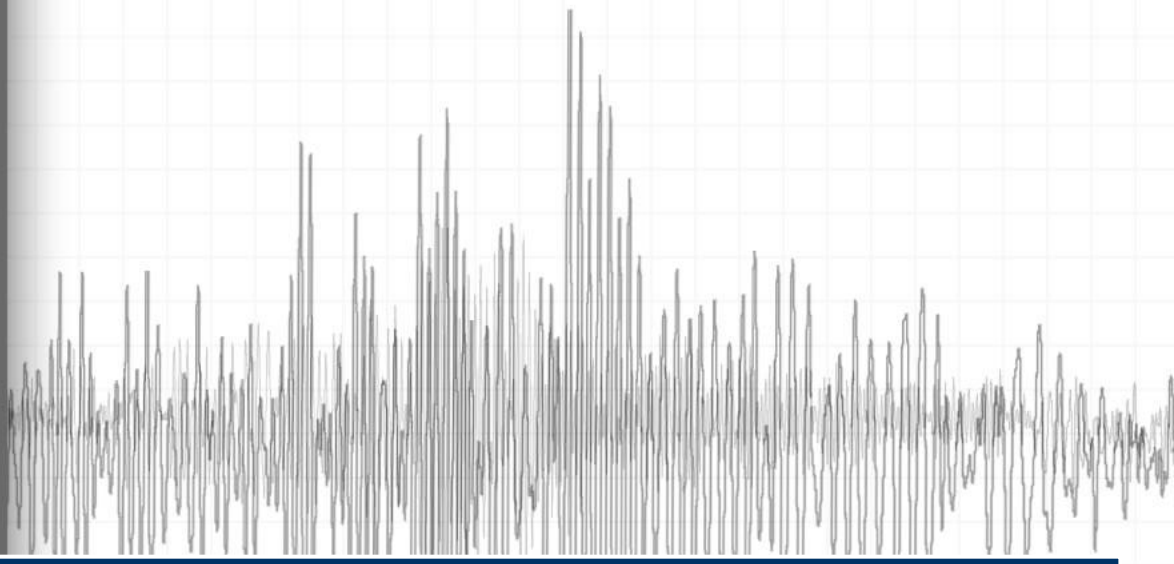
RESILIENCE INSTITUTE



Statewide Levee Inventory and Flood Protection Study: Report on Certification and Accreditation

November 2010

Prepared for WA State Department of Ecology

HUXLEY COLLEGE OF THE ENVIRONMENT
WESTERN WASHINGTON UNIVERSITY

Western Washington University, 516 High Street,
Bellingham WA 98225-9085 USA|+1 360.650.2707
www.wwu.edu/huxley/resilience

The following report has been prepared in partnership with the Department of Ecology (Ecology) to fulfill the requirement under Engrossed Substitute House Bill 2836 for a Flood Protection Study. These study documents and inventories accredited and non-accredited levees in the state of Washington. The document also identifies actions surrounding certification and subsequent accreditation. Study components include:

- Examples in Washington about the costs and processes regarding the technical review of the structural integrity of levee systems;
- An inventory and description about the level of protection of existing levee systems;
- Discussion of actions needed to improve the existing levee system and/or ensure certification for one-hundred year flood protection;
- Identification of current and future funding sources – including amounts available for making levee improvements.

Legislative Proviso

Sec. 3002. 2009 c 497 s 3039 (uncodified) is amended to read as follows:
FOR THE DEPARTMENT OF ECOLOGY - Flood Protection Study (20082855)
The reappropriation in this section is provided solely for the department to conduct a study to determine the number of decertified levees in the state and identify strategies for maintaining accreditation, re-accrediting, or recertifying levees so that they are recognized by federal agencies as providing optimum protection for the communities protected by the levees. The department must prioritize areas to include in the study based on population and the economic impact of potential flood damage.

The study must include the following components:
(1) A working group of levee managers, local agencies, and stakeholders to advise and inform the study;

(2) In-state examples of the costs and processes of technical review of the structural integrity of levee systems;

(3) An inventory, map, and a description of the level of protection of existing levee systems;

(4) The development of strategies and actions needed to improve the existing levee system and to ensure certification by the United States army corps of engineers for one-hundred year flood protection;

(5) The identification of current funding sources and the amounts available for levee improvements;

(6) Recommendation for additional new funding sources and options;

(7) The study must be completed and a report provided to the legislative committees by Dec. 1,2010

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

Today, levees reduce flood damage from many flood events for communities and agricultural areas throughout Washington State. The age and construction of these structures vary considerably. Many older levee systems, originally built for a different purpose, are at a lower design standard than is required today. Further, the flood risk to the public increases as development behind levees continues.

The Statewide Levee Inventory and Flood Protection Study was conducted to better understand the status of levees in Washington in two parts. The first part, consisting of this report, summarizes current levee policies and practices. A second part of the study is a statewide inventory of current levees and their protection status. The statewide inventory is summarized below, but delivered separately as a geospatial database and set of state and county maps.

This report discusses the requirements, processes, and costs associated with certification and subsequent accreditation of levees. The report also explains some of the key challenges levee owners have in complying with regulations and securing funding for levee maintenance, improvements, and certification. The report highlights several case studies to illustrate these issues. The report includes a discussion about alternatives to levees, and concludes with a list of next steps that may support flood damage reduction in Washington State.

Any discussion of levee accreditation should include flood risk and public safety. The 100-year standard may be woefully insufficient in some areas (such as highly urbanized environments) and perhaps overly protective in others (such as agricultural lands, undeveloped land, etc), thus FEMA accreditation should include risk and economic analysis.

Top Challenges of Certification and Accreditation

Today, significant challenges exist for levee owners seeking levee certification and accreditation. Based upon research and interviews with federal agencies, local governments, levee managers, and state agencies, four key challenges emerged:

- ***Loss of Accreditation***. The recently enacted Flood Map Modernization Initiative (1997) and associated map modernization programs have driven the Federal Emergency Management Agency (FEMA) to update flood insurance rate maps and re-assess flood risk levels. As part of the re-assessment, FEMA has begun reviewing levee accreditations to determine whether a levee meets all of FEMA's accreditation requirements. Some levees in Washington State may no longer comply with updated FEMA regulations or may be lacking current certifications needed for accreditation. Some areas considered protected prior to the establishment of accreditation guidelines may now be considered part of the regulated 100-year floodplain – with corresponding changes in insurance rate and requirements, building codes, and development restrictions.

Levee accreditation is being lost in several areas, but there are two specific floodplains (the Green and Puyallup Rivers) where the resulting floodplain maps are having significant impacts.

Lower Green River Floodplain – King County

The lower Green River floodplain is unique. While FEMA accredited its levees, the USACE never certified them as providing 100-year flood protection. Therefore, in essence the Green River Valley communities are trying to acquire certification for the first time versus re-validating a previously certified levee system. King County, the cities of Auburn, Kent, Renton, and Tukwilla are working with FEMA towards a process that will remove a significant portion of the floodplain from the mapped flood hazard area. The communities also approached the Governor's office to help them understand the hardship to the valley's economy and request financial assistance in the pursuit of re-accreditation.

Lower Puyallup River Floodplain – Pierce County
The Lower Puyallup River is experiencing aggredation (the increase in elevation due to buildup of sediment in the channel), and the County has experienced the difficulties associated with pursuing certification and accreditation in such environments. Pierce County and the USACE have begun a 5-6 year preliminary feasibility study entitled *The Puyallup Basin General Investigation Study for Flood Risk Management and Ecosystem Restoration*.

- ***The Economy Act.*** For levee owners seeking first time certification or updating a past certification, the recently amended Economy Act and associated Thomas Amendment (2000) have created challenges. The Economy Act limits the United State Army Corps of Engineers' (USACE) ability to provide certification evaluations for non-federally owned and operated levees – a majority of levees in the state – by limiting the Corps ability to compete with the private sector. Non-federal levee owners must now gain certification using the private sector or attempt to find a federal partner agency willing to enter cost-sharing agreements. With a federal partnering agency, levee owners can request levee assistance from USACE. However, finding federal partners has proven difficult.

- ***Compliance with the Endangered Species Act.*** In Washington, levee owners face additional challenges. To be eligible for USACE's disaster and rehabilitation assistance, levee owners are required to maintain the levees to the current standard, which is requiring some owners to manage large vegetation (e.g. removing saplings, trees, and some scrubs). However, removing large vegetation might result in violations of the Endangered Species Act. Past variances to vegetation policies are currently under review.

- ***Limited Funding for Levee Improvements.*** Levee certification is a required, albeit costly process for local jurisdictions seeking FEMA levee accreditation. One of the biggest hurdles in seeking levee improvements and levee certification is finding the capital to fund such endeavors. This is especially true for local levee owners and operators, who are ineligible for most federal technical assistance. Many levees require significant technical analysis before they can be certified. However, this work can cost millions of dollars. There are three broad categories of funding sources available to levee owners and operators: 1) local governments such as special districts, 2) state programs such as FCAAP, and 3) federal programs such

as U.S. Army Corps of Engineers programs, federal rehabilitation funding, and congressional funding. All federal funding requires congressional approval is specific to levee improvements and not for certification.

