Managing Floods and Floodplains in Puget Sound

A Synthesis of Flood Manager and Decision-maker Interviews and Research

Prepared by MacIlroy Consulting
for The Nature Conservancy
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INTRODUCTION

Purpose

River flooding is a significant problem in Puget Sound, Washington and across the United States. Over the last several hundred years, human settlements, changes in climate, altering of channel courses, changes in governmental policies, and other factors have put more people and more infrastructure in harm's way while significantly degrading the ecosystem functions of our nation's floodplain areas.

The Nature Conservancy has focused for some time on the improvement of floodplain habitats and ecosystems both within Puget Sound and across the nation. This report was requested by The Nature Conservancy to gain an understanding of the perspectives and needs of people involved in the day-to-day management of flood issues in Puget Sound. In particular, The Nature Conservancy was interested in better understanding the criteria flood management decision-makers use as they consider flood programs and projects and the concerns and barriers they face. The Nature Conservancy was interested in how and if economic information related to multiple benefits such as open space, salmon recovery, and water quality improvements was used and if decision-makers considered or used "green infrastructure" in their flood risk reduction efforts. For the purpose of this report, "green infrastructure" is a term that includes protection of naturally functioning floodplains, wetland preservation and restoration, levee setbacks and removals, and other designs that incorporate more natural floodplain processes. "Gray infrastructure" is a term that includes use of floodwalls, rock armoring and levees that are designed with a predominant focus on flood risk reduction.

Methods

To gain an understanding of these perspectives, online research and document review was completed and a series of interviews and discussions were held with Puget Sound decision-makers during the spring of 2013. Some people interviewed are tasked predominately with flood management; however, most of the people interviewed are responsible for broader floodplain management issues, which include stormwater, water quality, salmon recovery or agricultural preservation. Puget Sound interviewees included dike district staff or former commissioners, city and county floodplain managers, County Commissioners, and floodplain technical and policy staff. Staff from federal and Washington state agencies were not interviewed at the request of TNC as their input is being gained in other forums. Tribal staff from two tribes was contacted, but were unable to participate in interviews. Several Puget Sound and national case studies were explored in greater depth as examples of either significant failures or successes related to designing and constructing flood reduction programs that simultaneously provided improved ecosystem functions.

The Nature Conservancy has been provided with an in-depth set of detailed notes from each interview, however per the agreement with those interviewed, these notes are held confidentially within TNC. One set of interview notes was not provided to TNC at the request of the person interviewed. TNC was also provided a set of specific recommendations based on the synthesis that follows. The interview questions are provided in Appendix A. Definitions of a few commonly used terms and acronyms are provided in Appendix B.

Document Organization

This document is organized as follows.

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Disclaimers

Floodplain management, programs, permitting, standards, and funding are incredibly complex, dynamic, overlapping, conflicting and spoken about with differing terminology. It is important to note that a rigid and formal interview process was not followed and the questions found in Appendix A served only as a starting point for discussion and were not covered in entirety with each person. Thus, this document is the result of MacIlroy Consulting's synthesis of responses by interviewees to open-ended questions and may not reflect the ultimate perceptions and interests of those interviewed. The report should be used to inform potential next steps for The Nature Conservancy and guide additional follow-up and outreach work, not as a rigid and comprehensive set of conclusions.

Due to the complexity of floodplain management MacIlroy Consulting and The Nature Conservancy chose to conduct fewer but more in-depth interviews instead of reaching a larger interview pool. While this approach limits the number of individual perspectives that contribute to this report, the commonality of responses across even the limited pool of interviewees is notable, both within and outside of Puget Sound, Washington.

Given only 18 people were interviewed for this report and the relatively small flood management community, specific names of those interviewed and the location of the case studies have been withheld to protect those interviewed.

Acknowledgements

TNC staff have expressed their gratitude for the direct, honest and candid responses of those interviewed and greatly appreciate and acknowledge the significant amount of time those who participated in this process provided to MacIlroy Consulting.

SECTION 1: FLOOD MANAGEMENT IS CHANGING

The philosophy, vision, information and culture driving flood management have changed dramatically, with significant shifts occurring over just the last two decades. In general there has been an overall shift from single purpose flood control to an integrated approach to flood risk reduction and improving ecosystem health and functions. Responses from interviews and information discovered through online research clearly highlighted a variety of changes to the flood management community.[i] While the changes synthesized below are not exact for every system in Puget Sound, flood managers and documents from across Puget Sound and from the outside case study areas routinely described these overall trends.

The transformation of flood management is driven by a variety of factors including changing values, policies, and regulations; improved capacity to technically evaluate river systems; improved coordination; increased expense and complexity of maintaining and improving infrastructure; and a perception that flood magnitudes and frequencies are increasing.

The result appears to be that flood managers increasingly consider stormwater, water quality, salmon recovery and other multiple benefits. It also appears that the era of believing 100-year flood protection should be provided in most places is giving way to a more nuanced evaluation of what is really needed, and possible, to construct and maintain.

1.1 Changing Values, Policies, and Regulations are Transforming Flood Management into Floodplain Management

This section focuses on first on changing values and then on the changing policies and regulations that are transforming flood management into floodplain management.

1.1.1 Changing Values

The focus of efforts in the middle to late 1800's was on "river improvement." A channelized, frequently dredged, armored and leveed river was seen as providing the highest community benefit through the efficient conveyance of water, increased transportation corridors, improved drainage and reduced flood risk. Stretches of levees and dikes were often built and maintained by farmers and local communities, the federal government, and others played a role in dredging activities. The river appears to have been viewed predominately as a source of transportation, water supply and commerce; something that could be tamed.

As frequent floods inundated burgeoning local communities and regularly destroyed infrastructure - people, communities and the government began to focus on "flood control." This flood focus led to a more systematic engineering approach to the river that included building dams and better-constructed dike and levee systems. This new approach consciously sought to protect and encourage new and developing infrastructure including developing rural floodplain cities. At times, absent an overall management system, "dike wars" commenced. Dike wars occurred when people, in various parts of a river system, sought to protect their own interests, and absent a larger unified effort, would increase the height of their dikes to shunt floodwaters elsewhere. Flood control projects appear to have been undertaken with minimal understanding of the ecological impacts, long-term risks to developing floodplain communities or the limitations, both short and long-term, of a constrained river system.

As values, regulations, governments and communities have changed, the concept of floodplain management has begun to emerge. Floodplain management today is a more integrated vision that often includes managing to achieve results for stormwater, water quality, urban growth planning, listed species and Treaty Trust obligations, and environmental and community amenities in addition to flood management and risk reduction for human safety and protection of property.

It is not possible within the scope of this report to ascertain all the causes of the movement toward this more comprehensive approach, but it is important to note some of the important shifts below that have occurred in just the last 20 years, since the 1990's.

1.1.2 Changing Policies and Regulations

There has been a significant shift in the regulatory landscape for counties and cities and those seeking permits for maintenance, repairs and capital improvements of flood control

structures. The focus of the changes noted below is at the national and statewide scale. It is likely that local regulations have similarly changed, but that was not researched for this report. These changes have impacted how people and institutions view and respond to flooding impacts and it is clear from interviews that it has shaped the vision floodplain managers create for the floodplains of the future. The following list provides examples of changes and is not comprehensive.

- Growth Management Act: The GMA requires state and local governments to manage Washington's growth by identifying and protecting critical areas and natural resource lands (including floodplains), designating urban growth areas, preparing comprehensive plans and implementing them through capital investments and development regulations.
    - Adopted in Washington State 1990
- National Pollutant Discharge Elimination System: As authorized under the Clean Water Act, NPDES controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Stormwater generated from development built prior to 1990 was not treated and is discharged into the local waters without treatment. Sites developed after 1990, have to meet new stormwater regulations.
    - First Phase 1 permits issued 1995
    - First Phase II permits issued 2007
- Endangered Species Act: ESA was designed to protect critically imperiled species from extinction as a "consequence of economic growth and development untempered by adequate concern and conservation."
    - Puget Sound Chinook listed in 1999
    - Puget Sound Salmon recovery plans adopted in 2007
    - Puget Sound Steelhead listed in 2007
- Shorelines Management Act: The overarching goal of the SMA is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines" through the development of Shoreline Master Programs.
    - In 2003 all city and counties were required to update their 30-year old regulations
- Federal Emergency Management Act's National Flood Insurance Program: Congress created the NFIP to help provide a means for property owners to financially protect themselves. The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the NFIP. Participating communities agree to adopt and enforce ordinances that meet or exceed FEMA requirements to reduce the risk of flooding.
    - 1994 Community Rating System began which encouraged outreach and education to communities at risk to flooding
    - 2008 Biological Opinion issued by National Marine Fisheries Services (FEMA BiOp) requires NFIP implementation to meet the requirements of the Endangered Species Act
    - 2011 Cities and counties begin to respond to how they will meet the conditions of the FEMA BiOp
    - 2012 Community Rating System program values habitat improvements for first time and devalues home elevation strategies

    - 2012 Biggert-Waters Flood Insurance Reform Act
        - Does not forgive any portion of the 17 billion NFIP debt and requires FEMA to create a repayment schedule for funds borrowed from the Treasury. It directs FEMA to include catastrophic loss years when assessing flood risk in order to set and collect annual risk based premiums.
        - Requires FEMA to develop risk models, flood zones, and insurance rates that account for several typical non-accredited levee scenarios. This acknowledges previous Flood Insurance Rate Maps did not accurately reflect residual risk behind or below flood control structures, giving residents living behind them a false sense of security.[ii]
- Federal Emergency Management Act's Mitigation Program: Hazard Mitigation programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages.
    - 2004 Repetitive Loss mitigation programs started
    - 2009 Washington State home elevation requirements no longer allow for more than a 10% expansion of home footprint when rebuilding in floodplains
- US Army Corps of Engineers System Wide Improvement Framework: SWIF (sometimes also seen as SWIP) is a plan developed by a levee sponsor and accepted by USACE to implement system-wide improvements to a levee system (or multiple systems within a watershed) to address system-wide improvements, including correction of unacceptable inspection items, in a prioritized way to optimize flood risk reduction while maintaining Public Law 84-99 status. It supports local and federal efforts to develop solutions that achieve multiple requirements (Treaty Trust and Endangered Species Act obligations). [iii]
    - 2011 SWIF launched (being pursued in several Puget Sound watersheds)
- USACE Certification and FEMA Accreditation: Levee certification is a technical finding for floodplain mapping as part of the National Flood Insurance Program previously performed by USACE. An "accredited" levee is a levee that FEMA has shown on the Flood Insurance Rate Map as providing flood risk reduction from at least the 1% annual-chance flood.
    - Recent changes to USACE policies now require local governments to seek third party evaluation rather than the previously low cost and quick USACE certification.
- Recent changes in FEMA flood hazard mapping and levee decertification by US Army Corps of Engineers alerted a number of floodplain residences and businesses to the fact they live in a floodplain and are at risk of flooding.

