value for relocate + low value for soft] x 0.85.

This portfolio of 112 projects is expected to cost, using the average values, \$13.7 million (2019 dollars). We expect 6-8 projects to be funded each year of the 15-year analysis period.

Table 6 provides other model variables and parameters. Sources include historical data on septic loans from WDOH (2014b) and personal communication with Craft3 staff; AACE (2020); An and Cordell (2020); and professional judgement of Northern Economics staff. Details about specific sources for each value are provided in Appendix 4. The variables can vary between the lower and upper bounds, while the parameters remain constant.

Table 6. Other model variables and parameters

Variable	Lower bound	Most likely value(s)	Upper bound
Loan acceptance rate (%)	72	76	95
Overage/contingencies rate (% of new loan principal)	-3	0	10
Loan interest rate (%)	2	4	6
Interest rate on fund balance (% of positive fund balance)	1	1.5	2
Default rate (% probability of lifetime default risk)	5	5	10
Default recovery rate (% of defaulted payments)	--	25 or 60	--

Parameter	Value
Administrative fee for <\$75,000 loan (% of loan)	1
Administrative fee for >\$75,000 loan (% of loan)	2
Term (years)	15

The project team used the Microsoft Excel-based software @Risk to simulate the loan portfolio and determine how much seed funding would be needed to establish a self-sustaining revolving fund. The impact of each variable on fund performance was examined by running a simulation with 5,000 iterations. In each iteration of the simulation, the program randomly selected input values for each of the variables and records the resulting outcome. Comparing the outcome of each iteration of the simulation reveals the expected distribution of outcomes and the variables that have the most impact on fund balance.

The model's variables define the loan terms and risks to the fund, such as project overages and loan defaults. Each of the 10 project scenarios were also treated as variables in the model due to uncertainty in the number of projects and their cost. Future project costs were inflated using the USACE Civil Works Construction Cost Index System, which is the same method used to escalate past project costs as described in Section 2.2/Appendix 3. The simulation assumes a triangular distribution for each variable, using their bounds and most likely value.¹⁰ The number of projects within each scenario is distributed evenly across the model's 15-year analysis period, and the first loans are withdrawn from the fund in 2021.

Results of the financial analysis indicate that \$4.5 million in seed money should be enough to capitalize a self-sustaining loan fund. A description of specific simulations run to estimate seed money needed, detailed results, and a discussion of issues that might impact the fund's operation is provided in Appendix 4.

The project team simulated three capitalization schedules: \$500,000/year for 9 years, \$1 million in years 1-2 then \$500,000 in years 3-7; and lump sum in year 1. The longer capitalization schedules would limit the number and/or value of loan disbursements in the fund's early years. In the model, annual loan disbursements ranged from \$396,000 to \$791,000 with a total of \$9.7 million disbursed over 15 years.

Table 7 and Figure 3 provide a summary of outputs for the \$500,000/year capitalization schedule simulation in tabular and graphical forms. Similar summaries for the other simulations are provided in Appendix 4.

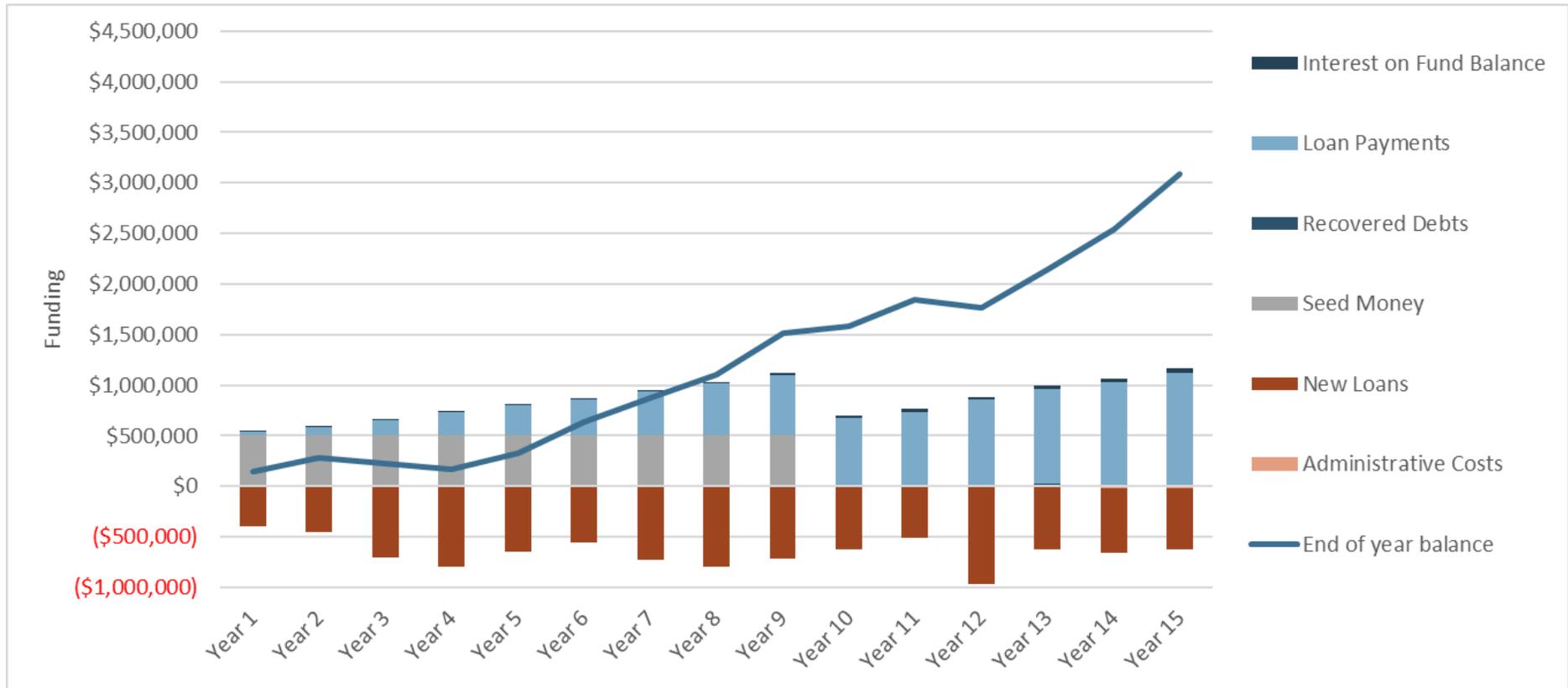
In addition to capital needed to create a fund, development of a new loan program will require agency staff to develop guidelines/rules, procure a financial institution to service loans, and, if necessary, execute an interagency memorandum of understanding. A review of potential sources of funding for fund capitalization and administrative start-up costs is provided in Section 4.

¹⁰ A **triangular distribution** is defined by minimum, mode (or most likely), and maximum values for the variable to take. The mode determines the height of the resulting triangle, and the probability of any value between the mode and the minimum or maximum decreases linearly.

Table 7. Distributed seed money financial model summary table

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1,000s of Dollars														
Seed Money	500.0	500.0	500.0	500.0	500.0	500.0	500.0	500.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0
New Loans	(396.2)	(447.3)	(705.5)	(791.4)	(646.1)	(554.4)	(716.3)	(791.4)	(705.5)	(617.1)	(496.2)	(949.6)	(616.3)	(646.1)	(605.5)
Base Amounts	(396.2)	(447.3)	(705.5)	(791.4)	(646.1)	(554.4)	(716.3)	(791.4)	(705.5)	(617.1)	(496.2)	(949.6)	(616.3)	(646.1)	(605.5)
Overages/ Contingencies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Administrative Costs	(0.4)	(0.9)	(1.7)	(2.6)	(3.5)	(4.3)	(5.4)	(6.3)	(7.5)	(8.6)	(9.6)	(11.4)	(12.7)	(14.2)	(15.7)
Loan Payments	37.5	81.0	151.6	233.2	301.7	362.2	442.6	514.5	598.4	673.8	736.3	859.3	941.4	1,030.0	1,115.5
Interest	16.5	34.8	64.1	96.4	121.0	140.3	166.7	195.7	218.8	235.8	244.7	278.0	289.8	301.4	308.6
Principal	21.0	46.2	87.6	136.8	180.7	221.9	275.9	338.3	399.0	457.5	511.1	600.8	671.2	748.1	826.4
Bad Debts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(19.5)	(19.5)	(19.5)	(19.5)	(19.5)	(19.5)	(19.5)	(19.5)
Recovered Debts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.6	0.0	0.0
Interest on Fund Balance	2.1	4.1	3.4	2.5	4.8	9.4	12.9	16.3	22.4	23.4	27.2	26.1	31.6	37.6	45.6
Year Total	142.9	136.9	(52.2)	(58.4)	156.9	312.9	233.8	233.1	407.7	71.6	257.7	(75.5)	369.6	407.3	539.9
End of year balance	142.9	279.9	227.7	169.3	326.2	639.2	873.0	1,106.1	1,513.8	1,585.4	1,843.1	1,767.6	2,137.2	2,544.6	3,084.5

Figure 3. Distributed seed money financial model summary chart



3. MODEL PROGRAMS

As noted in Section 1.1, loan programs supported with a revolving fund are commonly used to advance public priorities. Here we describe six model loan programs to provide ideas for the structure and operation of a residential shoreline program in Puget Sound. Five of these programs issue loans for residential projects, three include nature-based shoreline protection and/or flood hazard mitigation as eligible activities, and three operate in Washington. Table 8 provides a summary of key loan program attributes.