State-wide Levee Inventory and Prioritization

As the additional portion of the Statewide Levee Inventory and Flood Protection Study, the first integrated statewide levee inventory was developed. This inventory catalogs levee system locations and known protection levels throughout Washington State. The inventory consists of two parts. Firstly, a database of the levees in Washington State was constructed that includes the known location, level of protection, and certification/accreditation status of levees. Secondly, a coarse-scale prioritization scheme was developed to identify levees that have particularly significant implications for levee-protected urbanized areas. In line with the focus of this study and guiding proviso, particular attention was paid to levees that are accredited, provisionally accredited, or considered de-accredited as providing 100-year protection.

The total of identified levees tallies to 697 miles. Of these, approximately 125 miles (18 percent) could be considered "levees of focus"- levees that are currently accredited, provisionally accredited, or de-accredited. Only about 9 percent of the 697 levee miles in Washington are currently accredited. The levee inventory can be broken down to the county level. Of the 39 counties in the state, 30 have identified levees. The counties with the greatest length of levees, measured as levee miles, are Snohomish, Skagit, and King. When analyzing the lengths of "levees of focus," Cowlitz, King, and Pierce counties have the most mileage of accredited, provisionally accredited, or de-accredited levees.

With further research, the statewide levee database may be used to develop a prioritized list of levees needing site-specific attention such as repair, setback levee strengthening, certification and accreditation, or removal. One possible prioritization strategy could rank levees based upon the probability and consequence of failure. It could be a good idea to identify and prioritize those levees with a high probability of failure with more devastating consequences to receive funding first. For this study, a preliminary prioritization scheme using census and available state economic data was performed. Using Geographic Information Systems (GIS), a coarse-scale prioritization scheme was developed to identify and quantify potential impacts of levees of focus (accredited, PAL, or de-accredited) based on population and economic impact of failure. While robust prioritization modeling was not feasible due to the lack of information regarding

hydrologic areas protected by levees, the prioritization scheme provided an initial assessment for identifying geographic areas most impacted by levees.

Improving Washington's Flood Hazard Reduction

Levee accreditation can be an extremely costly and arduous process, and is not suitable for all levee locations. In regions already extensively developed, levee improvements and accreditation may be the most desired and appropriate action. However, for areas seeking to maintain and restore floodplain connectivity, other non-structural alternatives may be better suited to achieving sustainable risk reduction goals.

For those areas where levee accreditation is desired, current federal policies are likely to make levee accreditation too costly for many non-federal levee owners, especially those in rural districts. State assistance can be a valuable and needed asset for impacted communities. This assistance could take the form of mediating conflicting regulations, regulatory assistance, facilitating communicating between stakeholders, incentives and targeted funding for levee improvements and flood protection alternatives such as options to rehabilitate levees to a different performance standard lower than 100-year protection.

The Statewide Flood Protection and Levee Inventory Study has detailed levee accreditation challenges and provided an initial inventory of levees and their protection levels in Washington State. Further steps to strengthen the inventory to the point of assisting prioritization of state support are necessary. Further research is needed to develop data on failure impacts, flood protection alternatives, and their costs. Additionally, continued updating about the existing digital levee database needs to keep the database current and further eliminate discrepancies in the data. Further validation and collaboration between local levee entities and federal agencies can help resolve conflicting data on levee location and protection levels, improving the quality of the levee inventory.

II. INTRODUCTION

This report has been prepared in partnership with the Department of Ecology as part of the Flood Protection Study (20082855), defined in the Engrossed Substitute House Bill 2836 (Chapter 36, Laws of 2010).

The Statewide Levee Inventory and Flood Protection Study was conducted to better understand the current status of accredited levees in Washington. The Study is divided into two parts. The first part of the Study, consisting of this report, summarizes current levee policies and practices. A second part of the Study is a statewide inventory of current levees and their protection status. The statewide inventory is summarized below, but delivered separately as a geospatial database and set of state and county maps.

This introduction section briefly discusses the use of levees for flood protection and the current state of knowledge about our nation's levees. The purpose of the report is introduced, including a discussion on how we gathered, analyzed, and validated information. An overview of the levee certification and accreditation process is also included. This overview will give readers a basic understanding of the processes before reading the more detailed and technical explanations in later sections. The introduction concludes with a brief description of how the report is organized.

BACKGROUND

Washington State is one of the more flood-prone states in the country. In the 20-year period from 1990 to 2010, Washington State had 13 Presidentially-declared flood disasters, one of the highest number of flood disasters for any state nationwide (FEMA, 2010). The state also ranks high in flood policies, claims, and number of affected communities. Washington has more flood insurance policies than most other states west of the Mississippi.

Like many states, Washington has historically managed flood risk by building levees. Levees are fabricated barriers along rivers, streams, channels, sloughs, and other water courses. A levee's primary purpose is to protect land when waters in streams and rivers

rise. Levees keep rising water within the stream or river channel, protecting areas behind the levee from floods. However, if a levee is not tall or strong enough to withstand rising waters, or not adequately maintained, it can fail. When levees fail, areas behind the levee may face unexpected and devastating flooding.

Today, levees of various sizes provide flood protection to hundreds of communities throughout the state. Levees are often part of complex systems that can include floodwalls, pumps, interior drainage systems, closures, and transitions. There currently exists a range in levee design and function for levees in the state. Levees in urbanized areas often are often to contain periodic flood events without overtopping. In other areas where hydrologic connectivity is desired and risk not as prevalent, levees may be designed to overtop during floods to relieve hydrologic pressure on the system.

In addition to the currently utilized functions, the age and original design of Washington's levees vary considerably. Some older levee systems were built with what is now considered substandard materials. Many older structures also were designed to provide lower levels of protection than needed today. Further, some communities have developed many areas behind older levees. A failure of one of these levees will affect a greater number of people and businesses than in the past.

PURPOSE OF STUDY

Currently the federal government does not have an authoritative inventory of the number or condition of levees in the United States. The Association of State Floodplain Managers notes:

> "At present the nation lacks data and information about the physical location of its levees, their ages and conditions, the levels of protection each provides, whether levee failure warning and evacuation plans exist and are exercised, who owns and maintains a specific levee system, and the adequacy of the operation and maintenance plan, exercises, and implementation." (ASFPM 2007, pp. 2).

In 2007, Congress amended the Water Resource Development Act. This act required that the U.S. Army Corps of Engineers develop and maintain an inventory of levees owned and operated by the federal government. However, the vast majority of levees in the country are owned and operated by local governments and private owners. State and local

governments were asked to provide data about their local levees, but only on a voluntary basis. Few states or local agencies have provided any formal information (ASCE 2009). Thus, the nationwide levee database continues to be under development and incomplete (USACE 2009). In the absence of a comprehensive levee inventory, there are many uncertainties regarding location, performance, and condition of levees both nationwide and within Washington State.

Levee Inventory

A state levee inventory is one of the first steps towards better managing levees and flood risk in Washington. This Flood Protection Study provides synthesized information about levees in Washington State for the first time. We collected spatial data from levee management agencies across the state. To integrate all the information gathered into a single database, data was formatted to adhere to Department of Ecology guidelines. We validated geospatial information in the levee inventory in a formalized validation process, where local jurisdictions were asked to verify attributes of each individual levee at the county level.

The levee inventory includes the most current data available on the location of levee systems. Where available, the inventory notes what level of protection the levees are designed to provide. Additionally, the inventory catalogs which levees in the state have been accredited and de-accredited by FEMA. (The certification and accreditation processes are summarized below and discussed in detail in Section III and IV of this report.)

The statewide levee inventory takes the form of a searchable table and a geospatial database of levees and the protection each provides. A summary of the database development and key findings are discussed in Section VIII, including a number of maps and tables. However, the full geospatial database is a separate deliverable to Ecology and is part of this document.

Report on Policies and Challenges

A second step toward better managing levees in Washington is more fully understanding the challenges of managing levees. This report documents the policies that affect levee management, certification, and accreditation. Many of these policies affect what funding levee owners and managers can access to maintain, improve, or certify their levees.

The report is the results of a series of interviews, the collection of known information on levee locations and protection, policy research, and stakeholder review. We interviewed regional management agencies and stakeholder groups from June 2010 to October 2010. Interviews included United States Army Corps of Engineers (USACE) Portland, USACE-Seattle, USACE-Walla Walla, FEMA Region X, and city governments. We often followed face-to-face meetings up with phone calls to help clarify particularly complex issues. We reviewed technical documents, policies, and guidance documents related to levee certification, accreditation, and management. We then solicited feedback from interested stakeholders across the state in a formalized report review process. We also presented initial study findings at the Northwest Regional Floodplain Managers Association conference in September 2010 to receive further feedback. The report summarizes the findings from these interviews, literature review, and stakeholder review.

CERTIFICATION AND ACCREDITATION OVERVIEW

Levees provide flood hazard reduction at various levels to private, public, and critical service infrastructure. Yet it is difficult for communities to determine how much protection a levee provides just by visual inspection. Qualified engineers must review levees and the results passed on to the community. From this knowledge, individuals and communities can make important decisions about where to purchase property, whether to purchase flood insurance and how best to build and protect structures in areas that may flood.

In the 1960s, the national government was experiencing an increase in flood losses and escalating costs of flood disaster relief. In 1968, the U.S. Congress created the National Flood Insurance Program (NFIP). The intent of NFIP was to reduce future flood damage through community floodplain-management ordinances. Furthermore, the program provided property owners in flood-prone areas the opportunity of purchasing subsidized flood insurance.