As will become apparent through the rest of this report, the changing nature of federal and state policies regulations is an important driver of flood management.

1.2 Improved Technical Capacity

The technical capacity of local floodplain managers and the tools they have access to has contributed to the changes in floodplain management. Interview respondents noted the relative newness of Geographic Information System (GIS) capabilities, the ability to make

high resolution maps through LIDAR, salmon recovery spatially explicit implementation plans, better hydrologic modeling capabilities, longer timeframes for data evaluation, increases in monitoring and data acquisition, access to reports and information via the World Wide Web, aerial photography, increased computer capabilities and staff expertise and a myriad of other tools and resources. People noted the significance of this improved technical capacity because it allowed them to be more explicit, and has lead the way for people to see how different elements of the floodplain are connected. At times this has fostered a more coordinated and collaborative approach.

> *"Our staff laid out a plan for what toppage elevations should be. Since that plan was made the dike districts have really gone along with it – it used to be a war out there with people raising dikes. This has really changed. Hydrologic modeling has helped people see how they are connected."*

1.3 Improved Coordination and Interaction

Several significant shifts in coordination have occurred over the last 20 years that change the fundamental nature of how visions for floodplains are created and the scale of effort that can take place in terms of ability to raise and coordinate funding and implement flood programs and projects. Interestingly it appears there are increases in coordination happening both within and across governments. Also interviewees noted increased interactions between tribal governments and local governments with one dike district staff meeting with tribal staff for the first time following my interview.

The following bullets provide a sense of some of the improvements in coordination that were noted through interviews and research.

- Countywide flood control zone districts have recently formed in Whatcom, King and Pierce counties. These FCZD's have taxing authority with the capacity to raise greater levels of funding for coordinated flood management at the county scale. Annual funds raised range from roughly 1.5 to 35 million for capital improvements with additional funds raised for operations and maintenance.
- Dike districts that were interviewed are coordinating maintenance and levee heights.

  > *"I tell you when I was up in that helicopter in 2006 and I saw all of our levees overtopped—throughout the whole system and not a one of them breached. Now that is teamwork. It wasn't always like that. They came to agreement. It was the end of the dike wars. Those old farmer's would be buying each other drinks while someone else was on a tractor making their side of the levee higher. We just don't do that anymore."*

- Several staff interviewed acknowledged the need to look systemically at how to balance flood risk reduction and safety needs with other requirements like ESA. People noted that the US Army Corps of Engineer's new System-wide Improvement Framework planning process is one potential avenue to accomplish this.

- Several county staff noted how much internal coordination among their different divisions had improved resulting in better integration and planning for stormwater, flood control, salmon recovery and agricultural programs.

1.4 Increased Expense and Complexity

The expense and complexity of flood projects has stimulated significant changes in the approach, management and staffing of local governments involved in flood management. Almost everyone interviewed noted the increasing expense and complexity of building, maintaining and improving flood control facilities and infrastructure. This appears to be largely caused by permitting, increased staff requirements both in terms of number of staff needed as well as level of expertise required, lack of dedicated funding that results in having to solicit and manage funding from a variety of sources, larger and more complex and integrated projects, and a constantly changing and complex regulatory environment.

1.5 Managers Sense Changes in Flood Patterns and Wonder About the Future

Nearly everyone interviewed acknowledged that floods appear to be occurring more frequently, with greater severity and in the meantime more infrastructure and people have been put in harm's way. Specifically, interview respondents noted the floods of 1990, 1995, 2003, 2006, 2007, and 2009. This is consistent at the national scale where over the last 44 years the National Flood Insurance Program's five catastrophic loss years (defined as payouts of $1 billion or more) occurred in 2001, 2004, 2005, 2008, and 2011.[iv] In addition to more frequent and severe flooding, people also acknowledged that major floods are coming both earlier and later than has previously been experienced.

> *"It is clear the weather has changed as has the landscape. I have lived in this valley my whole life. It just isn't the same. Now with heavy rains you can see the flows simply come faster. You can feel and see the difference."*

Scientists suggest that warming and precipitation change have been implicated in observed changes in flood risk in Puget Sound. While observed precipitation change is probably mostly an expression of natural variability, it is consistent with cool season increases in precipitation projected by climate change scientists for the Pacific Northwest. Observed warming is likely due to a combination of climate change and natural variability with increases in temperature since the 1970's more strongly coupled with climate change. While University of Washington climate change scientists at the Climate Impacts Group believe it is not yet possible to statistically discern current changes in peak flow events from natural variability, the trend toward more frequent and severe flooding over an extended flood window is consistent with the trajectory scientists have suggested.[v]

Lastly, several of the interview respondents cited concern about increasing issues with sediment filling in river channels and altering flood risks and levee functions. Floodplain managers and an elected official noted that they did not have good access to climate change projections related to peak flows and changes in sediment transport and deposition.

Given these factors and others, nearly everyone expressed concern for the future and their ability to fulfill their flood management responsibilities.

1.6 Flood Management Increasingly Considers: Stormwater, Water Quality, Salmon, and Open Space

Over the last 25 years, local and state governments have set up new processes and programs relative to the hydrologic, ecological, social and regulatory systems to which they are responsive. All interviewed dike district, city and county flood managers, noted that they increasingly consider ecological factors.

Interviews suggested consideration of multiple benefit factors:

- Due to a values preference for multiple-benefit approaches to floodplain management,
- By requirement through the permitting processes or other governmental obligations,
- To stay competitive for limited grant funding,
- Due to a desire for highly local benefits such as parks or open space, or
- Some combination of the list above.

1.7 Flood Protection Vision is No Longer One Size Fits All

It also appears from interviews and documents, that an era of believing flood protection should be provided in most places is giving way to a more nuanced evaluation of what is really needed and possible to construct and maintain. Several floodplains managers are questioning if achieving 100-year flood risk reduction across entire systems or large portions of systems is feasible or desirable.

> *"Our last flood plan had 100-year flood protection standard everywhere. We cannot afford to make this a reality."*

Some areas can no longer afford to maintain their infrastructure and are slowly letting it degrade either by conscious decision or through simple lack of action. On the other end of the spectrum several flood managers are considering 200 to 500-year protection standards for their high value industrial areas where there is concern with the level of risk presented by the 100-year standard.

SECTION 2: CIRCUMSTANCES AND FACTORS AFFECTING FLOOD MANAGEMENT DECISIONS

2.1 Flood Management Institutions Function Differently

Institutional circumstances appear to influence floodplain management decision-making, and not all management institutions are the same across Puget Sound. Various combinations of limited and multiple purpose governments manage Puget Sound floodplains. Special purpose districts, like flood control districts and flood control zone districts, are limited purpose local governments separate from a city, town, or county government that perform limited functions. Cities and counties are multiple purpose governments. This is important as governments have different resources, capacity, and mandates that affect their vision for their flood infrastructure, their ability to partner,

secure and manage funding, and potentially their ability to consider green infrastructure options.

For instance, county and city floodplain managers and elected officials sit within multiple purpose governments that carry broad obligations under the Growth Management Act, Shoreline Management Act, Endangered Species Act and the Clean Water Act. Based on interviews it appears that this broader obligation is carried forward to some degree for County-wide Flood Control Zone Districts, because while they are special purpose districts focused on "undertaking, operating or maintaining flood control projects/stormwater control projects for areas of the county,"[vi] their decision-makers are all county or city elected officials that carry sensitivities to their broader responsibilities.

The broad ranging set of responsibilities and obligations carried by cities and counties, and even the Flood Control Zone Districts, is different from the Dike Districts. The purpose of the dike district is stated as "Construct, straighten, widen, deepen and improve all rivers, watercourses or streams causing overflow damage to land in the district."[vii] While the actual services provided include environmental protection in addition to public safety, staff emphasized, in interviews, their focus on flood risk reduction. Dike district staff and Commissioners frequently come from the farming and rural industrial community and may have no professional connection or institutionalized mandates to achieve the broader responsibilities set forth for multiple purpose governments like cities and counties. Their geographic size is also significantly smaller than the County and Flood Control Zone District areas.

These differences at times have implications for the criteria staff and elected officials use to select and implement projects, the information they have access to, the expertise and experience they have, the extent of the landscape they control, the suite of tools (regulatory and voluntary) at their disposal and thus their vision for the flood control systems they manage.

Based on findings from this research and interviews, city and county governments appear to have access to more and broader information; have technical and policy staff; are charged with protecting listed species, meeting water quality standards, protecting shorelines and creating livable communities in addition to flood control; and frequently operate at larger scales. They have a variety of means to access funding and pay for costs associated with floodplain management. Larger numbers of staff provide opportunities to seek and manage complex grants and participate in collaborations or partnerships. They, as institutions, are regularly engaged in broad public processes.

Dike districts on the other hand, are often completely voluntary or have very limited staff. While they have significant taxing authority, their base tends to be smaller geographic areas that are largely rural in nature. They also are directly taxing their neighbors and themselves in very close knit and small communities. Those interviewed demonstrated a highly detailed on-the-ground understanding of their districts, but they tended to have limited access to technical or policy information absent county, city or tribal partnerships, and have limited capacity to operate beyond their district without financial or broader institutional support. Dike district staff and others who work directly with the dike districts noted how they have been accustomed to dealing with dikes themselves in terms

of fixing repairs with their tractors or dumping rock. The increase in permitting, project scrutiny, complex grant requirements and other changes over the last half-century appear to come up against an apparent long-term culture of self-sufficiency and independence of action that is a source of pride.