3.1 Washington Clean Water Loan Program

A regional on-site sewage system loan program for homeowners with failing septic systems was established in 2016. Previously, there had been multiple independent programs run by local health jurisdictions. These programs were minimally capitalized, lacked effective marketing, and provided limited geographic coverage (WDOH 2014a). The Washington Department of Health (WDOH), with NEP funding support from EPA, established a [Septic Financing Advisory Committee](#) and conducted a series of assessments to develop recommendations for improving septic finance programs in the region.

The resulting regional [Clean Water Loans](#) program is a partnership between WDOH, Washington Department of Ecology (Ecology), counties, local health jurisdictions, and Craft3, a nonprofit Community Development Financial Institution (CDFI).¹¹ The agency partners are governed with a 2017 memorandum of understanding that designated Ecology as the lead administrative agency. Ecology conducted a procurement process and contracted with Craft3 to service the loans and serve as asset manager on behalf of the participating local governments. Local health jurisdictions, who have regulatory authority¹² over residential-scale septic systems, review septic repair/replacement designs, conduct final inspections, and notify Craft3 when a project is complete so contractors can receive payment for completed work.

The loan fund was capitalized with grants and loans from the Centennial Clean Water Grant Program and Clean Water State Revolving Fund (CWSRF) via Ecology's Water Quality Combined Funding Program, which distributes funding from multiple programs with an integrated application and review process. NEP grants from the Shellfish Strategic Initiative have also been provided to local jurisdictions for financing projects within their jurisdictions. Foundations, including the Bill and Melinda Gates Foundation, Boeing Company Charitable Trust, Greater Tacoma Community Foundation, Laird Norton Family Foundation, National Fish and Wildlife Foundation, Russell Family Foundation, and Titcomb Foundation, contributed about 30% of the capital dispersed for septic loans between 2002 and 2017 (Brown et al. 2017).

¹¹ **Community Development Financial Institutions** are mission-driven organizations that provide financial services to underserved markets by leveraging capital from foundations, banks, and government to respond to community needs. Craft3's mission is to strengthen economic, ecological, and family resilience in Washington and Oregon.

¹² [WAC 246-272A](#)

Table 8. Model loan program summary

Program	Eligible projects	Seed money source(s)	Loan terms	Special features and requirements
Washington Clean Water Loan Program	<ul style="list-style-type: none"> • Replacement of failing septic systems or connection to sewer • Covers full cost of design, permitting, and installation 	<ul style="list-style-type: none"> • Grants and loans from Centennial Clean Water Grant Program and CWSRF • NEP grants via WDOH • Philanthropic capital 	<ul style="list-style-type: none"> • 2.49% - 5.49% depending on annual household income • \$695 loan fee • Deferred and interest-only options for low income 	<ul style="list-style-type: none"> • All loans include a \$2,000 operations and maintenance reserve • Designer/contractor/installer must be on health agency approved list
Maryland Shore Erosion Control Construction Loan Fund	<ul style="list-style-type: none"> • Living shorelines on private and public lands • Community associations, non-profits, and public projects can finance 100% of project cost 	<ul style="list-style-type: none"> • MD Legislature provided an initial allocation of ~\$1 million then an additional \$650,000 a few years thereafter (1970s) 	<ul style="list-style-type: none"> • Zero interest loans • 5, 15, and 20-year terms • Loan agreement includes lien on home 	<ul style="list-style-type: none"> • Property owner must pay permit fees and all project maintenance • Private contractors who execute projects are certified by the Department of the Environment
Virginia Living Shorelines Loan Program (MPPDC Local Option)	<ul style="list-style-type: none"> • Projects certified by the Virginia Marine Resources Commission to meet the statutory definition of a living shoreline 	<ul style="list-style-type: none"> • Loans from CWSRF, as specifically authorized by the Virginia General Assembly (2015) 	<ul style="list-style-type: none"> • Linked to local home equity loan rates • 5-year term for <\$10,000 • 10-year term for >\$10,000 	<ul style="list-style-type: none"> • The program “insures” living shorelines by covering replacement costs that fail to take within 2 years • Loan secured with Deed of Trust
Shore Up Connecticut Loan Program	<ul style="list-style-type: none"> • Elevation of residential and commercial buildings • Properties located in VE or AE Flood Zones 	<ul style="list-style-type: none"> • CT Legislature approved \$25 million in bonding (2014) 	<ul style="list-style-type: none"> • 2.75% fixed rate • 1% origination fee • 15-year term • No P&I for first 12 months 	<ul style="list-style-type: none"> • Borrower must maintain insurance for duration of loan • Residential elevation to 500-year recurrence interval storm + 1 foot
Spokane Conservation District Direct Seed Loan Program	<ul style="list-style-type: none"> • Purchase of major agricultural equipment for direct seeding and no-tillage operations • Available in 20 WA and 4 ID counties 	<ul style="list-style-type: none"> • CWSRF loans • Grants from Ecology to offset administration costs, education/outreach, and marketing 	<ul style="list-style-type: none"> • 25% down payment • 5 and 10-year terms • No payments for 12 months 	<ul style="list-style-type: none"> • First position as lien holder for the implement • Operators must assist CD in assessing soil erosion rates and water quality for duration of loan
Washington Home Rehabilitation Loan Program	<ul style="list-style-type: none"> • Rural low-income households • Repairs and improvements on primary residences to increase health, safety, and durability 	<ul style="list-style-type: none"> • State capital budget 	<ul style="list-style-type: none"> • Maximum loan \$40,000 • 2.3% fixed rate (based on consumer price index) • Up to 7% admin fee 	<ul style="list-style-type: none"> • Priority to seniors, persons with a disability, veterans, and families with children <5 years old

In the first 14 months of the regional on-site sewage program, \$6.7 million of loans were disbursed for 269 projects with an average loan amount of \$24,921 (Brown et al. 2017). Demand remains strong; between January and September 2020 Craft3 funded 225 Clean Water Loans, about 80% of which were for properties in the Puget Sound region (D. Sideroff, pers comm).

3.2 Maryland Shore Erosion Control Loan Program

Maryland's Shore Erosion Control Construction Loan Fund has been suggested as a model to emulate since homeowner incentives were first being investigated as a strategy for Puget Sound; it was highlighted by both Futurewise (2014) and Faghin and von Reis Crooks (2015).

Maryland's program has been operating since 1968 with steady demand for financing assistance. It was created to provide interest-free loans to property owners for shore erosion projects. Since 2008, the program has focused its resources on living shoreline projects and no longer finances structural erosion control (Otts and Bowling 2013). On average the program receives \$600,000-\$700,000 in loan repayments annually. Program administration is funded by these repayments—less than 12% supports both the loan program and technical assistance staff—and the remainder is disbursed to 4-5 new loans a year (Subramanian, pers. comm.). More than 700 loans, about 500 of which were for living shoreline projects, have been dispersed in all and no new capital has been added to the fund over the past 52 years.

The program is managed by the Maryland Department of Natural Resources Shoreline Conservation Service. When a proposed project would protect multiple households, the program works with the local jurisdiction to establish a special assessment district for those homes for the purpose of financing shore erosion control. The loan is made to the local jurisdiction, rather than individual property owners, who uses the resulting tax revenue to repay the loan (Subramanian, pers. comm.). More information about special assessment districts is provided in Section 4.4.

Resiliency through Restoration Initiative

This Maryland program launched in 2017 provides grants to counties, municipalities, and nonprofit organizations to support the design and implementation of nature-based projects to build community resilience to climate change. Approximately \$8.35 million from the state capital budget has been allocated to support 16 community-scale projects (Chesapeake and Coastal Service 2020). This program is one element of a larger [Community Resilience Program](#), managed by the Department of Natural Resources Chesapeake and Coastal Service, that also supports watershed-scale efforts to understand, plan for, and educate about flooding hazards. The Shoreline Conservation Service provides technical assistance for living shorelines projects funded by this program (Subramanian, pers. comm.).