Participation in the NFIP constitutes an agreement between cities and counties and the Federal Government.[1] The city or county adopts and enforces floodplain management

[1] In order to take part in the NFIP a community must adopt an ordinance that is compliant with 44 CFR 60.3 and adopt a resolution specifying certain responsibilities.

ordinances for any new construction within Special Flood Hazard Areas. In turn, the Federal Government provides flood insurance for the community, insurance that provides a substantial level of financial protection against flood losses (FEMA 2010).

The NFIP uses flood protection maps, called Flood Insurance Rate Maps, to determine insurance requirements and development restrictions. Areas shown as floodplains on the Rate Maps typically have higher insurance rates, coverage requirements, more development restrictions, and stricter building codes than areas shown as being outside of flood plains. However, NFIP allows areas behind certain levees to be treated like areas outside the floodplain.

In order for levee protection to be shown on Rate Maps, FEMA must recognize the levee as providing protection from the base flood - currently defined as a flood that has an annual 1 percent chance of exceedance. (A flood with a 1 percent annual chance of exceedance is often misleadingly called a 100-year flood event.) To be recognized by FEMA, cities and counties take their levees or levee systems through an accreditation process. Accreditation indicates that FEMA formally recognizes that a levee or levee system provides protection against the base flood. Once a levee is accredited, those living behind the levee are treated as living outside the floodplain. Owners are freed from the requirements to purchase flood insurance or obligations to elevate or flood-proof buildings to the designated flood levels.

Local levee owners or managers must attain levee accreditation if they desire areas to be mapped as providing protection for a 1 percent annual chance of exceedance. However, prior to seeking accreditation, levee owners or managers must have the levee certified. A certified levee indicates that the levee structure and its operation meet technical requirements for containing waters from a flood that has an annual 1 percent chance of exceedance. Certification can be completed by staff or consultants, but it must be approved by a registered professional engineer or the Army Corps of Engineers. Historically, USACE performed levee certification. However, new certification policies reaffirm the responsibility to local levee owners and managers, as discussed later.

When a levee has been certified, local levee owners or managers forward certification documents on to FEMA. If all documentation is in order, FEMA may then accredit the levee. Then the NFIP Rate Maps are updated.

Levee accreditation does not explicitly guarantee public safety or protection from larger flood events. Rather, accreditation is used for floodplain mapping purposes as part of the NFIP. Many agree that in urban areas, levee protection against the base flood – the flood with a 1 percent annual exceedance – is insufficient for public safety. Protection above this level is often needed (FEMA 2006, ASFMP 2007). In fact, "100-year flood" events are likely to occur during a person's lifetime. A flood of this magnitude or greater has a 26 percent chance of occurring during the life of a 30-year mortgage (see Figure 1). As such, FEMA officially encourages even those behind an accredited levee to purchase flood insurance and act appropriately to protect life and property.

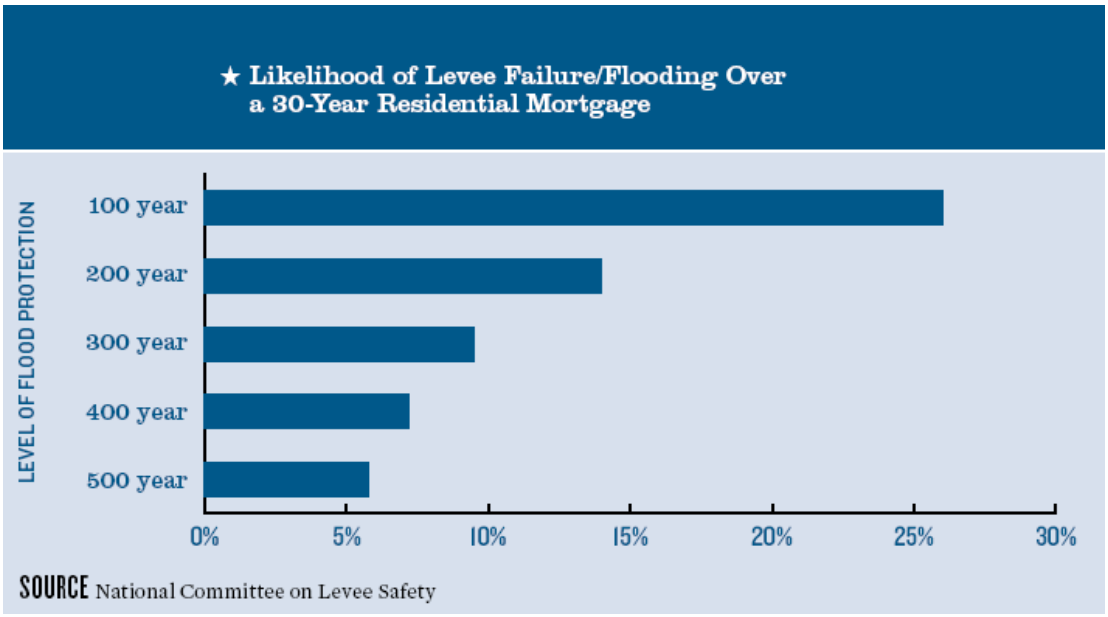


Figure 1. Likelihood of flooding from a 100 to 500 year-flood event during a 30-year period. (From the National Committee on Levee Safety).

REPORT ORGANIZATION

This report outlines the requirements and costs associated with the levee certification and accreditation processes. It documents possible funding sources for levee repairs and improvements – steps often needed to seek levee certification and later accreditation. Using three in-state case studies, it illustrates current trends in levee management.

Much of flood protection discussions revolve around whether or not levees provide protection from the base flood. Because levee certification determines whether this level of protection is provided, Section III provides details about the levee certification process. Certification is broken down into sections on the process for federal levees and for non-federal levees. Section III is followed by a brief section on FEMA's process for accrediting levees. The accreditation process in Section IV discusses FEMA responsibilities, differences between accreditation requirements and certification requirements, and the provisional accreditation designation that applies to select levees.

Levee certification is an expensive process, especially when certification through the private sector is needed. Furthermore, levees often need significant repairs and strengthening before certification will be granted. Section V discusses funding options, broken down into federal, state, local options. The eligibility requirements, fund availability, and use restrictions are covered for each. To illustrate the complexities levee owners experience gathering funds and meeting certification requirements, Section VI provides three in-state case studies. This section also provides a compilation of case studies on Cost-Sharing Federal Partnerships – a funding strategy some levee districts are attempting. The development of the levee inventory, along with key findings, is briefly summarized in Section VII.

Section VIII concludes the report with a broader discussion of levee management and the research performed to date. The section starts with a discussion of the limited role levee certification can play in comprehensive flood management, followed by a synthesis of findings related to funding, regulations, and inventory development. Next Steps, Section IX, discusses what can be done immediately to improve current weaknesses in the levee inventory, and steps needed for developing a levee prioritization scheme based upon this inventory. The section ends with ways Washington State could support levee owners and floodplain managers.

III. LEVEE CERTIFICATION

Levee certification (also referred to as levee evaluation) is the first technical step in formally verifying a levee's ability to protect against a 100-year flood. Certification, a designation obtained through in-depth assessment of a levee's structural integrity and existing condition, is required for subsequent levee accreditation by FEMA (See section on accreditation below). Though USACE has historically played an integral part in levee management and certification, Federal Law now limits USACE's authority in providing certification evaluations for all levee types. Currently, USACE remains involved in certifying federal levee systems and select non-federal levees that sponsor with a federal partner.

Below, certification for federal levees is discussed, a process where the USACE plays a prominent role. A following section discusses certification strategies for non-federal levee systems where USACE does not generally have the ability to directly perform evaluations.

CERTIFICATION OF FEDERAL LEVEES

A minority of levees in Washington (13 percent of the mileage) are federally owned and operated levees through USACE. USACE currently conducts evaluations of levees under direct operation and ownership of USACE, a process that FEMA terms levee system certification.[2] USACE's evaluation of federal levees follows USACE guiding documents,

[2] USACE has recently changed their terminology, now calling levee certification procedures levee evaluations. According to USACE, the change in terminology from certification to evaluation encompasses the levee system as a whole and is a better representation of FEMA's definition for certification.

USACE recently released Engineering Circular 1110-2-6067, which guides the procedures for evaluation of new and existing levees in support of the NFIP administered by FEMA. The Engineering Circular (EC) is not intended to be a design guidance document, rather it clarifies existing policy, procedural and technical guidance for levee system evaluations. The purpose of these evaluations is to determine how flood hazard areas behind levees are mapped on Flood Insurance Rate Maps. The new EC is not meant to replace existing technical guidelines or standards by FEMA (44 CFR 65.10) or USACE (ETL 1110-2-570) but is a change in terminology. Historically, and in past guidance, USACE has used the term "certification" when describing their role in levee performance determinations. USACE is no longer providing levee certifications, rather it is providing NFIP levee system evaluations, which meet and exceed the requirements of FEMA's definition of certification detailed in 44 CFR 65.2.

which FEMA recognizes as an acceptable alternative to FEMA's 44 CFR 65.10; costs are covered through federal dollars. For some federal levees, USACE evaluation may be a first step towards achieving FEMA accreditation and inclusion on NFIP FIRMs/DFIRMs.