2.2 Flood Control, Land-use, Insurance – A Conflict in Values

Many managers appeared to struggle with conflicting values and visions for floodplains that show up in levels of flood protection provided, land-use policies and regulations, and flood insurance mapping and rates. In Puget Sound some areas have no flood protection infrastructure or have levees designed to overtop with some degree of regularity (i.e., a 25 or 30-year flood) while other areas are basically designed with the intent that a flood will never occur (i.e., the Kent Valley). This varying degree of the level of flood protection interacts in both transparent and less clear ways with land-use, flood insurance and subsequent decision-making.

Dike district staff interviewed was especially critical of the lack of connection between land-use and flood control. For instance, one manager noted that if county policies allow for a structure of high economic or social value to be built behind a levee that is designed to overtop, then increased pressure to improve the level of protection or deal with drainage problems is often exerted by the community over time and the dike district is responsible for figuring out how to achieve this. Another noted how the county allowed a slough to be filled to provide additional farmland for a single landowner. The result of the slough being blocked is that now multiple houses frequently flood.

> *"There are places to grow and places not to grow. For instance, right now, we are building a regional health center,* ***right now!*** *in the floodplain behind a 25-30-year levee."*

> *"Land-use is concerning, but the dike district stays out of these discussions. It is hard, they make decisions that affect us, like allowing a slough to be filled and then we are told it is our responsibility to get the water out. How?"*

Also, traditionally as local governments met USACE and FEMA requirements, areas behind 100-year protected levees were essentially "removed from the floodplain." This process of "removal" often resulted in changes in land-use regulations and reductions or elimination of flood insurance requirements. This value of incentivizing development in floodplains comes in conflict with the value of "getting people out of harm's way." Several people noted that these conflicted values create significant issues with decision-making. People valuing getting people out of harm's way see land-use policies and insurance mapping and subsidized flood insurance as creating a false sense of security, generating a sense of entitlement to flood protection, and disregarding the impact one person's gain has on another. People valuing incentivizing development felt the flood risk can be reasonably mitigated; that floodplains are some of the best locations for jobs and the economy; and cities, businesses and individuals have already made investments in floodplain areas that should be maximized.

These differing values appear to influence decision-making significantly and are still being considered in terms of economic consequences, costs, comfort with the level of risk and other factors at local, state and federal levels.

Two managers also noted how decision-making has in many instances turned towards a perception that flood risk reduction is more about a bureaucratic paper exercise than a real exercise in accepting and taking reasonable steps to lower the risk of a major disaster. Respondents noted that this perception of flood management being a bureaucratic paper exercise is compounded by changing modeling, conflicting information based on different data sets or assumptions, changing FEMA policies and frustrating bureaucratic roadblocks that have major local implications. They also wondered if floodplain management essentially *is* at times a bureaucratic paper exercise that has lost its ability to speak to either of the underlying values.

> *The second big issue is FEMA remapping of the floodplains and flood hazard zones where the new maps and new criteria included a number of properties that were not in the floodplain before. As you can imagine the locals are very upset because they see their land values plummet, their permitting and regulatory burdens increase and it is almost like "red-tagging" them. What makes it more frustrating is that that portion of the system actually has certified dikes that FEMA recognizes but those dikes tie into a railroad grade that can't get certified – so the whole system fails certification. So because of a process step, FEMA won't recognize this feature even though the railroad grade is probably better built than the dikes. People are furious."*

2.3 Risk, a Critical Factor in Floodplain Management Decision-making

> *"Floodplain management is really about risk. Risk is essentially about frequency and consequence. One could really argue that levees do nothing for consequence but play a significant role in frequency. I think this is the crux of the issue. We have allowed people to build in the floodplains and as we have built levees, we have essentially increased our risk in terms of the consequences we face if a levee fails."*

The community and decision-maker perception of risk is one critical factor noted by many of those interviewed. The interviewee quoted above defines flood risk as both the frequency (or likelihood) of flood taking place and the consequence if it happens. This is a useful construct that many other managers referenced either in parts (risk of frequency or risk of consequence) or in entirety as they spoke of the systems they manage.

When flooding is both frequent and severe it appears to potentially influence the focus of floodplain management decisions and the role stakeholders play in shaping solutions in significant ways. In both case studies outside of the Puget Sound where significant multiple benefit flood risk reduction efforts were undertaken, programs were enacted because of severe and repetitive floods that engaged and motivated local communities to act. It is important to note that not only were floods repetitive, but the flooding impacted not only poor and disenfranchised communities, but shook the financial and leadership core of the community. Interviews suggest that absent the frequency of flooding and its

significant impacts (both in quantity of the citizenry affected and the magnitude of the economic and human life loss) what was accomplished would not have been possible.

In several of the interviews, managers noted how their communities and decision-makers reacted and prioritized differently based on their experience with either flood frequency or consequence. In some areas that have not flooded in 60 years, those interviewed noted how stakeholders were focused largely on regulations which limit or proscribe development, improving land values by changing flood risk status, and reducing insurance rates and requirements.

> *"My constituents want to be back out of the floodplain."*

As noted in the first quote, the perspective of "wanting to be out of the floodplain" by improving levees to gain USACE certification and FEMA accreditation, may reduce the risk associated with frequency but do little to reduce the risk associated with consequence. Some managers noted with frustration that government programs that support only the concept of reducing flood frequency without maintaining an awareness of consequence are failing to serve their communities well over the long-term.

In areas where there is frequent flooding or risk of flooding, respondents noted how their communities have been focused on reducing the consequences of flooding through home elevations, critter pads, home buy-outs, and flood control improvements. Many respondents noted that frequently people in Puget Sound love where they live and don't want to leave, though the ability to mitigate and reduce flood frequency was noted as often being significant in decision-making over time.

> *"Flood mitigation risk reduction is the most frequent and urgent service requested by city residents. If there is a public meeting, flood risk reduction will be the topic. People love living in the City and don't want to leave but also see what is at stake."*

2.4 Cost to Reduce Flood Risk vs. Cost of Problem a Critical Factor

Interestingly, both areas researched outside of Puget Sound that had successfully implemented large-scale system-wide flood risk reduction programs that also achieved broader ecosystem and community benefits had an approximately 1:2 ratio of what it cost to make the flood risk reduction improvement relative to the damages they had incurred. In one area, the economic damages incurred were on the order of 500 million dollars while the proposed fix was around 200 million dollars.[viii] Puget Sound has not seen nearly the economic and loss of life destruction that occurred in either of the two outside case study areas, yet the level of investment needed in Puget Sound is comparable with several county flood programs proposing 200 million dollar flood management plans. It is important to note that the areas with this level of proposed funding have the possibility of similar or much greater economic damage and loss of life than actually occurred in the case study areas, but it requires people to make decisions based on comparing the cost to reduce flood risk against the *potential* cost of the problem as opposed to actual damages.

2.5 A Common Set of Technical Criteria are Used to Select Projects

Flood management decision-making criteria and processes are fairly consistent across Puget Sound with some difference between the cities, counties and flood control zone districts and the dike districts. Most counties and flood control zone districts had institutionalized sets of criteria and processes for selecting projects and many had either recently developed flood plans or plans that they felt were sufficient.

It is worth noting that all managers and decision-makers seemed to go through some process of:

1. Identifying problem areas
2. Identifying possible types of solutions
3. Final design and permitting

Most managers use specific technical criteria, either documented or understood, to determine which projects should be pursued. As programs and projects are moved to final decision-making, which is often approved by elected officials, project decision-making can be influenced by political factors perhaps providing different weights and considerations beyond what is included in the staff process. Dike districts tend to be smaller and the problem areas are already well known. They utilize similar criteria to the cities and counties in terms of identifying possible types of solutions but are much more restricted as is mentioned above in their ability or interest in assessing a wide range of possible solutions absent other partnerships or interests.

Examples of the types of staff-level criteria applied to each of the steps noted above follows. A fuller set of criteria can be found in Appendix C. While slight differences occurred, these criteria are almost uniformly used with varying weights by those interviewed in Puget Sound.

1. Identifying problem areas
    a. Existing land-use of affected area (i.e., critical facilities to recreational)
    b. Severity of potential flood or channel migration impact (i.e., loss of life to inconvenience)
    c. Area of impact (regional to highly localized)
    d. Frequency of flood or channel migration occurrence
    e. How soon will impact likely occur

2. Identifying possible types of solutions
    a. Project effectiveness
    b. Durability of investment
    c. Cost of project relative to the economic benefit of the project
    d. Cost as a priority relative to other priorities
    e. Ability to raise funds
    f. Timing of funding availability
    g. Impacts or benefits: on other areas, drainage, ecosystem, community

h. Addresses other priorities: Endangered Species Act, Growth Management Act, Clean Water Act
i. Partnerships and access to new funding
j. Land ownership (public or willing landowner)
k. Project readiness
l. Feasibility
m. Mitigation requirements
n. Ability to meet FEMA, Corps, Natural Resources Conservation Service, or other applicable standards

Few staff spoke in any detail to the design and permitting criteria and focused more on the barriers and difficulties with this phase of decision-making and project advancement. These issues will be covered in the barriers section that follows.

Several staff and one elected official offered that if flood risk reduction projects get into a highly politicized debate then some of the following factors appear to drive decision-making:

- Fairness and equity
- Elected official, key political influencers and stakeholders' perception of severity and their urgency of finding a timely solution
- Certainty of securing project funds
- Funding need relative to other priorities and available resources
- Pressure of community to lower insurance rates, ease regulatory burdens, or increase property values
- Personalities, power, history and trust amongst decision-makers and staff

2.6 Economic and Human Safety Factors Drive Area Prioritization – Problems Solved Through Multiple Benefit Projects

Many respondents noted that an evaluation of traditional economic and human safety factors lead to the identification of areas for maintenance and improvement, while managers often sought to solve identified problem areas with multiple benefit solutions. As one floodplain manager stated, *"I guess I would say that we identify the problem because of economics and we fix the problem through multiple benefits."*

Many flood managers noted that multiple benefits were key to solving problems because sometimes solutions could address multiple stormwater, Endangered Species Act, or water quality requirements. Those interviewed also noted the important role that accessing additional funding could provide and that much of the additional funding was made possible through salmon recovery or other multiple benefit programs. All respondents also noted the increasing difficulty associated with getting through state and federal permitting if the project was not designed to meet, at a minimum, certain environmental standards.