3.3 Virginia Living Shorelines Loan Program

Virginia created a Living Shorelines Loan Program in 2016. Local governments are eligible to apply for Virginia CWSRF loans that can be used in two ways: (1) the Direct Funding Option allows for use of loan proceeds to directly fund construction of projects, and (2) the Local Plan Option allows the local government to utilize a loan to provide low-interest loans or other incentives to businesses or individual citizens to establish living shorelines (Virginia State Water Control Board 2019). Program guidelines were developed by the Virginia Department of Environmental Quality, State Water Control Board, and Virginia Resources Authority (the state agency financial manager of the CWSRF).

Living shoreline loan applications are accepted annually, concurrent with the CWSRF application cycle. For the Local Plan Option, a local government entity must develop a Local Plan that describes how it intends to administer the program. Once approved, the Virginia Resources Authority makes a loan to a local government entity, who then makes loans to the property owner at a higher interest rate and shorter term. Each property owner application must be individually approved the Department of Environmental Quality and Virginia Resources Authority.

The Middle Peninsula Planning District Commission (MPPDC), representing six counties and three towns, has the only approved local program at this time. The MPPDC has disbursed all \$500,000 of the capitalization funding obtained from the CWSRF; \$75,000 of the capitalization loan was forgiven by the CWSRF. Grants from Soil and Water Conservation Districts were used to reduce the homeowner contributions and were a factor in the high demand for loans (Lawrence, pers. comm.). The MPPDC is actively seeking Federal Emergency Management Agency funding to disburse for flood hazard mitigation projects and has developed a [Fight the Flood](#) program to connect property owners with specialized businesses to evaluate, design, and build flooding solutions.

Community Flood Preparedness Fund

This brand-new Virginia revolving fund created to provide grants and loans for flood risk reduction should be tracked as the program develops because it may serve as an additional model for Washington. In 2016, the Virginia General Assembly created a Shoreline Resiliency Fund but did not provide any appropriations to capitalize the fund. In 2020, it was renamed the Community Flood Preparedness Fund and designated to receive a portion of revenue generated by the sale of emission allowances.¹³ The fund will be managed by the Virginia Resources Authority and administered by the Virginia Department of Conservation and Recreation. It is anticipated that \$45 million in revenue from the Regional Greenhouse Gas Initiative¹⁴ will be put in the fund annually (Miller and Rovner 2020).

¹³ Code of Virginia [§10.1-603.24](#) and [§10.1-603.25](#) via [HB 22](#).

¹⁴ The [Regional Greenhouse Gas Initiative](#) is a carbon emissions cap-and-invest program that includes the electricity sector for ten New England and Mid-Atlantic states.

Program guidelines are being developed in consultation with the Virginia Department of Natural Resources and Special Assistant to the Governor for Coastal Adaptation and Protection. The authorizing legislation specifies that: (1) community-scale hazard mitigation and nature-based solutions to reduce flood risk are to be given priority for funding; (2) at least 25% of fund disbursements will be used for projects in low-income geographic areas, (3) localities are authorized to forgive loan principal for projects in low-income areas.

3.4 Shore Up Connecticut Loan Program

The Shore Up Connecticut loan program was created in 2014 to help residents not eligible or prioritized for federal disaster recovery funds after Superstorm Sandy (French et al. 2017). It was the first program in the nation to use non-federal resource to fund home elevation. Connecticut's Legislature approved \$25 million in bonding for the program, which was administered by the Connecticut Department of Housing in partnership with the Housing Development Fund, a Connecticut-based CDFI focused on affordable housing.

Between 2014 and late 2016, when the program stopped accepting new applications, there were 291 inquiries and 89 pre-qualifications (E. Harrigan, pers comm). An additional 19 applicants (21%) did not qualify. A total of 16 loans for \$2.5 million closed. Loan amounts ranged from \$10,000 to \$300,000. Eligible costs included surveying and engineering design; permitting; site preparation and excavation; lifting and foundation costs; utility disconnection and reconnection; stairs, railings, and code-required landings; wheelchair ramp, lift, or elevator with documentation; gutters and leaders; and soil stabilization (e.g., grass).

The program ended because demand was not as high as expected, given competing federal disaster recovery funding. Also, the Department of Housing had little experience with construction loans and ultimately determined that the program was not mission-critical (E. Harrigan, pers comm).

3.5 Spokane Conservation District Direct Seed Loan Program

The Direct Seed Loan Program offers low interest financing for farmers to purchase major agricultural equipment for no-till or direct seed operations. This equipment aids in the placement of seed and/or fertilizers in one or two passes, which reduces labor and fuel costs, improves soil tilth, reduces soil erosion, and improves water quality.

The program is managed by the Spokane Conservation District (CD). Between 1995 and 2017, Washington Department of Ecology provided \$19.5 million to Spokane CD who then issued 300 loans for direct seed purchases in 14 eastern Washington Counties (EPA 2017). Since 2017, Spokane CD has since expanded the loan program to serve six additional Washington counties—including Snohomish as the first in the Puget Sound region—and four Idaho counties.

3.6 Washington Home Rehabilitation Loan Program

In 2017, Washington’s Legislature created a revolving loan program to support home rehabilitation projects for rural, low-income households.¹⁵ The Washington Department of Commerce administers the program and local Rehabilitation Agencies in eligible counties administer the loans. In the Puget Sound region, these agencies are the Olympic Community Action Programs (Clallam and Jefferson); Community Action Council of Lewis, Mason, and Thurston Counties; Housing Authority of Skagit Council; and the Opportunity Council (Whatcom, Island, and San Juan).

The fund finances residential repairs and improvements that affect the health, safety, and durability of the home. Foundation/structural improvements, emergency storm repairs, and seismic retrofits are included in a list of example projects. Participating homeowners are allowed to defer repayment of loan principal and interest.



Armor removal (before and after)
Photos by Northwest Straits Foundation

¹⁵ [ESB 5647](#)

4. POTENTIAL SOURCES OF FUNDING

This section provides information about funding options for a residential shoreline loan program and ends with an analysis to help identify promising courses of action.

A residential shoreline loan program would not be a straightforward match for any single existing source of funding. Some common challenges to funding/financing climate change adaptation identified by Keenan (2019) are apparent in the collection of programs discussed in this section:

- Multi-benefit projects often require complex aggregations of funding from several different single-source programs (e.g., habitat, flood mitigation, community development).
- Bias towards planning large discrete projects, most often on public land.
- Lack of flexibility on restrictive eligibility requirements (e.g., two-year timeframes to complete projects, public land ownership) precludes innovation.

However, bills passed during the 116th Congress (2019-2020) indicate that there is growing federal interest in the revolving loan fund model to support state coastal resilience and pre-hazard mitigation. The [Coastal and Great Lakes Communities Enhancement Act](#) (H.R. 729), which passed the U.S. House of Representatives in December 2019, included a new Living Shorelines Grant Program that aims to fund nature-based shore protection for the benefit of coastal communities and habitats. There are efforts underway to advance this bill in the 117th Congress (e.g., Environmental and Energy Study Institute 2020a). In January 2021, the [Safeguarding Tomorrow Through Ongoing Risk Mitigation Act of 2020](#) (S.3418) was signed into law. This “STORM Act” authorizes the Federal Emergency Management Agency (FEMA) to distribute grants to states for establishment of hazard mitigation revolving loan funds. These funds are to be managed by state emergency management departments, who would make low-interest loans to local governments to finance projects designed to mitigate damage from future disasters. Funding options are likely to evolve rapidly in the coming years.

4.1 Grants

In this sub-section we describe several programs that could potentially provide grants to support start-up of a loan program, armor removal, and home elevation or relocation. None of these programs specifically prohibit grants being used to capitalize a loan fund, but such a proposal may not be competitive with direct funding for more traditional projects.

Table 9 summarizes general information about the individual programs and characteristics relevant to their suitability for supporting a residential shoreline loan program.