To explain USACE's role in evaluating federal levee systems, the following segment is divided into three parts. The first section below summarizes the process for USACE's NFIP Levee System Evaluations on differing types of levee systems. The second section describes the typical procedures and technical analysis USACE uses to perform NFIP levee system evaluations. This third section provides examples of the costs associated with these types of evaluations.

Summary of US Army Corps of Engineers Levee System Evaluation Process

USACE will perform NFIP Levee System Evaluation (NLSE), a levee certification in order to apply for FEMA accreditation, for those systems that it operates and maintains, or has maintenance responsibilities. USACE will perform NLSEs only if a non-federal government entity interested in achieving accreditation with FEMA, such as a county or local government, requests such an evaluation. USACE districts will work closely with the FEMA regional office and the non-federal sponsors to determine the authority and ability for USACE levee evaluations or support to non-federal levee certifications performed by a non-USACE entity.

USACE is authorized to provide levee system evaluations for all federally constructed projects and requests for other projects that meet the requirements of PL 84-99 (Flood Control and Coastal Emergencies Act (33 U.S.C. 701n) (69 Stat. 186). In these cases, a local sponsor makes a request for an evaluation to various offices within the USACE district, such as Engineering, Planning, or Operations. The request is then directed to the Levee Safety Officer (LSO) or the Levee Safety Program Manager in the local district. The district determines the levee system category and the Corp's authority, if any, over the project. The district then coordinates with FEMA regional offices and local sponsors for scheduling and determining the scope of work, which may be based on the availability of data and any engineering analyses that need to be performed. The USACE district concurrently investigates any funding mechanisms that may apply.

The process of achieving NFIP levee system evaluations is outlined in the list below, and shown in schematic form in Figure 2:

1. The district determines the type of system and which authority, if any, USACE has to perform the NLSE or support the evaluation.

2. USACE coordinates with the non-federal sponsor and FEMA to determine the scope of work and the schedule of the project. The project cost and scope of work may be dependent on the availability of data and the engineering analysis to be performed.

3. The district determines the appropriate funding mechanism for the project and follows the applicable authority for work performed on a reimbursable basis, such as under the Support for others or Economy Act agreements. USACE performs an initial screening of the proposed levee sponsors seeking NFIP levee system evaluations. The screening categorizes the levees as a way of identifying appropriate actions and the level of effort required for the NFIP levee system evaluations prior to performing a detailed and possibly costly process, which may not be needed. The three categories are defined as those likely to meet or exceed NFIP levee system evaluation requirements; those likely not to meet NFIP levee system evaluation requirements; and those levees requiring additional or more detailed engineering studies on which to base a determination. The initial screening includes a preliminary probability and uncertainty analysis of levee overtopping, which is detailed in EC 1110-2-6067.

4. The district performs a technical analysis by developing an investigative strategy (Investigation/Evaluation Strategies section) that will be based on a step-wise data collection process including O&M inspection procedures and inspection reporting, design and construction documentation, specific event performance records, and the NFIP levee system evaluation field inspection (Technical Evaluation Strategies section). The level of detail for the technical analysis would depend on the completeness of the technical background to demonstrate the adequacy of the height and structural integrity of the levee system. The technical analysis will adhere to the guidance in this EC, though any deviations to the analysis must be approved by USACE Headquarters through the Regional Integration Team prior to beginning the proposed analysis. The district will coordinate with the non-federal levee sponsor and FEMA throughout the technical analysis.

5. For every evaluation, the USACE is required to complete a NFIP Levee System Evaluation Report (NLSER) that details the results of the evaluation and reports either a positive or a negative finding. The NLSER must contain complete information, assumptions, documentation of data, and an explanation for the evaluation, which is clear to an individual not familiar with the project. (An outline of the NLSER can be found in Appendix D in EC 1110-2-6067.)

6. The district will perform the required review of the NLSER, coordinate the findings with interested parties and provides a final report to the FEMA regional office and the non-federal sponsor. USACE then performs an Independent Technical Review of the NLSER in accordance with Section 10 of EC 1110-2-6067. This review requires an independent qualified team to confirm that the NLSER complies with established policies and professional practices. If USACE determines the levee system no longer meets the criteria for the specified in the determination, it is authorized to revoke the certification.

7. USACE must then sign a letter stating the final determination of the levee evaluation and summarize key factors that lead to the conclusion. The letter must be signed by a senior staff member with experience in design, construction, inspection, operation, and evaluation of levee systems. Copies of these two documents are provided to the local sponsor requesting the evaluation, the corresponding FEMA regional office, and the state and county National Flood Insurance coordinator.

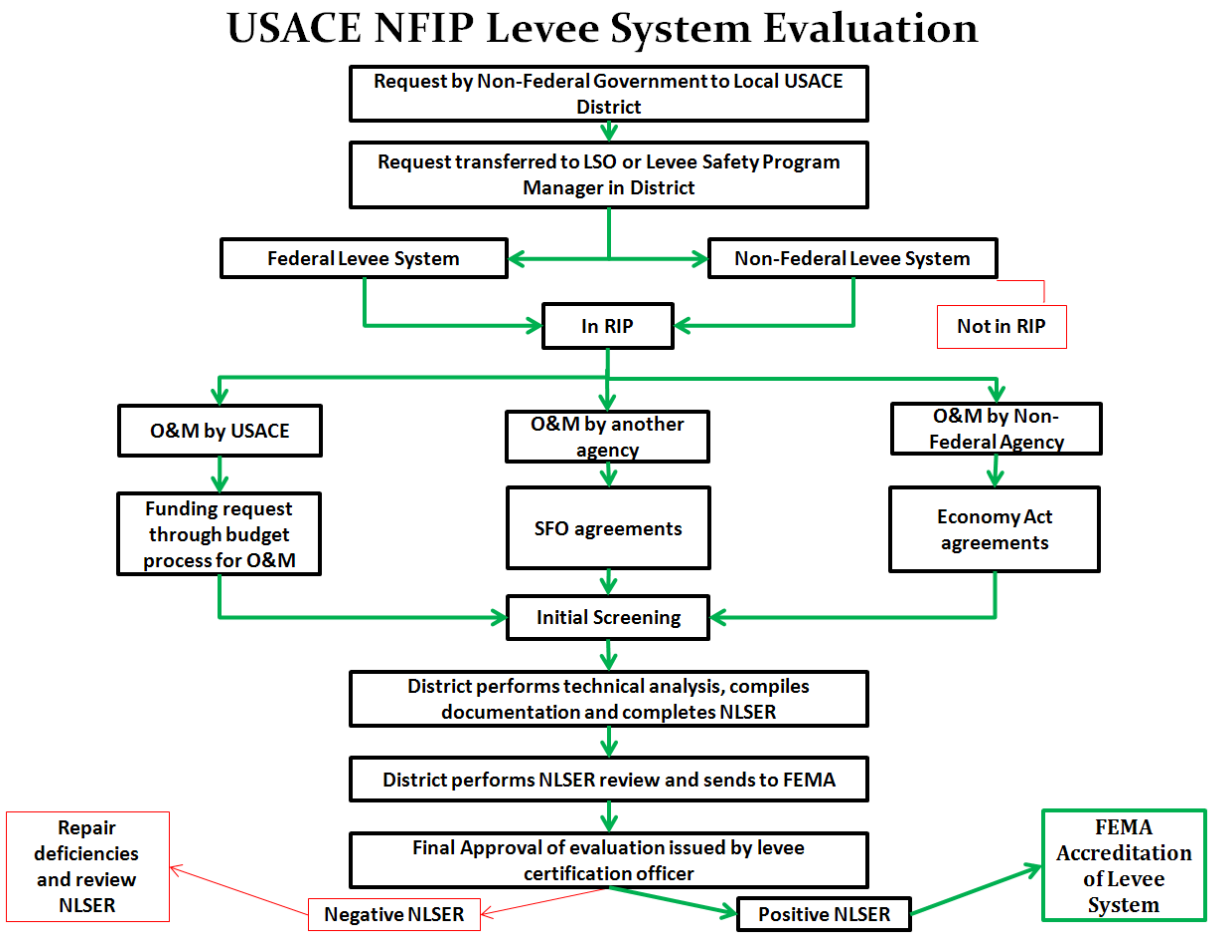


Figure 2. Flowchart for USACE NFIP Levee System Evaluation (NLSE) for federal and non-federal levee systems.

NFIP levee system evaluation findings

If USACE reports positive findings in the NFIP Levee System Evaluation Report, then the levee system is likely to be accredited by FEMA as providing 1 percent annual exceedance protection. The maximum validity for NFIP levee system evaluations is 10 years, unless a shorter timeframe is specified in the report. At the end of the validity date, the evaluation must be reviewed to determine if the system still meets NLSE requirements, but the evaluation determinations can be reviewed at any time prior to the period the validity ends.

The NFIP Levee System Evaluation may also result in negative findings. Such findings indicated that a levee system no longer meet the requirements for a NFIP levee system evaluation. Negative evaluations can result from deficiencies in structural features or operation and maintenance (O&M), or because of increasingly strict evaluation requirements (e.g. changed hydrology or hydraulics or updated structural and geotechnical design criteria). USACE must notify FEMA and the levee sponsor of the negative findings and review the evaluation determination. The Levee Safety Officer[2] or Levee Safety Program Manager for the geographic district must give the final approval for the NFIP levee system evaluations.