"There has been a significant change that has occurred over the last years. Now people always think about fish. Fish are always considered."

SECTION 3: BARRIERS TO EFFICIENT AND EFFECTIVE FLOODPLAIN MANAGEMENT

The following sections describe barriers and factors that are continuing to shape and influence efficient and effective floodplain management in Puget Sound

3.1 US Army Corps of Engineers Constraints Are Significant

Most people interviewed, both within and outside of Puget Sound, felt that US Army Corps of Engineers (USACE or Corps) as it currently operates is one of the most significant barriers to successful floodplain management and project implementation. People's criticism included all aspects of the Corps work, with the sole exception that local flood management staff noted and greatly appreciated the role the USACE played in the actual "flood fight."

The depth and breadth of concerns expressed related to the USACE and even the nervousness raising the issue, ("this is not politically correct", "I shouldn't say this", and "please don't quote me") give a sense of the magnitude of the issue and the complexity of even raising it for discussion.

"I'd have to say we were successful in spite of the Corps. They were, and still are, our biggest barrier."

The following is sampling of some of the concerns raised during interviews regarding the USACE:

3.1.1 Staff and leadership turnover

Both within and outside of Puget Sound those interviewed stated that regular turnover in project managers and USACE leadership creates challenges given the highly complex nature of floodplain management. Respondents from three different parts of Puget Sound and one of the case study areas outside of Puget Sound noted how the lead project manager had shifted 3 - 5 times during the life of a single project. New managers were noted as having different skills, ideas about what should be done, extended or changed the course of permitting and took local staff time to bring up to speed.

3.1.2 Current benefit-cost analyses don't include local factors of importance

Some of those interviewed noted that current benefit-cost analyses do not include factors of local importance like the project benefits and cost-savings of projects that address responsibilities like stormwater, water quality, and Endangered Species Act requirements or other local community benefits like parks, open spaces or other value-added attributes.

> *"Cost-benefit is huge but relates to monetary and infrastructure needs only (how much does it cost relative to the value of the infrastructure, commerce, and things like the railroad bridge, traffic volumes affected, etc). We would like for the Corps to put value on other things, but the Corps just doesn't work in those numbers and nothing is looked at that isn't through the Corps process."*

3.1.3 Concerns regarding General Investigations and System-wide Improvement Frameworks results relative to investment

General Investigations are analyses that result in a federally adopted plan for lowering flood risk. They hold the promise of bringing federal implementation dollars to build significant flood risk reduction programs. Many of those interviewed spoke to the intensive effort that the USACE run GIs have taken and the lack of discernable outcome or confidence that federal funding will be forth coming once the project is completed.

The System-wide Improvement framework is a relatively new USACE program that seeks to address system-wide flood issues consistent with other federal responsibilities (to the Tribes and ESA). Some who were interviewed expressed nervousness that the SWIF effort, while appealing in its system-wide consideration of multiple factors and that it grants at least temporary relief from the PL 84-99 (see below) vegetation requirements, will take tremendous amounts of time and effort and produce little in terms of meaningful products and on-the-ground impacts. One person expressed hopefulness that something better may result from the SWIF planning effort.

People also noted that the USACE is often slow or not able to incorporate new science and information even if it potentially has significant impacts at the local level.

3.1.4 Poor ability to work at the local level

Some of those interviewed described how the USACE lacks the flexibility, some believed interest, to support and make locally relevant decisions. They cited the USACE's benefit-cost program, the PL 84-99 program, permitting, and the manner in which they conduct themselves which does not feel to some of those interviewed like a partner so much as the ultimate decision-maker.

> *"They just don't do well solving local problems. I am a firm believer that local entities need more control. The Corps views are by and large old and antiquated. They have so much of the control but they aren't vested in our local communities. We live and work here. We have a lot of personal investment, care and concern. They come from outside. They don't live here. In many instances it is not clear that in the end they really care about the local perspective."*

3.1.5 Limited access to federal funds

Several staff interviewed noted that it was uncertain that the USACE would even be able to successfully bring significant federal resources to bear in constructing projects that would actually lower their flood risk. Interviewees noted that the expenses of working with USACE are increasingly clear and significant, while noting that the benefits are less and less clear.

3.1.6 PL 84-99 program

The Public Law 84-99 program allows the USACE to assist participating communities during a flood event (including sandbagging, emergency repairs, providing of clean drinking water, etc.) and provides significant federal funding for levee repair following a flood.

Local concerns with this program include USACE vegetation standards that do not address local government water quality and ESA requirements; benefit-cost implications on rural communities where the program may be disallowed because conservative land-use planning has kept significant development from happening behind the levees; cost of maintaining levees to meet USACE standards; and level of staff time required to participate in the program.

> *"The Corps really has no concept of ESA when it comes to their levee programs."*

The vegetation standards issue has been one of the most significant because it prohibits trees over a certain small size on levees. This standard creates issues in terms of addressing Endangered Species Act needs for listed Chinook and meeting water temperature requirements.

> *"These regulations put [us] in a bind – we have to achieve temperature requirements per Washington State Department of Ecology and the Environmental Protection Agency and then we have to meet USACE standards per the PL 84-99 program. They are in conflict."*
>
> *"I'd say the biggest barrier is really all the distractions. The vegetation management issue with the USACE has been a huge time suck. Now this whole PL 84-99 planning process is going to take a tremendous amount of time."*

3.1.7 Regulatory Process

Concerns about the regulatory process were significant and noted by everyone working with the Corps. These include:

- *Lack of certainty specific to information needed, costs, and timelines:* The lack of certainty of what studies or informational needs are required, the cost that is necessary to allocate to permitting, the duration and uncertainty of the process itself were all concerns stated by multiple managers.

  > *"We have one of the best designed multiple-benefit flood reduction projects ever. It has the support of everyone. I have no idea if we can get it through USACE permitting…"*

- *Mitigation* often does not produce desired results over time and more creative thinking or suggestions from local staff are not considered because they fall outside of rigid rules and guidelines.

- *Rigidity*: many people also noted how the USACE standards and guidelines frequently don't allow for the creative problem-

solving that many managers noted was critical in floodplain management.

"I would go so far as to say it [working with the USACE] is not sustainable and not workable to get projects done if this type of effort continues to be necessary moving forward."

3.1.8 A bureaucracy that is time consuming, inaccessible and impossible to navigate

One interviewee noted the Seattle District used to function more nimbly and respond to local concerns and ideas more effectively. It was noted that there has been a shift to a more bureaucratic, process-heavy, results poor environment over the last several years with more and more responsiveness to USACE headquarters in Washington D.C. than to local partners. Most of those interviewed noted that they felt daunted in navigating the bureaucracy and influencing outcomes because of the amount of staff time it takes to seemingly accomplish very little or far less than what was hoped for.

"If they were difficult to begin with, then they are extraordinarily difficult now."

3.1.9 Levee recertification process and impacts

Many respondents noted the impact of the recent shift in USACE policy that shifted the recertification process from the USACE to a third party consultant. Where levee managers used to easily receive a letter from the USACE recertifying their levees, now they must hire a third party consultant and provide much more documentation and analysis. One manager stated that they had spent $3 million to simply get a list of the improvements needed to meet the new standards. Flood managers are re-evaluating the cost and ability to maintain structures given the significant shift in costs and wondering if the certification process sets untenable land-use and insurance drivers into motion.

"It is a choice whether or not to pursue levee certification and I think people are starting, at least at the staff level, to consider if pursuing certification makes it harder to link land-use and flood risk reduction together. People will have to realize they are incurring risks by living in the floodplain … people have a false sense of security and the costs of certification and maintaining flood control structures are huge and increasing."

3.2 The State and Federal Permitting Process Is Chaotic, Unpredictable and Expensive

"Permits are a major issue for environmentally beneficial projects as well as for flood risk reduction focused projects. Any permitting below the ordinary high water mark takes years. Then when things are built you are subject to the levee requirements. You try to do things right and the regulations just stand in the way."

It is clear from the interviews that permitting and regulations have helped shape the fact that flood managers consider ecological factors and make investments in studies and information to develop more environmentally sensitive projects and programs.

However, those interviewed frequently noted that the current permitting process is creating significant ill-will; hampering creative thinking; costing tremendous amounts of money and staff time; precluding and disenfranchising people with local knowledge; delaying project implementation; and perhaps most importantly a few questioned if the permitting process is even producing the desired ecological results.

"How do we deal with these individual permits? There is nothing to be done. They may ask you for anything they want."

The frustration expressed with the USACE permit process also extended to State permits authorized through Washington Department of Fish and Wildlife and Ecology. Specifically, respondents most frequently cited concerns with USACE Section 404, Joint Aquatic Resources Permit Application, and WDFW'S Hydraulic Permit Application.

> *"Then Ecology calls and they want me to go out to the site to measure the diameter of all of the cottonwoods. I ask why? What will they do with that information? Why do they need it? They have no idea – I am just supposed to come up with thousands of dollars to get the work done. They seem bothered that I even ask why they need the information! When we were on site with the Corps the project manager didn't even know the very basic native trees!"*

Those interviewed cited concern with the length of time, inconsistency and uncertainty of the process and requirements, poor quality analysis and findings, and expense. One manager noted how biologists weigh in on engineering issues and how the permit staff have extensive demands with no consideration of the cost, durability, or flood risk reduction effectiveness of more environmentally friendly designs.

Much of the frustration stated was also tied to the very complex funding packages that flood management staff cobble together and the need to move through permitting in a somewhat expected amount of time to be able to draw on time-limited resources. Also, long and drawn out permitting processes regularly eat up staff and project funding.

> *"Their regulatory division has no sense of urgency, no timelines. Nothing moves. There is no real thinking happening over there. I have brought in the Division Manager. They say everything looks good, but then something isn't quite right. Not quite enough information… I have had to ask for 3 extensions from my grant source. I don't think they will grant me another."*

Several of those interviewed also felt that the permitting process penalized those trying to do the right thing. As one manager stated, *"permitting now makes crooks out of good people."* By this he meant that he felt as if the permit staff viewed him as if he was a crook, as someone wanting to do bad, as opposed to being treated like he was trying to do the right thing and helping him be successful.