Table 9. Grant program summary

Grant program	Competition scale and deciding entities	Timeline	Requirements and funding available	Characteristics relevant to suitability for supporting a loan program
National Coastal Resilience Fund	National – NFWF and NOAA	Annual – for 2020 pre-proposals were due in April	<ul style="list-style-type: none"> • 1 to 3-year timeline for completion depending on type of grant • 50% match required • Awards range in size from \$125,000 for planning to \$1-5 million for restoration • \$31 million was available in 2020 	<ul style="list-style-type: none"> • Focus on direct support for large, discrete projects • Use of funding on private property could be a challenge • Planning focus area could be a source of funding for loan program start-up/development
Resilient Communities Program	National – NFWF	Annual (4 years) – for 2020 pre-proposals were due in February	<ul style="list-style-type: none"> • 2-year timeline for completion • 50% match required • Awards range from \$100,000 to \$500,000 • \$3 million available annually 	<ul style="list-style-type: none"> • Program seeking scalable, nature-based resilience solutions benefitting affordable housing • Fire hazards are the priority for the West, SLR for Eastern seaboard
Puget Sound National Estuary Program	Regional – Habitat Strategic Initiative	Annual	<ul style="list-style-type: none"> • Development of a loan program has been identified as a priority and is in 2018-2022 Action Agenda 	<ul style="list-style-type: none"> • NEP awards have been used to fund loans • Home elevation/relocation activities likely not eligible
Estuary and Salmon Restoration Program	Regional – WDFW, RCO, PSP	Biennial	<ul style="list-style-type: none"> • 2-year timeline for completion (per project phase) • 30% match required 	<ul style="list-style-type: none"> • Focus on direct support for discrete projects • Home elevation/relocation activities likely not eligible
Puget Sound Acquisition and Restoration Fund	Regional – PSP, RCO	Biennial	<ul style="list-style-type: none"> • Projects must be on a Lead Entity Four Year Work Plan project list • Projects must be approved through the local Lead Entity before being submitted for consideration 	<ul style="list-style-type: none"> • Focus on direct support for large, discrete restoration projects • More straightforward paths to state capital funding are available

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Table 9. Grant program summary (cont'd)

Grant program	Competition scale and deciding entities	Timeline	Requirements and funding available	Characteristics relevant to suitability for supporting a loan program
Salmon Recovery Grant Program	State – RCO	Annual	<ul style="list-style-type: none"> • Projects must address actions defined in regional salmon recovery plans or Lead Entity strategies • 2 to 3-year timeline for completion • 15% match required 	<ul style="list-style-type: none"> • Focus on direct support for discrete projects • Removal of shoreline armoring is an eligible activity • Lead Entities that prioritize nearshore overlap with some key Shore Friendly geographies (Island, San Juan, East Kitsap) • Private landowners are eligible to receive funding for projects on their land
Coastal and Marine Habitat Restoration Grants	National – NOAA	Annual	<ul style="list-style-type: none"> • 1 to 3-year timeline for completion • Awards range from \$75,000 to \$3 million • \$4 million was available in 2020 • Projects evaluated on ability to support recovery of ESA-listed species or Magnuson-Stevens stocks 	<ul style="list-style-type: none"> • Focus on direct support for discrete projects • Action Agenda is provided as example of document supporting landscape context of projects • Puget Sound has been listed as geographic priority area in past years
National Estuary Program Coastal Watersheds Grant Program	National (28 NEP watersheds) – RAE	Annual – for 2020 letters of intent were due in August	<ul style="list-style-type: none"> • 1 to 2-year timeline for completion • Awards range from \$75,000 to \$250,000 • \$1 million available annually 	<ul style="list-style-type: none"> • A program goal is to support and expand promising approaches for resilience and adaptation • Could be a source of funding for program start-up/development
Building Resilient Infrastructure and Communities Program	National (with some state set-aside) – WEMD and FEMA	Annual – for 2020 pre-applications were due to WEMD in September	<ul style="list-style-type: none"> • Projects must be aligned with approved Hazard Mitigation Plans • 3-year timeline for completion • 25% non-federal cost share required • \$500 million plus \$600,000 state allocation was available in 2020 	<ul style="list-style-type: none"> • Program goals include promoting innovation, providing ancillary benefits, and considering future conditions • Activities must not duplicate activities that another federal agency or program has more specific authority to conduct • High administrative complexity

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Table 9. Grant program summary (cont'd)

Grant program	Competition scale and deciding entities	Timeline	Requirements and funding available	Characteristics relevant to suitability for supporting a loan program
Flood Mitigation Assistance Program	National – WEMD and FEMA	Annual – for 2020 pre-applications were due to WEMD in September	<ul style="list-style-type: none"> • All properties must have National Flood Insurance Program policies in place at time of application • 3-year timeline for completion • Elevation projects that cost >\$175,000 require a benefit-cost analysis • \$160 million was available in 2020 	<ul style="list-style-type: none"> • Local governments, special districts, and federally recognized tribes are the entities responsible for identifying and implementing mitigation activities • Program focus on severe repetitive loss and repetitive loss properties • High administrative complexity
Hazard Mitigation Grant Program	State – WEMD and FEMA	Intermittent – requires major disaster declaration	<ul style="list-style-type: none"> • 25% non-federal cost share required • Declared counties given priority 	<ul style="list-style-type: none"> • Relocation and elevation of homes are eligible projects • High administrative complexity
Community Development Block Grant Program	<ul style="list-style-type: none"> • HUD has formulas to allocate annual appropriations • Larger cities and counties receive block grants directly from HUD • Commerce awards grants to smaller “non-entitlement” jurisdictions 	Annual, plus intermittent special appropriations in response to economic crises and disaster recovery	<ul style="list-style-type: none"> • Project needs must be specified in jurisdiction consolidated plan • Funds must principally benefit low- and moderate-income persons (80% of median income) • Commerce estimates \$11 million will be available for General Purpose Block Grants to non-entitlement jurisdictions in 2021, with applications due in June 	<ul style="list-style-type: none"> • Rehabilitation of residential structures is an eligible activity • CDBG funds can be used for loans • In 2020, specialty grants were provided for COVID-19 Response Services • In 2009, specialty CDBGs were a mechanism for federal stimulus appropriations after the mortgage foreclosure crisis

4.1.1 Coastal Resilience

This relatively new category of grant programs is small but is likely to grow as the impacts of climate-related disasters increase. The [National Coastal Resilience Fund](#) is a competitive grant program established in 2018 and run through a partnership between the National Fish and Wildlife Foundation (NFWF) and the National Oceanic and Atmospheric Administration (NOAA).¹⁶ This program supports projects to restore or expand natural infrastructure (coastal wetlands, dune and beach systems, reefs, mangroves, barrier islands) that provide protection from rising seas and extreme weather. In 2020, \$31 million was available for projects in one of four focus areas:

- Community capacity building and planning — Grants expected to average \$125,000 and be completed in two years.
- Project site assessment and preliminary design — Grants expected to average \$125,000 (depending on the scale and scope of the project) and be completed in one year with a 50-60% design as an outcome.
- Project final design and permitting — Grants expected to average \$250,000 (depending on the scale and scope of the project) and be completed in eighteen months with a 90-100% design as an outcome.
- Restoration and monitoring — Most projects expected to range \$1-5 million and be completed in three years.

Nonprofit organizations, local governments, state agencies, tribes, educational institutions, and commercial organizations are eligible applicants. The 2020 request for proposals (RFP) emphasized contiguous areas of natural habitat maintained at a significant size for the habitat type.

The [Resilient Communities Program](#) is a partnership between NFWF and Wells Fargo that offers \$3 million/year in grants to help communities prepare for fire, flood, drought, or sea level rise with restoration and conservation projects. In 2020, the three project categories were adaptation through conservation projects; community capacity building and demonstration projects; and adaptation focused on affordable housing and small business. Individual grants are expected to range from \$100,000 to \$500,000 and projects should last up to 2 years from the start date. Nonprofit organizations, local governments, state agencies, and federally recognized tribes are eligible applicants.

¹⁶ In 2018, Congress shifted funding for NOAA's [Coastal Resilience Grants Program](#) to the National Oceans and Coastal Security Fund or "Title IX Fund" ([16 U.S.C. §7501-7507](#)). This transferred administrative responsibility to NFWF, although oversight authority remains with NOAA. The Coastal Resilience Grants Program had been funded via Congressional appropriations to NOAA in fiscal years 2015 to 2018 but was "effectively discontinued" by the Consolidated Appropriations Act of 2018 (Congressional Research Service 2019).

4.1.2 Habitat Restoration

This relatively large category of grant programs has supported many armor removal efforts for the benefit of nearshore habitat in the region. [Puget Sound NEP/geographic funds](#) granted through the Habitat Strategic Initiative have been a key source of support for many projects implementing near-term priorities identified in the Shoreline Armoring Implementation Strategy. Developing additional financial incentives was one such priority, and a Near Term Action (NTA) proposal included in the 2018-2022 Action Agenda for Puget Sound (Puget Sound Partnership 2018) was development of a residential shoreline loan program. This feasibility study is the first phase of that proposal, and as a result administrative start-up and/or loan fund capitalization may be eligible for some additional NEP funding. However, there are many pressing needs and competition is high for the available funding, so future support is not guaranteed. Funding recommendations are made on annual cycle and based on specific guidance from EPA that reflects input from the [Puget Sound Leadership Council](#).