Costs for levee system evaluations

The cost of performing levee system evaluations for FEMA accreditation varies depending on the site location, the amount of existing data, and of the degree of repairs needed to meet the structural integrity requirements for levee accreditation. For example, the cost of USACE levee evaluations is highly dependent on the amount of reliable and relevant data accumulated in the investigation and evaluation strategies process. Costs may also vary regionally, based on whether or not extensive geotechnical analysis is needed. Hydrology and hydraulic analyses required for levee accreditation are also variable depending on the site location. However, FEMA uses rough cost estimates for hydrology and hydraulic studies when determining partner contributions to flood mapping projects[3]. FEMA estimates a detailed riverine hydrologic analysis costs $1,880 per linear mile and a detailed riverine hydraulic analysis is $3,930 per linear mile. (Agency, 2009)These estimates are not representative of individual projects but are used to estimate the value to FEMA and not the actual cost for the analysis.

Estimating actual cost of a levee evaluation is site specific and can vary depending on the amount of existing data to support the evaluation or of repairs are needed. For example, USACE estimated levee evaluations for three diking districts in Cowlitz County, WA (Longview, Kelso, and North Kelso) would cost an estimated $210,000 per district. As there are different miles of levee in each district, the overall costs for the evaluations are

[2] The Levee Safety Officer is required to be a registered professional engineers, as defined in the Levee Safety Program Implementation, CECW-HS Memorandum, USACE, 16 November 2007.

[4] FEMA estimates for contributions to flood mapping projects are detailed in the Cooperating Technical Partners program "Blue Book" for map modernization efforts.

dependent on the miles of levee segments, existing data, and any repairs that may be needed before the levee system can meet the requirements of the NFIP levee system evaluation. Longview diking district has nearly 15 miles of levee, the most out of any district in Cowlitz, so the cost for evaluating the system will be closer to the USACE estimate of $210,000 for the initial investigation and NFIP levee system evaluation. In contrast, a levee certification from a private engineering firm has been estimated at approximately $350,000 to $2,115,000 per district, depending on the miles of levee, existing data, and necessary repairs required for CFR 65.10 (Stone, 2010).

CERTIFICATION OF NON-FEDERAL LEVEES

A significant number of levees (at least 42 percent of the mileage) within Washington State are non-federal levees owned and operated by agencies other than USACE. Levee owners and communities must demonstrate that levee systems meet and will continue to meet standards in safety and design in order to be included in the NFIP. With USACE unable to provide National Levee System Evaluation's for non-federal levees, private engineering firms are being contracted to evaluate and analyze a levee system to issue a certification determination in compliance with FEMA requirements. The process for private certification of non-federal levees is shown in Figure 3.

In the past, private engineering firms have primarily assisted in preliminary and preparatory levee assessment work -- compiling and reviewing the necessary data and documents needed for certification. Typically, those firms assisting in certification determinations have been large, national engineering firms with adequate resources to perform the needed geotechnical analyses. One such firm recently prepared the Horseshoe Bend levee certification package, which received certification in September 2010 and currently awaits accreditation from FEMA. The certification of Horseshoe Bend by a private entity sets a precedent, as it is one of largest private certifications of levee systems in Washington State and may serve as a model for future levee owners seeking alternative means of certification.

Private certification has significant cost implications for levee owners. Because most non-federal levees are owned, maintained, and built by an entity other than the certifying party, firms must perform exhaustive geotechnical analyses before they are confident in certifying a levee's structural integrity. Such extensive review may increase costs for certifying. Costs fluctuate for non-federal levee owners, depending on the size and

ramifications of the project. Additionally, certain levees may be in a state of disrepair and need critical maintenance completed before becoming realistically eligible for certification and subsequent accreditation. In seeking out private certification, a non-federal levee owner must be ready to finance a significant amount of costs associated with the hydraulic and hydrology analysis as well as the geotechnical analysis.

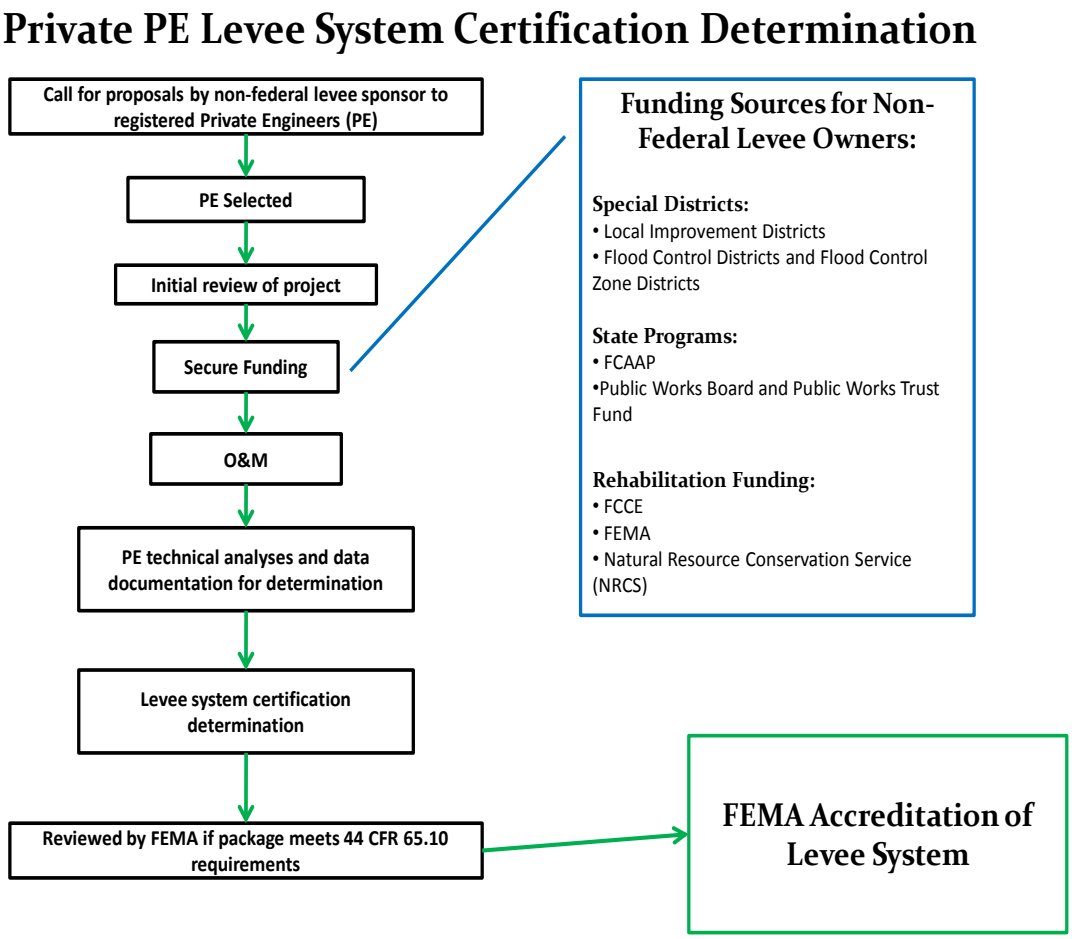


Figure 3. Certification process involving the private sector

Processes Associated with Certification of Non-federal Levees

The process for non-federal levee certification relies heavily on requirements documented in the Federal Emergency Management Agency's (FEMA) Section 65.10 of the NFIP regulations *Guidelines and Specifications for Flood Hazard Mapping Partners*, and in

Procedure Memorandums issued to clarify the procedural requirements for FEMA contractors and mapping partners. FEMA plays a pivotal role in the process of approving levee accreditation. As administrator of the National Flood Insurance Program (NFIP), FEMA is responsible for assessing flood hazards and related risks and providing appropriate flood hazard and risk information to communities in the form of flood insurance maps (FIRMs). In regards to levee systems, FEMA is *not* responsible for building, maintaining, operating, or certifying levee structures. FEMA does, however, develop and enforce the regulatory and procedural requirements that determine whether a completed levee system provides 1-percent-annual-chance flood protection. FEMA relies on Federal, State, and local agencies and private levee owners to provide them with the required data and documentation on levee systems.

Among other requirements, in order to receive certification for a non-federal levee, a private engineering firm conducts a geotechnical analysis. This analysis includes extensive research into aspects of design and safety of a levee system, as outline below in 44 CFR 65.10. Although USACE generally adheres to greater requirements in design, maintenance, and operation than FEMA, a private firm must only comply with 44 CFR 65.10 to ensure FEMA criteria for safety and design for accreditation purposes.

Non-federal levee certification through a private engineering firm is a viable option to the alternative federal certification process. In choosing this option, the process that levee owners must follow is simply to adhere to FEMA's guiding documentation 44 CFR 65.10 (discussed in more detail in Appendix B). However, non-federal levee owners may face higher certification costs, which come with hiring a private engineering firm.

Costs and Complications Associated with Certification of Non-Federal Levees

Costs associated with non-federal levee certification are difficult to reference, since each levee improvement and certification project is vastly different. Securing funding is a major task for local levee owners, since most are unequipped to cover the costly endeavor. Nationwide, the estimated shortfall in five-year funding requirements for levees is 48.87 billion (ASCE 2009).

Small communities and non-federal levee owners often find it difficult to obtain the necessary funding for levee repair and the documentation preparation required for a complete certification package. Even for those levee owners that have adequate funding for certification, it may be difficult to find a private engineering firm willing to provide a

certification determination. Many private engineers are hesitant to give a "stamp of approval." Certifying a levee meets and will continue to meet minimum safety and design standards, brings potential liabilities.