Lastly, several managers noted that the permit process could be intensely personal and that biases and personal feelings could ultimately play a role in whether or in what

timeframe a permit was authorized. Managers also stated they felt they had no recourse or ability to affect the process even when ultimately engaging Congressional staff and elected officials.

3.3 Lack of Flexible and Consistent Funding Commensurate with the Need

"I estimate it will take five years to complete the work. You ask if we are on a timely implementation track? If we have a major flood next year, then no. If we don't for the next five years, then yes."

Several counties have fairly recently established Flood Control Zone districts that are countywide efforts focused on stormwater and flood control and flood risk reduction. These districts have the capacity to raise significant ($3-35 Million) levels of funding compared to individual dike districts or smaller cities. Many noted how critical this funding is because it is fairly dependable and can be applied to locally identified needs.

Given many FCZDs are relatively recent institutions, several staff noted it may be possible to increase the amount of funding over time to better address identified needs. While, the highest level of funding was 35 million dollars annually, this is compared to a multi-hundred million dollar, multi-river system need. Based on interviews it appears, FCZDs have recently largely completed routine maintenance and are embarking on significant capital improvement efforts. So even these highly organized districts still have a significant funding need that has to be sought elsewhere. Many managers noted that they receive key funding from the Salmon Recovery Funding Board, Estuary and Salmon Restoration Fund, the legislature and other funding sources. Almost all of the areas have processes in place and existing plans for where and how their systems can best be improved for flood risk reduction, salmon recovery and other factors.

Comments from interviews with dike district staff suggest that the majority of their projects are funded through their tax assessments. Their efforts are at times supplemented for major repairs and projects with grant funding or funds received through their participation in the PL 84-99 or Natural Resources Conservation Service (NRCS) programs. Dike district respondents noted that the majority of their projects are focused on regular maintenance and repair with limited to no capital improvement efforts unless guided by a larger effort such as a USACE General Investigation or other countywide effort.

With this context, the following is a bulleted list of funding concerns, budget shortfalls and barriers identified through the interviews. Many are connected to the underlying issue that flood projects are magnitudes more complex and expensive than in the past.

- Increased need for staffing or consultants (permitting, complex public and agency coordination, complex inter-governmental coordination, modeling, engineering, design, attorneys, grant writing, complex grant management, etc.)
- Maintenance costs are significant and have been unfunded for years, especially in the smaller dike districts.
- Capital improvement needs (scope and magnitude of levee setback projects exceeds current funding)

- There is no regular source of dedicated funds for flood risk reduction through the legislature.
- Grant programs have limitations on what they fund, methods of assessing benefit-costs that make projects ineligible, or timeframes that don't fit within the timing constraints of the project.

> *"We really need pots of money that are not so onerous…funding sources that value things like: the cost-benefit of dealing with polluting septics, parks, open space values, habitat improvements, fish benefits, etc. [these] are [issues] commonly associated with dealing with frequently flooded areas. The current federal programs don't assign any weight to those things."*

- Construction funds for flood risk reduction (i.e., building of levees) can be the hardest to secure because many of the grant funds available are focused on multiple benefits, but won't support the flood component.
- Grant programs that once existed and were critical have been defunded.

> *"Another barrier to implementing projects is that there is no longer funding available to deal with hazardous materials. It used to be that the State had a program through Ecology that dealt with Tanks and Petroleum clean-up - a Toxic Clean-up program. But now that isn't funded. So we have a property … that is an old gas station. We could buy a prime piece of property [for restoration] for $50,000, but we don't know what the clean-up will be. It could be millions. How can we take on that kind of liability without some hope for assistance from the state? So better not to buy it, not to fix it."*

- Need site-specific analyses related to climate change including predicted changes in hydrology, sediment transport and deposition, and sea level rise.
- Need site specific modeling, monitoring and development of system-wide approaches to flood risk reduction that address other issues like stormwater, water quality, agriculture, and salmon recovery.
- Inability to purchase frequently flooded homes that may not meet FEMA qualifications and exceed local funding.

3.4 Need a System-wide Vision and Plan for Floodplains

No one interviewed spoke directly to the overall need for a system-wide vision and plan for floodplains, but many spoke to aspects of it and acknowledged that they had many of the pieces already pretty well developed.

Many managers specifically called out the historically developed landscape they are charged with managing: they noted cities built entirely or significantly in floodplains and floodways, critical infrastructure in high risk areas, levees built to protect agriculture that now protect billions of dollars worth of investments and other challenging situations. They noted how they are managing a system that was built in pieces and across eras with

different values. While they are trying to move toward a more systemic, organized and long-term vision, the existing landscape presents challenging and difficult questions that must be addressed. This is compounded by the fact that the institutions, regulations, and policies that guide floodplain management were similarly built in pieces and across eras with different values. While most areas have fairly well developed flood plans, many of them still fail to really address some of these underlying issues and concerns.

Some of the key questions that local floodplain managers struggle with are:

- How do flood managers support floodplain agriculture and what frequency, timing and magnitude of flooding can it really sustain and remain viable?
- How do flood managers achieve stakeholder or regulatory requirements for no net loss of agricultural lands, no net loss of habitat, salmon recovery and flood risk reduction?
- What is the long-term vision for the small cities that lie either entirely or largely in the floodplain or floodway? How do we balance insurance costs meant to realistically address risk, expense of maintaining and building flood control structures, land-use policies that promote development, and other risk and economic trade-offs?
- How will flood managers address local landowners faced with a migrating channel in areas that are not currently armored or leveed?

> *"What we really need are some pilot projects that focus on soft, cheap-but-effective fixes for agricultural lands that are not [currently] leveed. We have a bunch of stretches along the river that are not armored or leveed but where there will be a need to help with protecting agricultural lands. If we don't' find options, then the farmers will put a lot of pressure to do hard rock fixes because they are cheap and effective. [The County] comes up with projects that require a lot of engineering, construction costs, permitting costs, etc. but the small farmers, private landowners and dike districts simply can't afford that level of investment. What are some cheaper options?"*

- How can we ensure our federal and local spending both protects existing infrastructure in high value locations like the Kent Valley while not penalizing areas that instituted stricter land-use policies in their floodplains?
- Can Puget Sound flood managers clarify their vision for Puget Sound floodplains and through a bigger and louder voice address the common barriers faced by many managers?
- Would a broader vision allow for easier permitting if State and Federal permitting agencies could see the overall plan for flood risk reduction side-by-side with the plan for achieving water quality, stormwater and salmon recovery improvements?
- How do we get the information we need about how the climate is changing so we can address the issues related to changing flood risk?

3.5 Local Barriers

Managers identified the following local barriers.

3.5.1 Challenges of moving individual residences and communities

- Many individuals and communities don't want to leave high-risk flood areas. This is especially true if the area hasn't flooded recently or experienced repetitive flooding of significance. Many respondents noted that the level of funding is so low that they can almost always simply wait repetitively flooded properties out and when it has been absolutely critical they have at times used condemnation.
- FEMA disaster relief undercuts local efforts to buyout homeowners or is even profitable, thus encouraging people to stay in frequently flooding areas.

  "Disaster relief is also a problem. Take for example, after the last flood the disaster people came in and they pay a woman $22,000 for disaster relief. We, the county, can then only offer this woman $6,000 because her property is worth $28,000. The county isn't allowed to double use public funds. But the woman then sells her property for $10,000. So she makes $32,000 instead of $28,000 and the buyer gets a $28,000 property for $10,000. The County ends up losing out because now we have someone else in that property. This property regularly has up to 3 feet of water when it floods. The disaster funding undercuts what we are trying to do locally."[ix]

- Many repetitive loss locations are home to very low income people who have limited other options

  "Another barrier is that out frequently flooded properties are frequently home to the very low income. We come in and offer them $50,000, but as one woman said to me, "where would I go?" These people can't afford to move anywhere else. How can we get them to leave if there is nowhere else for them to go?"
- Many of the areas where flood risk reduction efforts are needed have owners who do not want to give up land to increase levee height, set back levees, or lower levee prism. Cost of land can also be too expensive to easily consider a range of flood risk reduction options.

3.5.2 Elected officials as decision-makers

- One person cited the importance of flood protection programs being focused on community good, acknowledging that it is not possible to protect the individual. However, he felt that elected officials are commonly compelled by the individual case, which can divert limited staff time and resources and create a haphazard flood program.
- Elected official turnover and the frequent lack of flood-related experience means that constant education about flood risk, floodplain management and flood projects is necessary. This requires staff time and expertise in communicating complex technical information to policy makers.

3.5.3 Staff expertise and capacity at the local government (city and county), dike district, state and federal levels.

- Projects are getting increasingly complex and difficult to design, permit, coordinate, conduct outreach for and generally manage. Thus the range, level and cost of expertise required to design and build flood control projects is expanding.
- Internal processes for project management and coordination are increasingly necessary, putting additional strain on limited staff.
- It is only possible for staff to move so much money per year. Receiving additional funds for projects absent increased staff capacity will not help move projects forward.
- Reductions in staff have created shortages. One dike district manager noted that it took 5 weeks to schedule a 1-hour emergency meeting with County flood management staff.

3.5.4 Lack of land-use decisions made consistent with an overall plan for flood control and flood risk reduction

Many of the people speaking in interviews noted that often land-use regulations still allow for additional development in harm's way and are not coordinated with actual flood protections.

3.5.5 Enabling legislation of flood control zone districts

One respondent noted that the enabling legislation for flood control zone districts positions district staff awkwardly between the Executive and Legislative branches of government. This dynamic leads to sometimes conflicted and differing guidance to staff on how to proceed on very contentious issues.

3.5.6 Lack of access to climate-related analysis and information at a locally relevant scale

Many of those interviewed noted that they did not have access to locally specific climate-related data regarding predicted changes in flows, sea level rise or shifts in the transport and deposition of sediments that potentially significantly affects their flood control infrastructure.