The [Estuary and Salmon Restoration Program](#) (ESRP) is a partnership between WDFW, the Washington Recreation and Conservation Office (RCO), and Puget Sound Partnership (PSP) that provides funding for Puget Sound nearshore habitat restoration and protection. ESRP is funded through the state capital budget and receives project support from multiple federal programs. ESRP has been the home for Shore Friendly since 2019, and developed a [Small Grants Program](#) that prioritized residential-scale bulkhead removal in 2020. Projects are solicited, ranked, and recommended for funding on a biennial cycle.

The [Puget Sound Acquisition and Restoration Fund](#) (PSAR) invests money from the state capital budget in habitat restoration and acquisition to support salmon recovery. It provides state match for several federal grant programs. This program is managed by PSP, who solicits proposals from local salmon recovery Lead Entities on a biennial schedule. RCO's [Salmon Recovery Grant Program](#) also funds smaller projects submitted by local Lead Entities in a process that is run together with and generally has the same requirements as the PSAR solicitation process. Both of these programs focus on funding discrete projects identified in regional salmon recovery plans and Lead Entity strategies.

Two nationally competitive grant programs may support armor removal projects. NOAA's [Coastal and Marine Habitat Restoration Grants](#) program provides funding for coastal and marine habitat restoration. Proposals are evaluated based on their ability to help recovery of species listed under ESA or stocks managed under the Magnuson-Stevens Fishery Conservation and Management Act. Puget Sound has been identified as a regional priority for this program during previous grant cycles.

The [National Estuary Program Coastal Watersheds Grant Program](#) is administered by Restore America's Estuaries. Goals of the program include addressing urgent and challenging issues that threaten the ecological and economic well-being of coastal areas, and support and expand promising approaches for watershed resilience and adaptation. Puget Sound is one of the geographic areas eligible for this program.

4.1.3 Hazard Mitigation

This category consists of three Federal Emergency Management Agency (FEMA) assistance programs that could be used to fund home elevation and relocation activities.

The new [Building Resilient Infrastructure and Communities](#) (BRIC) program was created by the Disaster Recovery Reform Act of 2018 to replace FEMA's Pre-Disaster Mitigation (PDM) program. Some goals of this new program—promoting innovation, encouraging partnerships, and supporting projects that increase resiliency, provide ancillary benefits, and consider future conditions—align well with the intent of a residential shoreline loan program. To be eligible, projects must align with approved Hazard Mitigation Plans. Washington's current plan, Washington Emergency Management Division (2018), is effective through 2023. This plan references the Action Agenda and the Shoreline Armoring Implementation Strategy in the "Mitigation Strategies – By Agency" section (i.e., as a component of the state's comprehensive mitigation program).

For 2020, the total available funding of \$500 million will be distributed in three ways: state/territory allocations of \$600,000, a tribal set-aside, and \$50 million for a national competition. A 25% non-federal cost share is required. The maximum federal share available to any single project is \$50 million. The period of performance is 36 months, but applicants may request longer for highly complex projects.

The [Flood Mitigation Assistance Program](#) (FMA) provides annual funding for projects and planning to reduce or eliminate long-term risk of flood damage to structures insured under the National Flood Insurance Program (NFIP). Individual homeowners, businesses, and non-profits may apply for funding through eligible sub-applicants (like local governments) who then sponsor applications at the state level. All properties must have NFIP policies in place at the time of application. Projects that focus on severe repetitive loss and repetitive loss properties receive highest priority for individual projects. Project cost-effectiveness must be validated with a Benefit-Cost Analysis (BCA). However, elevation projects that cost \$175,000 or less are considered to be cost effective and do not require BCA.

Both the BRIC and FMA programs are administered in coordination with the Washington Emergency Management Division (EMD). EMD is the entity that submits a state application package to FEMA. EMD requires potential sub-applicants submit a pre-application for state-level competition, after which they invite full sub-applications. State agencies are not eligible sub-applicants. Only local governments, including cities, counties, special district governments, and federally recognized tribes, are eligible sub-applicants. These local authorities are responsible for identifying and implementing mitigation activities. All sub-applicants must have FEMA-approved hazard mitigation plans by application deadline. For 2020, EMD required pre-applications in September 2020 and full applications in November 2020. The final state package will be submitted to FEMA in January 2021.

The [Hazard Mitigation Grant Program](#) provides competitive (state-level) grants for planning and projects designed to reduce or eliminate the effects and costs of future disaster damage. Grant applications are solicited by EMD after a Presidential Declaration of Major Disaster. Available grant funding is equal to 20% of total federal disaster assistance dollars provided by FEMA. Grants have a 25% non-federal match requirement, which the state may split with the local grant recipient. Applications are reviewed and ranked by EMD prior to submission to FEMA. Declared counties are given priority. Relocation and elevation are among eligible projects.

4.1.4 Community Development

Housing rehabilitation is an eligible activity under U.S. Department of Housing and Urban Development (HUD) [Community Development Block Grant](#) (CDBG) programs, which support affordable housing and economic development in low-income and disadvantaged communities. Jurisdictions can use these funds to undertake a wide range of community development activities so long as they benefit low- and moderate-income persons, aid in the prevention or elimination of slum and blight, or meet other urgent community development needs specified in the jurisdiction's consolidated plan.¹⁷ Some larger jurisdictions are “entitled” to receive CDBG directly from HUD, while “non-entitlement” jurisdictions work through the Washington Department of Commerce (Commerce).¹⁸ HUD and Commerce offer general purpose and specialty block grants. Types of specialty grants include Housing Enhancement and Disaster Recovery. Grantees are allowed to make financial assistance available in the form of loans.

EPA’s Office of Sustainable Communities occasionally offers [Smart Growth Grants](#) to support activities that improve the quality of development and protect human health and the environment. EPA and FEMA have a [Memorandum of Agreement](#) to support smart growth strategies for disaster resilience and recovery.

4.2 Loans

As demonstrated by some of the model programs described in Section 3, loans are an option for seeding a residential shoreline loan fund. However, there are drawbacks to this approach. Since those loans would need to be repaid the capital would not revolve, and additional capital would be required for the fund to be able to continue issuing loans. This approach may also result in higher costs to homeowners, as interest rate charged would need to be higher so that the lender would receive a return. The lender would also need to be patient given the likely 15-year (or longer) term of the homeowner loans.

A loan from the [Clean Water State Revolving Fund](#) (CWSRF) managed by Ecology could potentially be used to start a loan program. As described in Section 3.3, loans from the Virginia CWSRF were used to create that state’s Living Shorelines Loan Program and loans from

¹⁷ [42 U.S.C. § 5305](#)

¹⁸ A list of “non-entitlement” jurisdictions is provided at <https://www.commerce.wa.gov/wp-content/uploads/2016/06/CDBG-2014-List-of-Local-Governments.pdf>.

Washington’s CWSRF support Spokane Conservation District’s Direct Seed Loan Program. The purpose of the fund is to support water pollution control, but statute directs Ecology to give priority consideration to projects referenced in the Action Agenda¹⁹ and “green project reserve” projects²⁰ are also eligible. Armor removal could potentially be eligible but may not be a priority given the extensive need for water quality funding in the region. Perhaps removal projects where there was clear water quality nexus, such as where armor was constructed from creosote-treated wood, would be more competitive during the application ranking process. Flood control projects are ineligible for CWSRF support.²¹

Local governments can apply for loans or recoverable grants from the [Washington State Housing Trust Fund](#) to support single family home rehabilitation projects. The fund is managed by the Washington Department of Commerce (Commerce) to benefit of low-income households and populations with disproportionate need for housing assistance (e.g., seniors). Projects located in rural areas of the state are to receive at least 30% of the funding disbursed.

Philanthropic capital could be another option. Private foundation funding is thought to be well-suited where it adds to public funding streams and/or supports pilot projects with greater risk profiles (Keenan 2019). This could take the form of an impact investment (i.e., loan that would need to be repaid) and/or grants. In addition to the local foundations noted in Section 3.1, several national foundations have previously invested in adaptation-focused programs (e.g., Kresge Foundation, Doris Duke Charitable Foundation, Rockefeller Foundation, MacArthur Foundation).

4.3 State Appropriations or Bonding

In recent years there has been growing interest by Washington’s Governor and Legislature to support habitat priorities identified [Southern Resident Orca Task Force](#), as well as resilience activities. However, the impact of COVID-19 pandemic on state budget is a factor that may reduce the likelihood of receiving an appropriation specifically for a residential shoreline loan program in the near-term.