Further complicating matters, there are conflicting levee standard guidelines from several governing agencies, including the National Marine Fisheries Service (NMFS), USACE, and FEMA, as well as difficulty in ensuring compliance with the Endangered Species Act. The primary issue confronting the management of Washington levees is a conflict between compliance with guidelines of the USACE Rehabilitation and Inspection Program (RIP), (a primary source of levee rehabilitation funds should a levee become damaged during a flood event) and the presence of vegetation on levees. USACE enforces strict vegetation guidelines on levees. No vegetation beyond two inches in diameter is allowed. Removing larger vegetation is proving problematic for Washington levee managers, because of fear that regular removal of riverine vegetation on levees runs contrary to the goals of the Endangered Species Act (ESA). Given the presence of endangered species in many of Washington's rivers, local levee managers are concerned with the conflicts inherent in complying with USACE vegetation standards, while potentially opening their jurisdictions to third-party lawsuits on Endanger Species Act grounds.[4]

Certification Costs

As with federal levees, the cost of certification varies depending on the site location, the amount of existing data, and of the degree of repairs needed to meet the structural integrity requirements for levee accreditation. In many instances, the bulk of costs incurred for local managers may be the physical levee modifications needed to bring systems up to standards needed to meet certification and accreditation requirements. (It should be noted that the costs for such construction are site specific, and change according to the type and extent of repair needed.) Such physical levee improvements may be in addition to the separate cost of preparing the certification package.

For levee certification, the cost of studies and analyses to support certification by a professional engineer varies depending on the location and size of the certification

[4] A regional variance has been allowed in the maximum allowable size of levee vegetation. Dubbed the "Seattle Variance," USACE has allowed vegetation up to four inches in diameter. At the time of publication the "Seattle Variance" is under review at USACE national headquarters.

project. Additionally, there is great disparity in the cost of geotechnical analyses that support certification between private engineers and USACE. Private engineers must adhere to specific guidelines set forth in 44 CFR 65.10 in relation to the number of boring holes required for an accurate geotechnical analysis, whereas USACE is authorized to use engineering judgments to determine the necessary number and distance between boring holes.

In western Washington, geotechnical analyses generally accounts for 80 percent of the total cost for private levee certification (Meyer, 2010). One private engineering firm has suggested typical costs to perform a geotechnical analysis to support private levee certification to be $120,000 per linear mile in areas in Cowlitz County, based on rough estimates from drillers and the expected level of effort for the analyses. (Like private consulting firms, USACE districts often use private contractors for performing the geotechnical analyses for levee system evaluations.) Elsewhere, certification package preparation costs have been noted as higher. The certification package for the Horseshoe Bend levee in King County, for instance, approximated $ 1 million (as explained in more detail in the relevant case study section). Again, such ranges in certification cost are dependent on the amount of material present and the site-specific conditions.

Theoretically, FEMA uses the chart in the Cooperating Technical Partners program bluebook for estimating partner contributions to the costs associated with flood mapping projects. This chart identifies average estimated costs for generating hydrology and hydraulic analyses that could also be used to support levee certification. As with geotechnical studies, costs for hydrology and hydraulic analyses for levee certifications are dependent on the availability of information and the scope of the project. These numbers are not representative of the costs for any given non-federal levee sponsor to perform the modeling but provide an example of how much an average hydrology and hydraulic study may cost.

USACE Evaluation Assistance for Non-Federal Levees

While USACE cannot routinely evaluate non-federal owned/operated levee systems,[5] USACE does offer evaluation assistance to non-federal projects. In general, USACE can provide technical assistance in support of levee certification for all levee systems by:

- Providing existing information, such as, geotechnical data, mapping, as-built drawings, construction documentation as well as previous and current inspection reports;
- Performing specific technical analysis USACE is uniquely equipped to perform, including slope stability and seepage analyses or hydrologic and hydraulic modeling; and
- Reviewing analyses performed by others, if requested by a local sponsor.

USACE can also offer levee evaluation assistance through the federal Rehabilitation and Inspection Program (RIP) -- a program that provides funding to owners and managers in the event that a levee is damaged from flooding. USACE provides initial eligibility inspections, as well as continuing inspections of levees enrolled in the USACE RIP program. It should be noted, however, that enrollment and an active status in the RIP program does not provide any funding for levee maintenance or operation for non-federal projects. Rather, the RIP program provides a partnership in funding levee repairs to flooding damage. Furthermore, enrollment in RIP does not pertain, in any direct way, to the certification/evaluation or subsequent FEMA accreditation of levee projects. Even for levees in RIP, responsibility for certification rests solely with the levee's local sponsor, who must either partner with a non-USACE federal agency, or hire a Professional Engineer (PE) to inspect levee construction, maintenance, and operations and ultimately provide certification for the levee project.

[5]In the past, USACE had the authority to certify non-federal levees via the Economy Act (Title 31, Subtitle II, Chapter 15, Subchapter III, 1535 – agreements between Federal Agencies) where a local sponsor has collaborated with another federal agency. If the federal partnering agency deemed the levee project was of relevance to the federal partnering agencies interests/mission and provided funding for the levee project, USACE was authorized to conduct the levee certification determination. We have not found a levee sponsor successful in achieving a certification determination through USACE using the Economy Act in Washington State per our interviews with the three USACE districts in Washington. Since the release of EC 1110-2-6067, USACE is no longer authorized to use cost-sharing agreements for the sole purpose of levee evaluations.

IV. LEVEE ACCREDITATION

Levee accreditation follows the levee certification process. Levee accreditation is a process by which FEMA formally recognizes a levee as providing protection from the base flood (the "100-year flood") and maps the levee or levee system on the National Flood Insurance Program (NFIP) accordingly.

This section explains the levee accreditation process in detail, focusing specifically on the role FEMA plays in this process. The first section explains FEMA responsibilities, followed by a section that clarifies the special circumstances of provisionally accredited levees and existing guidance for these structures.

FEMA RESPONSIBILITIES

FEMA plays a key role in the process of approving levee accreditation. As administrator of the National Flood Insurance Program (NFIP), FEMA is responsible for assessing flood hazards and related risks and providing appropriate flood hazard and risk information to communities in the form of flood insurance maps (FIRMs).

FEMA is not responsible for building, maintaining, operating, or certifying levee structures. FEMA does, however, develop and enforce the regulatory and procedural requirements that are used to determine whether a completed levee system should be credited with providing 1-percent-annual-chance flood protection.

Requirements for accreditation are documented in Section 65.10 of the NFIP regulations, in Appendix H of *Guidelines and Specifications for Flood Hazard Mapping Partners*, and in Procedure Memorandums issued to clarify the procedural requirements for FEMA contractors and mapping partners. FEMA relies on Federal, State, local agencies, and private levee owners to provide the required data and documentation on levee systems in order to successfully accredit a levee. (Readers may refer to Appendix B for a more detailed description of the guiding document 44 CFR Section 65.10, which specifies FEMA accreditation requirements.)

FEMA VS. USACE REQUIREMENTS

It should be noted that while FEMA accreditation requirements and USACE evaluation requirements are often similar, they are by no means identical in either scope or purpose, and are intended to be used in conjunction with one another. Positive USACE NFIP levee

system evaluations will not ensure accreditation by FEMA, and accreditation is not always appropriate. To this end, it is possible to be in USACE compliance, while not mapped as accredited with FEMA. However, since the guidelines under Engineering Circular 1110-2-6067 meets and exceeds 44 CFR 65.10, a positive levee system evaluation from USACE is likely to be accredited.

PROVISIONALLY ACCREDITED LEVEES (PAL)

For levees certified in the past but needing accreditation, one strategy to allow time for levee improvements is to seek inclusion in the Federal Emergency Management Agency's (FEMA) Provisionally Accredited Levee program. A *Provisionally Accredited Levee* (PAL) is a levee that FEMA has previously been accredited as providing 1 percent annual chance (100-year) flood protection in a flooding event, and for which FEMA is seeking non-readily available data and documentation to demonstrate the levee system is in compliance with 44 CFR Section 65.10 of the NFIP regulations.

If a levee qualifies for the PAL designation, the local agency can be granted up to 24 months to document that a levee has been designed, built, operated, and maintained to provide an adequate level of protection needed for certification. Additionally, a levee owner or community has 90 days to sign an agreement issued by FEMA stating that it must be in full compliance with 44 CFR 65.10 within 24 months. During the 24-month review period, the levee or levee system gets a PAL designation that it provides 100-year protection on any Digital Flood Insurance Rate Maps (DFIRM), with a note indicating that the levee is only provisionally accredited. Under this PAL designation, affected areas are not required to purchase flood insurance during this review period. Subsequently, if a levee owner provides documentation that a levee meets all requirements of 44 CFR 65.10, except for the maintenance portion; it may be eligible for a 1-year "maintenance and deficiency" period. During this period, specific changes and updates will be made.

FEMA has issued several Procedure Memorandums to assist levee owners in complying with the PAL program and fulfilling accreditation requirements of 44 CFR 65. To assist levee owners better in evaluating a levee and understanding mapping requirements, FEMA issued Procedural Memorandum No. 43 (PM 43) entitled "Guidelines for Identifying Provisionally Accredited Levees." Additionally, Procedure Memorandum No. 53 (PM 53) entitled "Guidance for Notification and Mapping of Expiring Provisionally Accredited Levee Designations" was issued to serve as a reference and notification of

guidelines regarding the 24 month review period for levee systems designated as PALs. Please see Appendix C for further detail about the PM 43, defining the concept of PAL and describing the five scenarios under which a levee or levee system qualifies as a PAL.