3.6 Regulatory Uncertainty and Changing Programs

Almost all of those interviewed expressed frustration at the seemingly constant and difficult to track changing regulatory and political environment around floodplains. While many of these issues are captured in more detail, the level of unrest that has been generated over the last 5-10 years merits special attention as a barrier and influence on effective and efficient flood management.

Most often sited were the:

- Frequently changing federal and state permitting processes and requirements
- The FEMA Biological Opinion and flood hazard mapping changes have created a situation with a lot of uncertainty and high stakes for highly developed floodplain areas. Many respondents noted the extensive requirement of staff time and energy to sort through and address or respond to these changes.

Several also noted the ill will that these changes are broadly generating for those who live in floodplain areas.

- FEMA's Community Rating System changes are shifting what is considered in granting insurance rate reductions, which affects local government's focus.
- Defunding of State programs to assist with costs of hazardous clean-up changes what local governments can accomplish for water quality through their flood management actions.
- Uncertainty associated with USACE programs and regulations requires staff time, expense and is creating a lot of frustration at the local level.
- Uncertainty associated with recent changes to flood insurance policy premiums and the affect that will have on residential and business areas.

3.7 No Standardized Tool for Quantifying Multiple Benefits

Many respondents noted benefit-cost analyses run by both the USACE and FEMA limit their ability to implement project and programs that would best serve local needs and interests.

> *"But the value of things like public access, are not captured anywhere. If we set back this levee and added 100 acres to our city's park system – this gets nothing in the Corps cost-benefit process. But it may be huge, looking forward in terms of setting up projects that are likely to secure other sources of funding and be of local value."*

Those interviewed consider multiple benefits at some point in their decision-making process. However, as flood managers sought to maintain status in current FEMA and USACE programs (i.e., Community Rating System, FEMA mitigation grants, PL-8499, etc.), many interviewees noted that the fact that neither of these organizations included benefits such as water quality improvements, parks, open space, ecosystem improvements, Endangered Species Act contributions or other benefits in their benefit-cost analysis limited locally both the project identification and project development phases of their work. Thus, while interview respondents would potentially prefer to weight these contributions higher in their decision-making, they felt unable to do so. Almost all the respondents noted that additional multiple benefit economic analysis would not be useful unless it was conducted at the project scale because of the larger institutional barriers presented by USACE and FEMA.

"salmon, water quality, eagles, the human quality of life side [are] not captured through the current economic and commerce side. Quality of life is such a big key. See most levees are private. People are dying for places to walk, for walking trails, access to the river. We really have missed it!"

Interestingly, the failure to include a fuller range of costs and benefits also shows up in other ways. Take the following example,

"[Our City] has looked at submitting FEMA grant applications for acquisition, but the properties didn't meet FEMA's cost-benefit ratio…because the program criteria make it more of a damage response than a preventative measure. For example, the fair market … is high so it doesn't make for a successful application if a $300,000 home consistently

incurs $10,000 damage. So now the City rarely pursues acquisition because we know we won't be eligible to get the funds."

For the city cited in this example, there has been $17.7 million paid on 947 claims though November 30, 2009. This represents an average of $18,723 per claim, cumulatively representing the 5th highest payout total in the State of Washington. So while the per-flood cost ratio of damage to the impacted homes isn't significant enough to qualify as part of the program, the cumulative cost of these frequently flooded homes over time is significant within Washington.

3.8 Removing Homes Works, Yet There is a Backlog of Willing Sellers

There is a demonstrable economic and ecological value to removing repetitive loss properties yet new repetitive loss properties are outpacing mitigation at a 10 to 1 rate nationwide and across Puget Sound there is a backlog of willing seller repetitive loss properties or other frequently flooded areas that don't qualify as part of the nationwide repetitive loss program.

In 2007, US Congress directed FEMA to fund an independent analysis of the FEMA Hazard Mitigation Grant program. The analysis showed that "every dollar spent on a FEMA hazard mitigation grant produced, on average, four dollars of benefits—a significant return on public dollar expenditures, comparable to a 14% rate of return on a 50-year annuity." The report goes on to say that, "Flooding [mitigation] has an average benefit-cost ratio of 5.1."[x] The flood mitigation actions assessed in this study were limited to acquisition and buy-out. Reduced environmental damage was also assessed as part of this third party benefit-cost analysis. So economically and environmentally it appears addressing repetitive loss properties is an effective strategy.

Ironically, a 2013 report to Congress states:

> Historically, it is estimated that approximately 1% of the properties insured under the NFIP have accounted for over a third of claims paid…Importantly, the annual increase in new Repetitive Loss Properties is outpacing FEMA mitigation efforts by a factor of 10 to 1.[xi]

It is unknown if this 10 to 1 statistic pertains specifically within Puget Sound and if this increase is being driven by new development, increased frequency and magnitude of flooding or other drivers. However, the total number of repetitive loss properties for all high vulnerability counties in Puget Sound, namely Whatcom, Snohomish, Skagit, King, Pierce, Thurston and Mason is 818 total properties and 71 severe repetitive loss properties.[xii] There are additional properties that were noted by city and county staff that fail to meet the federal guidelines for qualifying as a repetitive loss property but regularly flood. Several managers mentioned that they had a backlog of willing sellers in frequently flooded or high-risk areas caused by their inability to qualify for federal funding and a lack of local funding.

3.9 Gray is Gray and Green is Green

Many managers noted with frustration that "green" funding sources don't pay for "gray" project attributes even when the overall benefits of the project are

ecologically significant. For example, one person noted that he could not use Salmon Recovery Funding Board Funds to rebuild a levee that is being set back with improvements to flood risk reduction, water quality and available salmon habitat. Similarly, many noted that many projects being built today are a combination of "gray" and "green" but funding sources, messaging and partnerships still get hung up in antiquated ideas about the difference between flood control and other multiple benefit efforts like salmon recovery, water quality and stormwater. In indirect ways several people hinted at the fact that the flood control community has come largely around to the importance of addressing ecology and environmental issues, but there is uncertainty if the environmental community has come around to supporting flood control projects.

> *"I guess I have not found that just trying to sell one agenda over another works very well. We have to be able to describe the multiple benefits of these projects even if we don't say all the benefits to everyone. We also may need to push someone else's agenda to get support for our own. We are going to need to be creative to get the work completed that is necessary."*

SECTION 4: IN PUGET SOUND, IS GREEN INFRASTRUCTURE MORE POWERFUL WHEN TIED TO GRAY INFRASTRUCTURE and VICE VERSA?

> *"The project engenders such strong support because it addresses multiple interests and goals in a realistic manner. The project does not rely on a single approach, such as raising levees or moving all structures out of harm's way but combines multiple strategies in a way that makes optimal use of engineering and ecology…. Levees are to be set back, a flood by-pass created, bridges replaced or raised, new levees and dikes constructed."*

The following quote is ascribed to a very successful flood risk reduction project outside of Puget Sound. While no one in Puget Sound spoke as directly or forcefully to the dynamic and possibilities generated by the deliberate and intentional weaving together of green and gray infrastructure, this sentiment seemed apparent in much of the tone and information provided by those interviewed.

People described the benefits and barriers associated with green and gray infrastructure; their love of the areas they are responsible for; their concern for protecting life and infrastructure; and their care for fish, wildlife and open space in a manner that engenders a sense of hope borne of seeing how hard people are working to do what they believe is truly best for their communities.

Most county and city staff interviewed noted the larger role that multiple benefits were playing in project selection and attributed this change to:

- Mandates for local governments to address ESA, GMA, and SMA;
- Access to additional funding; and

- Improvements to the local quality of life.

The following sections describe factors that suggest movement towards a goal of ultimately making optimal use of engineering and ecology through the combination of both green and gray infrastructure.

4.1 Funding, Regulations, and Local Values Driving Towards Greener Infrastructure

There are some critical factors that are driving people to consider green infrastructure where it makes sense. The manner in which flood managers acknowledged the potential to link flood projects to broader community benefits was notable. However, many seemed thwarted by the barriers noted above in terms of how to bridge their visions with the reality of the regulatory environments, institutional constraints and barriers within which they operate.

The following list, while short, is significant in terms of the appeal of green infrastructure options:

- Access to multiple partners
- Access to additional funding and funding sources
- Creation of quality of life improvements
- Ecological improvements
- Meeting multiple government obligations
- The belief it will help with permitting
- Potentially lower maintenance costs

> *"In terms of creating bioengineered projects, we have not had one failure. They are a good design when put in the right place. Maintenance on those projects is definitely good. We have problems with our vegetation exceeding federal standards though. This is a big deal."*

4.2 Green Infrastructure is Likely Not an Everywhere Solution

Green infrastructure is likely not an everywhere solution. Flood managers frequently noted that in some places gray infrastructure is desirable if not the only currently feasible solution. While some of this desirability could likely be influenced if some of their barriers were addressed, it is likely not possible to do so everywhere given limited resources and the existing landscapes described by managers.

Some of the benefits of gray infrastructure that were noted were:

- This is the existing infrastructure and we have built up around it
- Design and project construction is often simpler
- Historically quicker to implement (changing with increased permitting)
- Costs are often less
- Landowner issues are simpler
- Techniques are "known" in terms of their life expectancy and result
- Staff and volunteers are skilled in executing (permitting, project, maintenance)
- Fewer partnerships required
- Because of their size, projects can be funded through regular and available funds

- Some situations are very challenging to address with existing green infrastructure designs or within the larger context in which the site sits
- It is quick, easy and effective to dump rock during an emergency

4.3 Flood Managers are Allies for Green Infrastructure

Flood managers consistently stated, in a variety of forms, their interest in being good floodplain stewards and noted the many ways in which they attempt to balance conflicting values, challenging situations and the ultimate responsibility of protecting life and property. One person noted he did not necessarily always know how to best combine flood risk reduction with ecological benefits and a few noted how those with the responsibility to ensure ecological benefits were being achieved (permit staff) often lacked expertise but perhaps more importantly failed to create situations that engendered trust, respect and creative problem-solving.