In 2019, the Legislature passed [SSB 5106](#) to create a [Washington Disaster Resiliency Work Group](#) to review disaster mitigation funding and program administration in other states and evaluate whether an ongoing disaster resiliency program should be created in Washington. The scope of this effort is broader than climate-related disasters; seismic risk is a major consideration. The Work Group’s final report to the Legislature recommended that an ongoing resiliency program be created and housed in the Governor’s office (Office of the Insurance Commissioner 2020).

¹⁹ [RCW 90.50A.080\(1\)\(b\)](#) per [33 U.S.C. §1383\(c\)\(6\)](#)

²⁰ Includes green infrastructure and “environmentally innovative projects” per [WAC 173-98-030\(42\)](#).

²¹ [WAC 173-98-110\(11\)](#)

In 2020, the Legislature added budget proviso creating a Climate Resiliency Account and requiring development of a list of prioritized actions and investments that mitigate the effects of climate change and strengthen the resiliency of communities and the natural environment.²² However, the Governor subsequently [vetoed](#) the \$50 million set aside in this new account due to the fiscal threat posed by COVID-19.

One issue that needs to be considered before seeking an appropriation to capitalize a residential shoreline loan fund is clauses in Washington’s Constitution prohibiting state and local governments from giving or loaning public funds to any individual, association, company, or corporation (Article VIII, section 5 and 6). Case law indicates that acting without “donative intent” and demonstrating that an action would result in significant public benefit are key factors in determining if use of public funds constitutes an unconstitutional loan or gift.²³ It would be prudent to request an Office of the Attorney General legal opinion prior to requesting an appropriation.

Tax-exempt nonrecourse revenue bonds or private activity bonds have also been suggested as mechanisms to capitalize a loan program (Futurewise 2014, WDOH 2014c). This approach would present issues similar to using a loan as seed funding, because the bond would need to be repaid and the capital would not revolve. WDOH (2014c) consulted with the Washington State Housing Finance Commission about issuing bonds for the septic loan program; they determined that the Commission could not borrow at a tax-exempt rate or issue private activity bonds since the loans would be made to individuals.

4.4 Special Assessment Districts

Special assessment districts, such as Local Improvement Districts (RCW 35.43) and Flood Control Zone Districts (RCW 86.15), allow local governments to raise revenue for public projects by taxing the property owners that would receive benefits from that project. They are commonly recommended as a mechanism for financing climate change adaptation. Since residents who would gain the most from a program or project bear more of the cost, special districts can be a mechanism to ensure adaptation is fair and equitable (Levy 2018, Mullin et al. 2019, Keenan 2019).

As mentioned in Section 3.2, the Maryland Shoreline Conservation Service works with local jurisdictions to establish a special assessment district when issuing living shoreline loans for projects that would protect multiple households. The local jurisdiction uses the resulting tax revenue to repay the state loan that funded project implementation (Subramanian, pers. comm.).

Flood Control Zone Districts (FCZD) have been proposed as a potential funding mechanism in the City of Olympia’s seal level rise plan. FCZDs are quasi-municipal corporations formed by

²² [2020 supplemental operating budget](#), Sec. 129(16) and Sec. 175

²³ See [AGO 2009 No. 5](#) (Use of Public Funds to Repair or Replace Side Sewers)

vote of county commissioners. District boundaries cannot overlap with the boundaries of other FCZDs and are subject to review by the county's boundary review board (FCS Group 2017). FCZDs have taxing authority as a junior taxing district and can assess \$0.50 per thousand dollars of assessed value without voter approval, though they occupy a relatively low place in the state taxing district hierarchy and are therefore more likely to have their levies prorated to comply with taxation limits established in statute and the state constitution (FCS Group 2017).²⁴ Flood Control Zone Districts are specifically authorized to levy voluntary assessments under RCW 86.15.165.

Property Assessed Clean Energy Programs

Property Assessed Clean Energy (PACE) programs are often mentioned in the climate change adaptation literature as a promising model for funding property-scale projects (French et al. 2017, Keenan 2019, Vajjhala and Rhodes 2019). Through PACE programs, a local government finances energy efficiency and renewable energy projects on a private property. The property owner voluntarily allows for a special assessment to be placed on the property, thereby paying for the project over 10 to 20 years through property tax assessments.

PACE assessments are a debt of the property rather than the property owner, so if a sale occurs before repayment the remaining balance is transferred to the new owner.²⁵ This arrangement addresses some common disincentives to projects with large up-front costs and long cost recovery periods. Transferability of the debt may reduce owner hesitancy to make efficiency improvements if they do not plan to stay in the property long enough recoup costs. The property owner also benefits because there is no up-front cash outlay, the repayment period is longer than traditional financing options, and the "loans" are not a personal debt obligation that would affect credit. Ideally, monthly utility bill savings are enough to offset the increase in property tax. If this model were applied to home elevation and relocation projects, insurance savings would be a way to pay for the tax increase (French et al. 2017, Vajjhala and Rhodes 2019).

The PACE model, first introduced in 2007, has now expanded to 36 states. Most states offer financing only for commercial properties (C-PACE), but California, Florida, and Missouri have residential programs (R-PACE) as well.²⁶ Depending on the enabling legislation, capital to pay for projects is obtained from public sources (bonds, general funds) or private third-party financing. Several states have moved beyond funding energy projects and now allow programs to finance resilience-related projects (PACE *and resilience*, or PACER). Eligible projects include wind resistance in Florida; flood mitigation and wind resistance in Alabama; flooding and stormwater management in Virginia; and seismic upgrades in Utah, California, and Oregon (Environmental and Energy Study Institute 2020b).

²⁴ [RCW 86.15.160\(3\)](#), [RCW 84.52.043\(2\)](#), [RCW 84.52.010](#)

²⁵ In practice, it is more likely that a purchaser or mortgage holder would require payment of remaining assessment (Parker and Hughes 2013).

²⁶ <https://pacenation.org/pace-programs/#>

Washington joined this group in 2020, when legislation enabling a Commercial Property Assessed Clean Energy and Resilience (C-PACER) program passed.²⁷ The legislation authorizes PACER loans for privately-owned commercial, industrial, agricultural, or multi-family (5 or more dwelling units) properties. Eligible projects include energy and water efficiency improvements, renewable energy systems, seismic retrofits, stormwater management, flood mitigation, and wildfire and wind resistance. Implementation is delayed due to the effects of COVID-19 on the state budget; the Governor [vetoed](#) funding for the Department of Commerce to develop administrative rules and guidance documents for the statewide C-PACER program.

4.5 Insurance Surcharges

Adding surcharges to property and casualty insurance policies has been identified as an option for funding climate adaptation programs. For example, Keenan (2018) evaluated how 0.5%, 1% and 1.5% surcharges could be used to establish a regional resilience trust fund for New York, New Jersey, and Connecticut. Important considerations for structuring this proposal included: the equity and practicality of imposing a surcharge on an entire state versus coastal counties and establishing a smaller surcharge that does not expire versus a larger one that is temporary.

There is a precedent for insurance surcharges in Washington. A fraud and regulatory surcharge is paid by insurers authorized to do business in Washington, per RCW 48.02.190(2)(b). Calculations are made using premium volumes reported on prior year tax forms, and the cost can be passed on to policyholders. The revenue generated supports the annual cost of operating the Office of the Insurance Commissioner's insurance fraud program.

Notably, the Washington Disaster Resiliency Work Group mentioned in Section 4.3 is chaired by the Insurance Commissioner.

4.6 Analysis of Funding Sources

The most straightforward path to funding would be a state or federal appropriation large enough to cover program start-up and initial capitalization. While possible, this option is probably unlikely in the near-term. If significant funding for state resilience program is appropriated during the 2021 legislative session, there is a chance that pitching Shore Friendly technical assistance and loans as a ready-to-go model that could be replicated as part of a larger program addressing other geographies and other resilience needs (e.g., fire hazard mitigation, seismic retrofits) could result in some funding. Otherwise, during summer 2021 state agency partners could submit a budget proposal to the Governor for inclusion in the 2022 supplemental budget.