V. FUNDING AND STRATEGIES

One of the biggest hurdles in seeking levee improvements and levee certification is finding the capital to fund such endeavors. Levee certification is an involved and lengthy process that requires detailed study by qualified professionals. As such, certification is often an exceedingly costly process that proves burdensome for many local governments and managing agencies. With expenses for improvements needed for certification frequently running into the millions of dollars, local levee owners and operators face many challenges in bringing levee systems up to NFIP standards for 100-year protection.

The section discusses current and future funding for levee certification and improvement, ranging from local funding sources to state and national sources. The sources discussed here are divided into five categories: 1) special districts 2) state programs, 3) programs related to USACE 4) rehabilitation funding, and 5) congressional funding. Table 1 summarizes all funding sources discussed in this section and lists the type of work funded and eligibility requirements. These current and future funding sources may be used in varying combinations to provide support for improving levee systems, obtaining certification, and ultimately gaining accreditation.

Table 1. Possible sources of funding for levee improvement and/or certification

Name	Source	Work Funded	Eligibility (based on ownership)	Notes
Flood Control [Zone] Districts	Local	Assessments, Repairs	Non-federal	RCW 86.09
Local Improvement Districts	Local	Repairs	Non-federal	administered according to RCW 35.43
Benefit Assessments	Local	Assessments, Repairs	Non-federal	administered locally according to RCW 85.38
Flood Control Assistance Account Program (FCAAP)	State	Assessments, Repairs	Federal, Non-Federal	administered through Washington State Department of Ecology according to RCW 86.26 and WAC 173-145
Flood Plain Mgt Services Program	Federal	Modeling, small-scale studies	Federal, Non-federal	administered by USACE under PL 86-49
Continuing Authorities Program	Federal	Repairs	Federal, Non-federal	Congressional funds administered by USACE
Economy Act	Federal	Assessments, Repairs	Non-federal	Cost-shared agreement, under Support For Others
Flood Control and Coast Emergencies	Federal	Repair, Rehab	Federal	Levee repairs associated with PL 84-99, administered by USACE
Natural Resources Conservation Service	Federal	Repair, Rehab	Federal, Non-federal	hazards created by disaster events, under PL 81-517, and PL 95-334
Federal Emergency Management Agency	Federal	Emergency Repairs	Federal, Non-federal	presidentially declared disasters - Stafford Act
Support for Others Agreements	Federal	Flood control projects	Federal, Non-federal	USACE provides reimbursable services
Diking and Drainage Districts	Local	Benefit Assessment	Non-Federal	RCW 85

SPECIAL DISTRICTS

A special district has no single definition, but generally means a local unit of government that is authorized to perform a set function. Special districts serve as a potential funding source for both local and federal levee owners seeking assistance in repairs and improvements associated with levee certification. Special districts are under the jurisdiction of local property owners, in which a benefit assessment is made according to property values. Washington special districts include, but are not limited to, municipalities, and units of local government. This section will discuss the following funding sources: 1) flood control districts, 2) local improvement districts, and 3) benefit assessments.

Flood Control Districts and Flood Control Zone Districts

One source of financial support for local levee improvements is utilizing flood control districts or flood control zone districts funding. Essentially a localized taxing district that focuses on flood protection, flood control districts and flood control zone districts have the capacity to undertake a variety of flood protection projects specific to levee systems. Depending on the nature of the improvements performed, work funded by these districts can potentially be used for supporting levee certification, as well as ongoing levee operation and maintenance. In Washington State, at least fifteen counties (Cowlitz, Jefferson, King, Lewis, Mason, Okanogan, Pacific, Pierce, Skagit, Snohomish, Spokane, Walla Walla, Whatcom, Wahkiakum, and Yakima) have established such regional taxing districts to further flood protection efforts.

Flood control districts and flood control zone districts are similar in that both provide flood control and protection by means of repairs and improvements. The main goals of these districts are to assist in maintaining flood control projects in specific areas or zones, and to construct, improve and maintain levees, dams, and dikes. These districts, generally governed by a district board, have the capacity to assess costs and benefits of levee certification, and approve project funding. Counties in Washington State utilize both flood control and flood control zone districts as a source for covering cost of repairs and maintenance to levees, as well as improvements that benefit an impending certification. The differences between these districts largely stem from the financing they receive, and that flood control zone districts are responsible for projects of special benefit to a specific area.

Flood control districts, established in 1937 under Revised Code of Washington Chapter 86.09 (RCW 86.09), are responsible for "investigating, planning, constructing, improving, repairing levees, dams, ditches" (Municipal Research and Services Center, 2009). Flood control districts receive financing from such county sources specific to rates and charges, special assessments, special assessment bonds, and utility revenue bonds.

Flood control zone districts, established in 1961 under RCW 86.15, "undertake, operate, or maintain flood control projects or storm water control projects or groups of projects that are of special benefit to specific areas of the county" (RCW 86.15.020). Flood control zone districts receive financing detailed according to "Excess Levies, Assessments, Regular Levies, and Charges "RCW 86.15.160, through assessments, storm water fee charges, and local improvement districts. Other sources of financing for flood control zone districts, include voluntary assessments, service charges, and general obligation (GO) and revenue bonds (Municipal Research and Services Center, 2009).

A major source of financing for flood control zone districts is the result of an annual property tax, where property owners are subject to a specially assessed tax rate. Each district must comply with RCW 86.15.160, which prevents property owners from facing a tax rate higher than fifty cents per $1000 of assessed value, with few exceptions. Differences in rates result from differences in geographical location, maintenance, and current state of flood protection structures. Table 2 below illustrates the variation in tax rates for some of these aforementioned districts in Washington State:

Table 2: Examples of Assessment Rates.

Flood Control Districts or Flood Control Zone District	**County**	**Annual Taxation Collected for Flood Control District or Flood Control Zone District**	**Levy Rate** amount per $1000 assessed property value
Silver Lake Flood Control	Cowlitz	$85,891	1.076946
King County Flood Zone	King	$35,783,314	0.10514
Mill Creek Flood (Assessment District)	Walla Walla	$50,000	0.023831
Whatcom County Flood Control District	Whatcom	$4,087,388	0.05725859
Yakima County Flood Control District	Yakima	$1,264,336	0.08724099

**Figures taken from 2010 County tax assessments.

Flood control districts and flood control zone districts are seemingly effective funding sources for levee system improvements, including financial support for levee certification. By facilitating such services, these districts provide important flood protection measures for business and property owners, while helping counties align themselves with existing floodplain regulations.

Local Improvement Districts

Local Improvement Districts (LIDs) are another potential source for local entities seeking funding for levee improvements or certification. LIDs are authorized through state laws, such as Revised Code of Washington Chapter 35.43, "Local Improvements; Authority and Initiation of Proceedings." LIDs provide the means to assist "benefiting properties in financing needed capital improvements through the formation of special assessment districts" (Municipal Research and Services Center, 2009). While LIDs are currently utilized by a select number of communities, more local entities within Washington State may consider LIDs as a local funding source for levee projects and certification in the future.

Pre-formation of a LID centers on concerned citizens encouraging and educating fellow property owners on potential improvements, and subsequently petitioning for a LID formation. Following the petition, the city must then perform a preliminary assessment and a cost estimate of the proposed project. In order for an LID to receive recognition by city council, property owners must prove that there is major support of the improvement. Formation and approval of an LID by city council then occurs through the following series of actions:

- City council passes Resolution of Intent that officially sets a public hearing date regarding the formation of the LID.
- The city clerk notifies property owners of their intentions to form the LID by mailing formation Hearing Notices.
- A city council meeting hosts a public formation hearing.
- A 30-day protest and appeal periods occurs, where property owners' input is considered.
- City council votes to approve or reject the formation of the LID.

Improvement projects are financed through bonds, which property owners within the improvement area will pay off annually. It is a city's responsibility to decide upon necessary levee improvements, and find proper engineers and contractors carry out these improvements. An overview of the basic steps regarding design, construction, and interim financing of a LID are as follows:

- Topographic survey of project location
- Project design
- Advertise for bids from contractors
- Award contract to low bidder
- Construction of project

Once improvements are complete, a final assessment occurs to determine both project costs and updated value of protected properties. The final assessment is presented to property owners and city council and property owners are given the opportunity to protest the final assessment. Because LID improvements increase property value, owners can protest if the increase in property value is believed to be either too small or to exceed the benefits of the project. The property value increase must be equal to or larger than the amount of the special tax collected for the improvement; however, the property assessment cannot be more than the value added to the property.

Local Improvement Districts serve as a plausible local funding source in areas that have a significant tax base. Although there are few examples of local entities utilizing a LID to repair, improve, or certify levees, it remains an alternative funding avenue for levee owners who have the means of generating finances via special taxation districts. Ultimately, the success of a LID stems from providing property owners with comprehensive knowledge of risk associated with levees, and encouraging community members to initiate responsibility for safety assurance in their community.