Also of importance, is that the flood managers appear to have a culture of creativity that was emphasized in a variety of ways through all the interviews. The managers are people who are faced each flood season with risk and manage crises. Not surprisingly, these appear to be people who thrive on teamwork ("the flood fight"), have strong personalities and views, value logical thoughtful preparation, but are willing to jump in and be creative if the "crisis" dictates otherwise. Most of them specifically cited the critical importance of creativity in their work and the need to be open to new and different ideas and imperfect but good solutions. The managers, in particular, appear to be problem-solvers with an incredibly rich understanding of the systems they manage. Lastly, those interviewed spoke in ways that convey a civic and systemically minded focus on the protection of life likely borne of the clear flood implications of a failure to act in the best interest of the community. This civic mindedness also shows up in their openness to broader community benefits.

Some however, spoke cautiously when speaking of implementing "green" strategies. Based on the larger context and information they provided, it appeared their sensitivities arose from past instances of feeling judged and disrespected, lack of resources or expertise, and the fact that some didn't feel understood in terms of their needs and constraints in addressing flood risk. The following quote states this concern by showing the inverse impact of feeling listened too and listening to others.

> *"This is the furthest we have come to really creating a forum where we can think creatively. It is a place where conversations are candid, personal and personable. There is real talking and real listening. We know the players so we are actually talking and listening rather than hearing only to decipher the quality of person. Without talking and listening you can't create empathy and without empathy there is no room for creative problem-solving. I'm not sure it will work. But we are not all just sitting in our own offices taking pot shots at each other. Before I didn't understand salmon recovery. I really didn't care and it was honestly just a hindrance to my job. But what we are doing is huge. I mean NOAA Fisheries is asking me about flood. And I find myself asking them about fish. We are actually exchanging information that is new to each of us."*

4.4 Long-term Vision, Short-term Game Plan: The List of Barriers is Long

Several managers noted that floodplain management and flood risk reduction specifically are a waiting game. The managers are seemingly adept at having a long-term vision and a short-term game plan. They wait for the right circumstances to act.

The list of barriers for both green infrastructure and gray infrastructure are long, many of them held in common. However, there are some key distinctions that might aid in charting a course of both short and long-term actions to help determine where and when projects that emphasize more the gray or the green side should be implemented.

The main barriers unique to green infrastructure noted were:

- Landowner willingness to remove or setback a levee
- Long timeframes for implementation
- Cost and complexity are significant
- Unknown effectiveness of new techniques
- Liability issues or community concerns associated with green infrastructure techniques such as log jams breaking loose and drainage impairments
- Actual flood risk reduction where needed and at a scale of significance
- Actual determination of a need and a benefit where resources are limited to explore or implement more expensive alternative approaches
- FEMA and USACE programs and processes undercut efforts to fund and execute multiple-benefit flood risk reduction projects

The main barriers unique to gray infrastructure noted were:

- Landowner willingness to set or layback a dike to improve flood capacity
- County and city burden of not meeting Shoreline Management Act, Growth Management Act, water quality, stormwater, or Endangered Species Act requirements
- New levees are not really desired by many flood managers because of their known construction and maintenance costs and environmental damage
- Permitting
- Lack of experience meeting new ecological standards which ultimately hold projects up in permitting and are increasing the cost and timeframe for implementation
- Potentially high maintenance costs depending on design and location

SECTION 5: NATIONAL AND STATEWIDE CONTEXT MAY BE IMPORTANT FOR SOLUTIONS TO BARRIERS

The following context from the national and statewide scale may be important to consider as TNC and others continue working to identify next steps and possible strategies for advancing work in Puget Sound and other floodplains.

5.1 Washington State has a Small Flood Risk at the National Scale

Puget Sound and Washington State present significantly smaller scale flood issues at the national scale. There are many different ways to tally and count flood losses and claims. Thus the following information gives a sense of relative value as exact numbers differ by document, agency, timeframe and method. Generally, 24 states report greater FEMA losses than Washington State. For comparison, Washington has received a total of $239 million in total FEMA claim payments since 1978. This is contrasted by Texas, Florida, Louisiana, New Jersey, Mississippi, New York and Pennsylvania all of which individually have payouts over 1 billion. Louisiana has the highest payout figures at 16.6 billion.[xiii]

Similarly, the National Flood Insurance Program stated in a 2011 statistic that Washington State has 50,660 policies in effect. Again, this is compared to Florida, which has 2,069,735 policies in effect. 15 other states rank higher than Washington State, and 9 of those have more than 100,000 policies in effect. This plays out in terms of the total number of claims through the National Flood Insurance Program from a 2010-2011 statistic. For example, Washington State had 153 claims, while New York and New Jersey each had over 20,000. While the flood season of 2010-2011 was not considered a significant flood year in Washington by most accounts, this graphic still provides a sense of relative scale of flooding issues at the national level. For instance New Jersey has over 200,000 policies in effect, so a reporting of 20,000 claims is still just 10% of their total policies held.

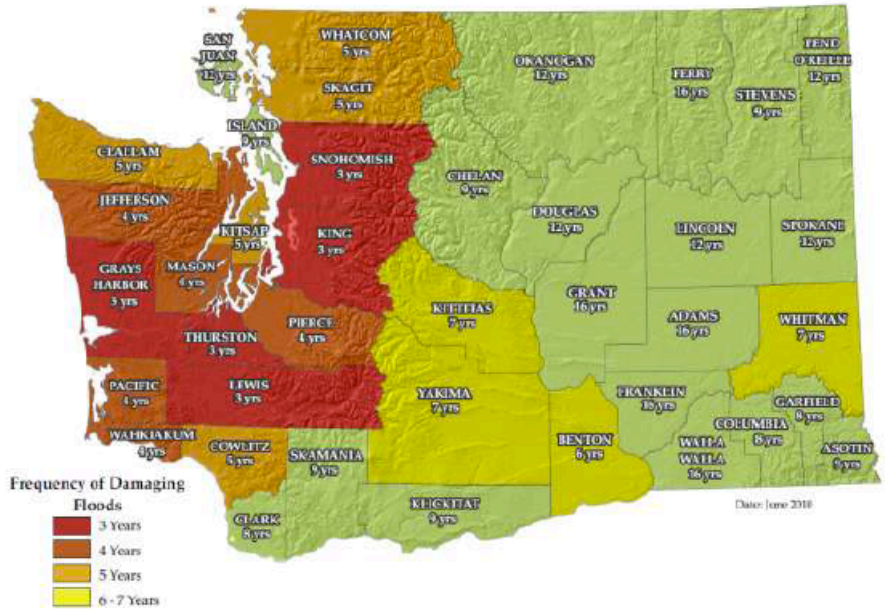
Compared to other states facing flooding problems, Washington's issues are relatively minor. This potentially affects Washington State's ability to easily influence or gain national attention for its concerns and issues regarding national flood policies and programs or may affect its ability to garner federal funding in support of efforts solely directed at flood risk reduction. This is especially true relative to the National Flood Insurance Program, which is currently more than 17 billion dollars in debt.[xiv]

5.2 Puget Sound has a Significant Flood Risk Within Washington State

The Washington State Hazard Mitigation plan has a series of graphics that show risk, vulnerability, and frequency of flooding that has caused major damages since 1956 across the State of Washington.[xv] The important role Puget Sound plays in Washington State is clear from both graphics. The second graphic, focused on flood frequency, shows that since 1956 there is already flooding causing significant financial damage occurring every 3-4 years in some areas.

Counties at Risk and Vulnerable to Floods

Frequency of Flooding Causing Major Damage, 1956 - Present

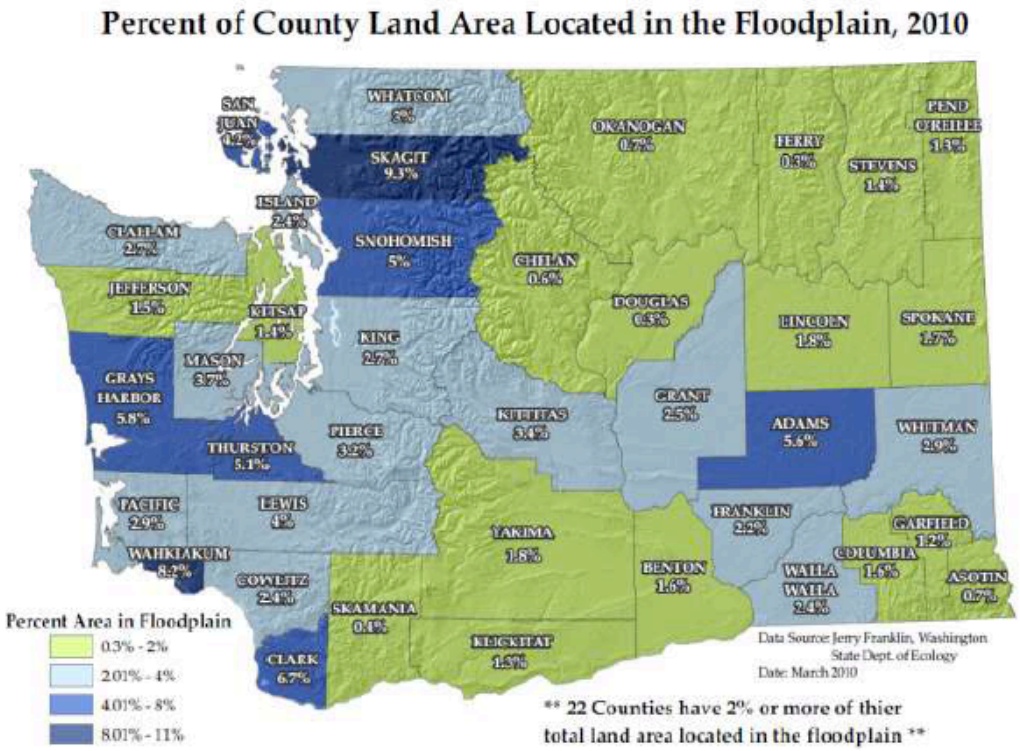


To again give a sense of scale of the Puget Sound flooding issue to date, the highest number of flood insurance claims within any county is from King County (home to the City of Seattle, which is not in any floodplain), which has had 2, 676 claims from 1978 to 2010 a span of 32 years. The counties that had shown high risk and vulnerability and significant damages in the previous graphics have all had between 877 and 1,958 claims over the same timeframe.