As noted in the beginning of this section, securing funding for a residential shoreline loan program will more likely require a combination of funding from multiple sources. Grant funding

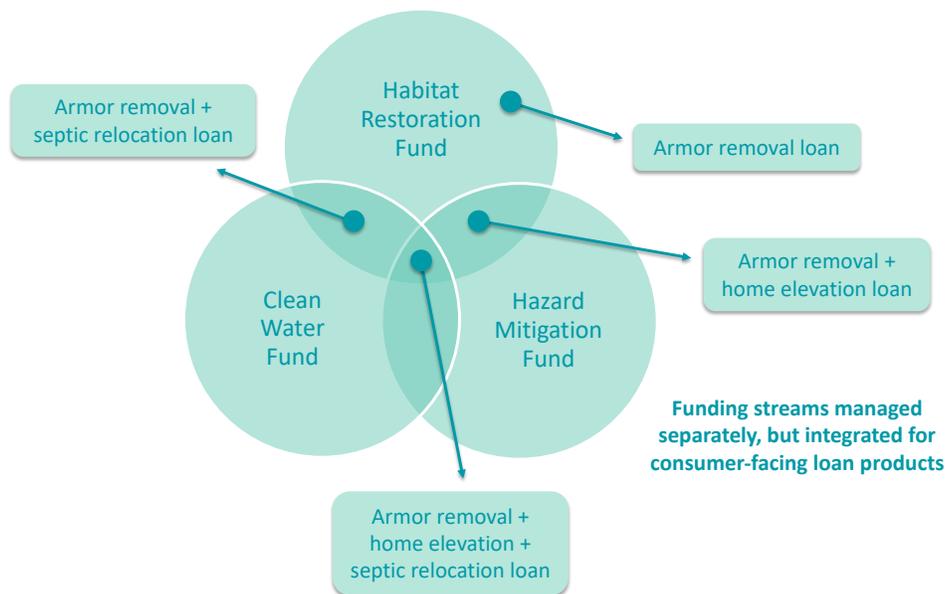
²⁷ [HB 2405](#), which created [RCW 36.165](#)

could be sought to support start-up tasks like seeking and securing seed money to establish the loan fund, developing program guidelines and eligibility criteria, pursuing any needed interagency agreements, and procuring a partner financial institution. Until a loan fund is revolving, program administration costs will also need to be covered. Given the strong habitat focus on the Shore Friendly program, the grant programs described in Sections 4.1.1 and 4.1.2 should be the first options explored. Historically, the funding programs that have been the most flexible and innovative are Puget Sound NEP/geographic funds and WDFW’s Estuary and Salmon Restoration (ESRP).

A grant on the order of \$600,000 should be enough to establish a program and begin issuing loans. If habitat grant(s) are used for initial capitalization, armor removal projects would likely need to be the program focus initially. Once demand for loans and interest in projects involving moving homes is firmly established, additional agency partners could be engaged to set the stage for accessing hazard mitigation and housing funding sources.

If additional capitalization funding is added from other single-purpose grant programs, multiple revolving funds may need to be established to finance projects involving both armor removal (habitat) and home elevation/relocation (hazard mitigation). As shown in Figure 4, a financial institution could maintain separate funds but offer an integrated consumer product. This type of arrangement may not be necessary if more general-purpose “resilience” funding is obtained for capitalization. But a benefit of this approach is that, if the funds are housed at the same institution where the Clean Water Loan Program operates, a homeowner could potentially finance relocating their septic system along with other project elements if necessary. The location of septic systems sometimes limits armor removal options, and it is expected that sea level rise will cause the many systems to fail in the future.

Figure 4. Concept for financing multi-benefit projects with single-purpose funding streams



5. PROGRAM DEVELOPMENT

This section outlines the next steps needed to develop a residential shoreline loan program, describes some options for its administration, and summarizes partner input received on potential project eligibility criteria.

Program start-up tasks include:

- Identify an agency willing to either dedicate existing staff time, or apply for grants to hire a temporary position, to seek funding and engage potential partners. Ideally, this entity would ultimately administer a loan program (Section 5.1) and establish a program manager position (0.5 - 0.75 FTE).²⁸
- Consult with the Office of the Attorney General to ensure that use of state funds for seed money would not constitute an unconstitutional loan. Economic analysis in Côté and Domanski (2019) could provide supporting evidence that a Shore Friendly loan program would provide significant public benefit.
- Seek and secure seed money to establish a revolving fund or funds. Section 4 describes potential funding sources. This task will entail preparing grant/loan applications and monitoring the emergence of multi-benefit resilience funding opportunities at the state and federal levels. Also recommended is engagement with state agencies (e.g., WEMD, Commerce) and key local partners to incorporate target activities into planning documents that could enable access to federal hazard mitigation and housing rehabilitation funding.
- Procure and contract with a financial institution to service loans and manage the fund(s).
- Develop program guidelines and, if necessary, an interagency memorandum of understanding based on the source(s) of funding secured (Section 5.1). Project eligibility requirements should be developed in collaboration with program partners (Section 5.2).
- Modify program guidelines and agreements as necessary if/when additional funding streams are added. For example, it may be possible to begin capitalizing a habitat-focused fund for armor removal before identifying funding for moving homes. Both funding and demand for climate adaptation are expected to increase as sea level continues to rise.

²⁸ This estimate is based on the 0.75 FTE program manager position at Ecology that handles administration of the on-site sewer loan program. Responsibilities of that position include serving as a contract officer for the agreement with Craft3; making project eligibility decisions consistent with program guidelines; handling cultural resources compliance for septic projects; reviewing and approving payment requests; handling annual funding requests (fund is not yet revolving); and responding to inquiries about the program from other states (S. Elsen, pers. comm.). We added a range that includes 0.5 FTE because the on-site septic program funds >200 projects a year compared to the <10 predicted in Section 3.1, and RCO currently handles cultural resources review for Shore Friendly projects.

5.1 Potential Administrative Entities

State agencies, local jurisdictions, conservation districts, and tribes are eligible to administer this type of program. Given the number of partners currently involved with implementing Shore Friendly and the proposed addition of housing-related projects, a mix of state and local agencies should be involved in the development and implementation of a loan program. Partner agencies could contribute funding, technical assistance, and/or be involved in review and approval of individual projects.

Several factors should be considered when evaluating potential roles for lead and partner agencies. The following criteria are proposed:

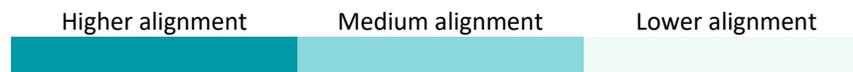
- Alignment of agency authorities/missions with loan program goals — Success is more likely if restoration practitioners are involved with armor removal, shoreline managers contribute to long-term planning, and emergency managers participate in hazard mitigation. Recall from Section 3.4 that Connecticut’s Shore Up Program was disbanded because of poor alignment with the mission of its administrative agency.
- Consistency with eligibility requirements of potential funding sources — A larger coalition of partners may allow access to a broader range of funding. State agencies are not eligible applicants for some types of federal programs (e.g., hazard mitigation). A promising organizational structure could be one similar to the Clean Water Loan Program (Section 3.1), where local entities are able to opt-in and contribute funding for their geographies under an umbrella agreement that increases operational efficiencies.
- Strength of links to existing Shore Friendly programs — Technical assistance provided by existing local programs is necessary to identify and scope potential projects. Local programs would also be a key in marketing the loan program.
- Strength of links to existing shoreline and sea level rise planning — All projects would need to be consistent with local rules (e.g., structure height requirements) and plans. To reduce the likelihood of maladaptation, individual projects must be considered in the context of local plans and associated public infrastructure maintenance needs. For example: if a group of homes had limited road access vulnerable to flooding, elevating those homes could disrupt the jurisdiction’s long-term plans for the road or area.
- Experience administering loan programs
- Technical expertise in coastal engineering and regional habitat priorities

From a political perspective, it may be beneficial to also consider an agency’s ability to expand this program model to other geographies (e.g., Pacific coast counties, freshwater lakes) and/or needs (e.g., fire hazard mitigation, stormwater retrofits, seismic retrofits).

Table 10 provides a matrix of potential partner agencies and the degree to which their programs may align with these criteria.

Table 10. Qualitative evaluation of potential program partners

Criteria	WDFW	Ecology	WEMD	Commerce	Conservation District(s)	Local Jurisdiction(s) and Tribes
Authority for restoration	Higher alignment	Higher alignment	Lower alignment	Lower alignment	Higher alignment	Higher alignment
Authority for shoreline management	Medium alignment	Higher alignment	Lower alignment	Lower alignment	Lower alignment	Higher alignment
Authority for hazard mitigation	Lower alignment	Higher alignment	Higher alignment	Lower alignment	Lower alignment	Higher alignment
Authority for PACER financing	Lower alignment	Lower alignment	Lower alignment	Higher alignment	Lower alignment	Higher alignment
Association with habitat funding	Higher alignment	Higher alignment	Lower alignment	Lower alignment	Higher alignment	Higher alignment
Association with hazard mitigation funding	Lower alignment	Medium alignment	Higher alignment	Lower alignment	Lower alignment	Higher alignment
Association with housing funding	Lower alignment	Lower alignment	Lower alignment	Higher alignment	Lower alignment	Higher alignment
Authority to levy special assessments	Lower alignment	Lower alignment	Lower alignment	Lower alignment	varies	Higher alignment
Current Shore Friendly partner	Higher alignment	Medium alignment	Lower alignment	Lower alignment	varies	varies
Engagement in residential SLR planning	Medium alignment	Higher alignment	Medium alignment	Medium alignment	Lower alignment	varies
Loan program administration experience	Lower alignment	Higher alignment	Lower alignment	Higher alignment	varies	varies
Coastal technical expertise	Higher alignment	Higher alignment	Lower alignment	Lower alignment	varies	varies
Ability to scale to other geographies/needs	Medium alignment	Higher alignment	Medium alignment	Medium alignment	varies	Lower alignment



5.2 Program Guidelines and Project Eligibility Criteria

This section captures some factors that should be considered when development of program guidelines and project selection criteria occurs during the program start-up period. The following reflects partner input received to date, as well as insights gleaned during research of model programs and review of climate change adaptation literature. This information should be considered a starting point—program guidelines must be developed with input from Shore Friendly and other program partners.