5.3 Land in Floodplains is Relatively Small and Significantly Varies by County

The Washington State Hazard Mitigation plan finds that approximately 2.5% of the State's total land area is part of a floodplain. The plan estimates that this includes approximately 100,000 households statewide out of a total of 2.6 million households[xvi]. This also means that less than ½ of 1% of all households can be found in the floodplain. However, the small number of households is contrasted by the significant economic development found in some of Puget Sound's floodplains. For instance the Green River Valley (also known as the Kent Valley) that drains into the Seattle area has 12 billion in assessed value, 10 billion of which provides taxable value.[xvii] This floodplain area is now the second largest warehouse district on the west coast and fifth largest in the nation. The Puyallup River valley, which drains out near the city of Tacoma is home to another significant economic engine of the State of Washington. Puget Sound floodplains are also often the site of wastewater treatment and water supply facilities along with major transportation corridors, medical centers, schools and other critical infrastructure. Floodplains also support cultural, commercial, and recreational fisheries and agriculture and are sought after areas for ecologically focused protection and restoration efforts.

Thus, it is useful to note the actual amount of floodplain area in each county as it varies significantly across the Puget Sound region and the state. For instance, Skagit County has 161 total square miles of floodplain compared to Snohomish with 104 and Pierce County with 53.



5.4 Federal Policies are Rapidly Changing

With recent super storms like Sandy and Katrina and the tremendous deficit currently experienced by FEMA, the federal landscape is in the process of changing. The Biggert-Waters Flood Insurance Reform and Modernization Act of 2012 is one such example of significance. It was beyond the scope of this effort to do significant research into the federal landscape beyond the barriers identified at the local level. A more thorough understanding and synthesis of the changes that are presently occurring federally within USACE and FEMA tied to the local concerns stated here would be of great benefit to TNC's continued understanding of the situation.

Appendices

Appendix A

INTERVIEW QUESTIONS

The following questions represent key questions that were considered with each interview. More specific questions for each person were asked based on specific circumstances associated with each person or in follow up to the questions below. Not all questions were asked of all people interviewed.

QUESTIONS

- What is most important to you or concerns you most as you consider addressing flooding in your area?

- What associated benefits, if any, do you see resulting from your flood management program?

- Do you feel you are on a timely path to reduce flood risk for your constituents?

- What management/project options are available to you as you manage your flood risk?

- What do you and the community consider as you weigh the range of alternative options (at both the programmatic and project scale)?

- Do you have a suite of levee setback or removal projects waiting to be built or in design phase? Do you have a summary of the amount of acreage, location, costs?

- Do you have new levee infrastructure proposed? Do you have significant areas of levee that repeatedly need maintenance and repair? Do you have a summary of the amount, location, costs?

- Do these projects have barriers to implementing them? Is there a difference in barriers between implementing nonstructural, structural and mixed structural approaches?

- What funding or regulations most influence your floodplain management decision-making?

- How do you address the issue of private property as you consider floodplain management programs and projects? Do you use condemnation? Under what circumstances?

- Does the local vision and objectives for floodplain management include a blend of traditional structural (levees and floodwalls), non-structural (levee removal) and mixed structural/non-structural options such as levee setbacks? And if so, what is the relative ratio?

- How does your personal vision for flood risk reduction compare to that of your constituency and your staff?

- Where are you making the most progress? What contributes to your success? Do you have a success story you like to tell?

- What type of information ends up being most important to you during your deliberations regarding flood risk reduction programs and projects?

- Would additional technical information have likely resulted in a different decision? If so what information made a difference and why did or would it have changed the decision?

- Do you feel you get the type of information you need as you consider flood risk reduction alternatives?

- Are you able to explore a range of options for flood risk reduction?

- Would more information related to the associated benefits of the options such as open space, trails, recreational opportunities, habitat for fish and wildlife, etc. be useful to you? If so how?

- Who do you see driving local flood risk reduction and infrastructure decision-making through the setting programmatic direction and ultimate project selection?

Appendix B

DEFINITIONS AND ACRONYMS

The following definitions are used for the purpose of this document.
Green infrastructure: floodplain management infrastructure that includes non-structural (levee removal) systems or a blend of structural and non-structural (levee setbacks or protection of existing floodplain functions) systems.

Gray infrastructure: floodplain management infrastructure that include armored and leveed systems as is focused on flood risk reduction.

Multiple benefit projects: this term often refers to ecological benefits such as a project that provides benefits for water quality, stormwater, salmon recovery, and wildlife. It also is used to include benefits such as parks, open space, trails and public access.

USACE: United States Army Corps of Engineers, federal agency responsible for Section 404 permitting under the Clean Water Act, emergency flood response, managing the Public Law 84-99 program (allows USACE to provide emergency flood assistance and assist with repairs), conducting General Investigations, and certifying levees.

FEMA: Federal Emergency Management Agency, a federal agency responsible for managing the National Flood Insurance Program (NFIP) and the Community Rating System (CRS) which includes mapping flood hazard areas.

FEMA BiOP: Biological Opinion issued by the National Marine Fisheries Service (NMFS) in 2008 finding that the National Flood Insurance program jeopardizes species listed under the Endangered Species Act (ESA). FEMA is required to bring its program into ESA compliance.

Appendix C

Decision-Making Criteria

The following criteria seem to pretty well capture the common criteria considered to identify and prioritize projects based on these two overarching criteria. Different counties may list these slightly differently or not have them written out explicitly, but the following list appears to be, generally speaking, the most commonly considered factors. The sub-criteria are listed in order of importance.

1. Existing land-use of affected area (consequence of flood impact)
    a. Critical facilities (hospitals, water treatment plants, etc.)
    b. Infrastructure (sole-access roads, highways, lifeline arterials, rail, interstate freeways)
    c. Commercial/Industrial (some counties place agricultural lands here)
    d. Infrastructure (all other roads)
    e. Residential (urban or high-density)
    f. Residential (rural and low-density)
    g. Resource lands (Ag, Timber, Mining)
    h. Developed Recreational
2. Severity of potential flood or channel migration impact
    a. Public safety and threat of loss of life
    b. Severe infrastructure or property damage
    c. Moderate to severe infrastructure or property damage
    d. Minor to moderate infrastructure or property damage
    e. Inconvenience flooding/channel migration
3. Area of impact
    a. Regional
    b. Severe (city centers, larger neighborhoods >20 homes)
    c. Moderate
    d. Localized
4. Frequency of flood or channel migration occurrence
    a. 3 or more occurrences in last 20 years
    b. 2 over 20 years
    c. 1 over 20 years
    d. Has not occurred in last 20 years but likely would occur in a 100-year flood
5. How soon will impact occur
    a. Damages will occur during next major highwater event
    b. Damages may occur during next major highwater event
    c. Damages will eventually occur

Once problem areas have been identified, then projects are often developed and ultimately selected based on the following aggregated criteria:

2. Project effectiveness
    a. Complete solution
    b. Majority of identified problem
    c. Partial or temporary
3. Benefit-cost analysis of project

a. Life of project
b. Ability to raise funds
c. Cost as a priority relative to other priorities
d. Cost of project relative to the economic benefit of the project

4. Multiple project benefits (usually weighed separately from the economic analysis)
    a. Aquatic and riparian habitat
    b. Water quality (including temperature)
    c. Public access
    d. Agriculture
    e. Stormwater benefits
    f. SMP or GMA connectivity
    g. Open space
5. Partnerships and Opportunity
    a. Partnerships/funding
    b. Land ownership (public or willing landowner)
    c. Project readiness

[ii] King, Rawle O., *"The National Flood Insurance Program: Status and Remaining Issues for Congress,"* February 6, 2013.

[iii] USACE Memorandum for Commanders, Major Subordinate Commands and Districts. Subject: Policy for Development and Implementation of System-Wide Improvement Frameworks, November 29, 2011 p. 2.

b. In some cases, the items on a levee system found to be "Unacceptable" or "Minimally Acceptable" might be complex to correct. Developing and implementing solutions to address such deficiencies might require a multi-year effort and coordination between multiple entities. This may be especially true when resources protected under the Endangered Species Act or Tribal treaty rights could be impacted by any changes to the levee system. USACE is making the SWIF process available to levee sponsors facing such challenges as a way to facilitate the development of solutions to satisfy the multiple requirements that apply to their levee systems while allowing levee sponsors participating in the SWIF process to remain eligible for P.L. 84-99 rehabilitation assistance funding while addressing deficiencies.

[iv] King, Rawle O., *"The National Flood Insurance Program: Status and Remaining Issues for Congress,"* February 6, 2013 p. 6.

[v] See Washington University's Climate Impacts Group website: http://cses.washington.edu/cig/

[vi] Taken from: http://www.mrsc.org/subjects/governance/spd/spdfunction.aspx

[vii] Taken from: http://www.mrsc.org/subjects/governance/spd/spdfunction.aspx

[viii] In the end the project cost roughly 500 million to build, but it was approved with the initial estimated cost.

[ix] This quote was altered to make the story clearer. The intent of the quote is unchanged.

[x] Rose, Adam, et. al, *Benefit-Cost Analysis of FEMA Hazard Mitigation Grants*, Natural Hazards Review, November 2007 p. 97-111.

[xi]King, Rawle O., *"The National Flood Insurance Program: Status and Remaining Issues for Congress,"* February 6, 2013 pgs. 20.
[xii] *Washington State Enhanced Hazard Mitigation Plan*, October 1, 2010 Tab 5.5 pgs. 34-35.
[xiii] Taken from FEMA Country-Wide Loss Statistics as reported from January 1, 1978 through December 31, 2012.
[xiv] King, Rawle O., *"The National Flood Insurance Program: Status and Remaining Issues for Congress,"* February 6, 2013 pgs. 17-18.
[xv] Note that the city of Seattle is in King County and the city of Tacoma is in Pierce County, which are both located on Puget Sound.
[xvi] Taken from: http://quickfacts.census.gov/qfd/states/53000.html
[xvii] 2010 Washington Department of Commerce PowerPoint presentation entitled, "Economic and Revenue Impacts of Potential Flooding in the Green River Valley." Authors: Sally Harris, Regional Services Manager and Tom Goodwin, King County Chief Economist