Ecological Focus

Habitat restoration is the primary goal of the Shore Friendly program, so there is an expectation that any projects financed through a shoreline loan program result in ecological lift. Shore Friendly program partners recommended that the program not include soft shore protection projects on unmodified shores as an eligible project under this program. Where soft shore protection is recommended as part of a larger project, every other option should first be eliminated. Care should be taken when writing guidelines for projects involving hazard mitigation to ensure that armor removal does not get deemphasized. This may be more of a concern if any resilience funding is used for capitalization prioritizes the built environment.

The highest priorities for armor removal are: (1) along feeder bluffs where sediment is impounded, and (2) where armor was installed lower on the beach face, with 1-2 feet below mean higher high water being a threshold for the largest ecological impacts (Dethier et al. 2016a, Dethier et al. 2016b).

Project Selection Criteria

Depending on the level of funding obtained and actual demand for loans, applications could be approved on a “first come, first serve” basis (as long as any minimum eligibility requirements are met) or held for some period of time and ranked so that only those projects with the greatest ecological lift are selected for funding. If a prioritization scheme is needed, the existing [Green Shores for Homes](#) rating system could be explored as way to score projects in a consistent way. Note that this system does not include other factors, such equity (discussed below), that should also be considered.

However, waiting too long to make decisions about whether a project qualifies for a loan could be a disincentive to participation. During focus group discussions, homeowners indicated that quick and streamlined application processing would be an attractive feature of a loan program (Colehour + Cohen 2014c). Procedures will also be needed for handling applications associated with emergency construction requests.

Fairness and Equity

In the context of climate resilience finance, Levy (2018) relates fairness to how the cost burden compares to benefits received (in terms of geography and risk reduction) and equity to how the cost burden reflects ability to pay. The types of projects that would be financed through a

residential shoreline loan program would provide both public and private benefits, and costs would be shared by property owners and the Shore Friendly program. Fairness could be incorporated into financing decisions by layering additional incentives (e.g., mini-grants, permit support) where the public benefit is higher. This already occurs to some extent when Shore Friendly programs seek external grant funding for high-priority removal projects. Equity could be addressed in a similar manner with the addition of need-based mini-grants to menu of incentive options. Equity could also be addressed through financing terms, such as zero or lower interest rates and deferrals for low-income borrowers.

Taking a wider view, the existence of a residential shoreline loan program could ensure that the relatively affluent population of waterfront property owners would be responsible for a larger share of adapting their properties to changing conditions. This could free up public resilience funding to cover a larger share of project costs for disadvantaged populations at risk from other hazards. Though it is notable that one vulnerable population—senior citizens—is represented at a higher rate in the population of waterfront property owners compared to the overall population. Data from Colehour + Cohen et al. (2014d) indicate that for parcels owned by Washington residents, 34% were owned by persons in the 60-69 age range and 24% by persons in the 70-79 age range.

A loan program that spurs construction activities could potentially provide opportunities for local business development and workforce training for disadvantaged, disenfranchised, or underrepresented populations (Levy 2018).

Avoiding Maladaptation

Although parcel-level interventions are recognized as a way to deliver scalable and replicable community-wide resilience benefits, the “go it alone” model can result in unintended consequences (Vajjhala and Rhodes 2019). Application review will need to include a mechanism to identify and remedy potentially maladaptive projects. For example: elevating a home at risk of condemnation due to a flooding-related septic failure would not be appropriate unless the system could be moved, or a sewer hookup was possible, as part of the project. It will also be critical to select appropriate sea level rise projections when determining how high to elevate homes, and base decisions about how far to move homes from bluff edge on the best available engineering practice.

6. RESEARCH AND POLICY NEEDS

This section captures research needs that could be added to the list of those previously identified in the Shoreline Armoring Implementation Strategy, as well as policy opportunities for the Habitat Strategic Initiative to consider pursuing.

6.1 Research Needs

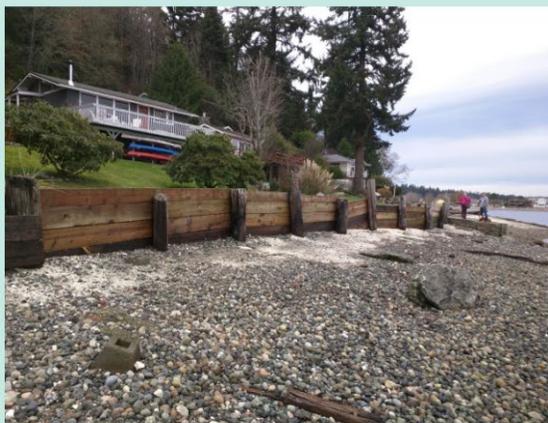
- Conduct additional social marketing formative research to inform messaging about coastal flooding and sea level rise, as well as barriers/motivators for hazard mitigation behaviors.
 - Assess knowledge about coastal flooding risk, level of concern about sea level rise, protection measures, flood insurance coverage, and factors likely to affect their decision to invest in mitigation measures.
 - Assess the level of interest in loans versus PACE-style property assessment.
 - Assess the importance of loan program features, such as ease of application process, response time, competitive rates.
 - Repeating questions from Colehour + Cohen et al. (2014b) and Colehour + Cohen et al. (2014c) would allow quantification of Shore Friendly program impacts around perceptions of hard armor and soft armor.
- Conduct economic evaluations, building on the work of Côté and Domanski (2019), to monetize the benefits of armor removal and hazard mitigation activities as well as the costs of inaction.
 - Structure any analyses so that they could be used for FEMA cost-benefit analysis.
 - Evaluate appraisal data region-wide to quantify impacts of projects on property value.
 - Provide information to help homeowners understand the benefits of taking action (e.g., lower insurance costs, avoidance of uninsured damage/repairs, and higher resale value (or lower risk of price decline due to rising seas), as well as the costs of not taking action (e.g., damage to physical structures plus temporary housing, mental stress, and lost productivity).
- Compile information on the number of NFIP insured properties, repetitive loss properties, and severe repetitive loss properties along Puget Sound’s marine shoreline. This information should be readily available in existing databases.

Intuitive thinking processes—based on past flood experience, worry, and trust—shape individual perceptions about the likelihood and consequences of future flooding. This results in behavioral biases that make adoption of protective measures much more likely after disaster occurs. (Aerts et al. 2018)

- Assess how many exiting septic systems are at risk of damage or failure from flooding or landslides, and where parcels are not large enough to relocate a system.
- Evaluate local code requirements for potential problems in permitting elevation and relocation projects (e.g., are variances possible for height restrictions and setbacks that could make elevation or relocation of existing structures difficult).

6.2 Policy Needs

- Lobby in support of federal bills involving capitalization grants to states for development of revolving funds. As noted in Section 4, two relevant bills from the 116th Congress (2019-2020) were the [Coastal and Great Lakes Communities Enhancement Act](#) (H.R. 729) and the [Resilience Revolving Fund Act](#) (H.R. 3779). The Environmental and Energy Study Institute and Coastal States Organization are working to advance this legislation in the 117th Congress.
- Monitor development of the C-PACER at Commerce to ascertain if it is possible and desirable to seek authorization for a corresponding R-PACER program for single-family residential properties.
- Advocate for the strengthening of mandatory flood hazard disclosure requirements during real estate transactions. Several other states require notification when a property is within a FEMA-designated special flood hazard areas or inundation areas.²⁹
- If a new resilience position/office is formed in 2021, it may be necessary to advocate for funding of residential-scale activities. Given the enormous need, balancing of community-wide and parcel-level investments is likely to be a challenge.



Armor removal (before and after)
Photos by Shore Friendly Kitsap

²⁹ The National Association of Realtors [State Flood Hazard Disclosures Survey](#) (2019) provides detailed information on relevant statutes in all states.

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