Benefit Assessments

RCW Title 85.38.140 to 85.38 170, Special District Creation and Operation, permits special districts in Washington to set assessment rates based on the assessed property value or total acreage, and direct benefit to those using or benefiting from the district's facilities. Special districts include diking, drainage, and flood control districts, which operate and maintain levees in Washington. Districts must use the guidance of RCW 85.38 to

determine how assessment rates are set for those receiving the benefit. Such assessments are used by districts to fund operation and maintenance of flood control projects and, in some instances, the certification of levees.

Assessments are generally based off a set dollar rate per $1,000 assessed property value. However, RCW 85.36, Powers of Special Districts, also authorizes rates to be based on dollar per acreage, per residence of a parcel, or per square foot of impervious surface (as does French Slough Flood Control District in Snohomish County). Districts are authorized to raise the assessment each year at their own discretion, depending on the funds needed for civil works activities. In Washington, districts are not limited to voter approval or a 1 percent increase like regular (non-voter approved) levies, such as library districts, hospital districts, and fire districts. Since special assessments do not face limitations in taxation amounts (which may otherwise preclude funding expensive levee improvements in a short time period), these assessments may be a viable funding option for expediting levee improvements.

Assessment rates vary across districts in relation to the appraised value of the property in each assessed area. As property values in urban areas tend to be higher than in rural areas, the ability to raise funds via assessments may be easier in populated districts where a small rate increase may be sufficient to cover civil works projects. An example of this variation is in Cowlitz County, Washington where a private firm estimated the cost to privately certify county levees to be $150,000 per mile. In the urban Consolidated Diking Improvement District 1 in Longview, Cowlitz County, the 2009 rate was $0.41 per $1,000 assessed property value. To fund certification, Longview diking district determined it would only have to raise the benefit assessment to $0.54 per $1,000 assessed property value. This can be compared to the nearby rural Diking Improvement District 1 in Willow Grove, Cowlitz County, which, in 2009, had the highest assessment rate out of the other districts in the county: $4.96 per $1,000 assessed property value. The higher rate in Willow Grove is due to less property available to be assessed for funding expensive civil works activities. The cost of using this assessment for private levee certification would increase the rate in the entire rural district to $94.77 per $1,000 assessed property value, according to Cowlitz Public Works figures from 2009. As can be seen from these examples, assessment rates for funding needed projects in urban and rural districts can be quite dissimilar.

Although using special assessment funding for levee improvements and certification in the various districts appears to be a possible option, urban areas are evidently more likely able to raise assessments for levee projects than rural areas. Additionally, the assessment may fluctuate if property values are volatile. If property values drop significantly, the assessment rates would have to increase automatically to maintain the same amount of revenue to support civil works projects for the budgeted year.

In addition to diking and drainage districts, another local option is a storm and surface water utility plan. Assessed at a city or county level, this special fee is collected and used for maintaining and operating facilities associated with surface water and stormwater management. Every parcel owner in the area is responsible for paying this fee, including home and business owners, city, state, and federally owned government parcels. There is a broader public benefit in using a stormwater utility fee, because this is a user-based fee, and unlike benefit assessments and special purpose districts, there is no limit on the amount collected. The fees can then be used for flood risk reduction and storm water management, including levee repairs and improvements.

STATE PROGRAMS

At the state level, several funding options currently exist for supporting local governments' pursuit of levee improvements.

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) program is a nationwide grant program administered through FEMA. PDM allots funding to state, and local government entities, as well as tribal governments and universities, for projects that seek to mitigate for hazard events. PDM grants are allocated on a competitive scale, with funding going toward projects where a community's risk would be greatly reduced in the face of a hazard event. PDM grants fall under FEMA's Hazard Mitigation Assistance grant programs, where mitigation efforts are defined as protecting property and life, and reducing economic and physical losses associated with a disaster. For more information on how to apply for this grant program, visit FEMA's "FY 2011 Hazard Mitigation Assistance Unified Guidance" (FEMA 2010).

Flood Control Assistance Account Program

The Flood Control Assistance Account Program (FCAAP) is a Washington grant program administered by the Washington State Department of Ecology. The authority for FCAAP derives from two sources, Chapter 86.26 RCW: State participation in flood control maintenance, and 173-145 WAC: Administration of the flood control assistance account program. In the past, these funds have been used to support levee projects in Washington and exist as a potential source for funding or supporting levee certification. However, FCAAP funding for flood-related projects is dependent on funds appropriated by the Washington Legislature each biennium. This funding cannot be carried over from one biennium to another. No grants were made under the FCAAP Program in the 2009-2011 biennium due to reductions in the State Operating Budget

Purpose

FCAAP funds help support flood hazard management plans, emergency repairs to flood control structures, and maintenance of flood control structures. These grant funds can support all flood control works, including maintenance, repairs for non-federal levees, and private levee certification assistance via funding of required studies.

History

FCAAP originally started in 1951 as the Flood Control Maintenance Program. The program was renamed the Flood Control Assistance Account Program in 1984, but continued to use 98 percent of its budget to support levee maintenance projects, according to the Washington Department of Ecology (Ecology). Around 1990, FCAAP shifted its primary focus from supporting levee projects to a wider emphasis on floodplain planning.

Funding is still available for levee projects under Flood Damage Reduction (FDR) Projects, a subsection of FCAAP, but these projects have constituted a small part of the overall FCAAP budget instead of the pre-1990 98 percent budget allotment. Though funding for FDR projects only receive 25 percent of the FCAAP budget, legislators have the ability to appropriate additional funds for specific projects if there is an immediate need within a specific biennium. In the past, the Washington State Legislature has acted to increase FCAAP funding to target specific flood management projects in emergencies. After the severe flooding in February 1996, the legislature made a special appropriation of an additional $5 million to the FCAAP program to specifically deal with the effects of the flood.

Eligibility

Local jurisdictions seeking assistance for levee projects are eligible for grant funding from the Flood Damage Reduction and the Emergency Construction Projects categories of FCAAP. However, as a prerequisite of receiving funds, local jurisdictions must be actively participating in the National Flood Insurance Program (NFIP).

Flood Damage Reduction funding can be utilized for both nonstructural and structural projects, however, highest priority for funding in this category is given to projects recommended in the Comprehensive Flood Hazard Management Plans. Nonstructural projects include floodplain preservation / restoration, while structural projects include traditional flood control works such as levees, dikes, and revetments. To be eligible for Flood Damage Reduction funds, the local jurisdiction must be participating in the NFIP, and is required to have a Comprehensive Flood Hazard Management Plan or be in the process of developing a plan with a prioritized list of flood hazard reduction projects. The jurisdiction must also be compatible with its plan, and have applied for all required permits (Ecology W. S., 2007).

Local jurisdictions also may use FCAAP funds for emergency levee repairs under the Emergency Construction Projects category. To be eligible for emergency project funds under FCAAP, local jurisdictions are required to be in a declared state of emergency by the city or county, and be in need of an immediate project to protect people, property, or other critical resources. In addition, jurisdictions must have the proposed project approved by appropriate regulatory agencies prior to the beginning of the project. Approving agencies include, but are not limited to, the Washington State Department of Ecology and the Washington State Department of Fish and Wildlife.

Funding Amounts

FCAAP was originally appropriated with $4 million in 1984. As of 2008, this figure has not increased, but has been spread over an increased number of projects. As such, the available funds for those seeking assistance for levee projects has decreased. Since 1990, the majority of FCAAP funds have been designated for Comprehensive Flood Hazard Management Planning, which typically receives 45 percent of overall awarded funds (Ecology W. S., 2007). Flood Damage Reduction projects generally receive only 25 percent

of the FCAAP budget and emergency projects are only allotted 10 percent, however these percentages can change each new biennium with legislative action.

Table 3 shows representative FCAAP projects and the percentage the grant funds would cover for each project, as well as the typical funding range. Grant funds will cover up to 50 percent of the Flood Damage Reduction projects (also known as Flood Hazard Reduction projects) in the range of $20,000 to $100,000. FCAAP Emergency Construction Project funds can be used to cover up to 80 percent of the costs for eligible jurisdictions in need of emergency levee repairs. The local jurisdiction is responsible for at least 20 percent of the remaining costs. As shown in Table 3, FCAAP funding ranges vary depending on the needs of the jurisdiction and the availability of funds.

Table 3. Types of projects and funding specifications for FCAAP appropriations

Type	Allowable %	Match	FCAAP Funding Range [1]
Comprehensive Flood Hazard Management Plans	75%	25%	$50,000 - 200,000
Other planning projects (Mapping, Flood Warning Systems, Public Awareness Programs, etc.)	75%	25%	$5,000 - 50,000
Corps Feasibility Studies	25%	75%	$100,000 - 200,000
Flood Hazard Reduction (Construction) Projects	50%	50%	$20,000 - 100,000
Flood Hazard Reduction Technical Studies	50%	50%	$10,000 - 50,000
Acquisition	50%	50%	$50,000 - 100,000
Fish Habitat Protection / Enhancement	50%	50%	$10,000 – 40,000
Emergency Construction Projects	80%	20%	Varies by need and availability of funds

Adapted from
http://www.ecy.wa.gov/programs/sea/grants/fcaap/pdf/FCAAP_Guidelines_FINAL.pdf

USACE RELATED IMPROVEMENT PROGRAMS

In addition to the state resources discussed above, several funding avenues for levee improvement exist at the federal level. These resources, administered through the U.S. Army Corps of Engineers (USACE), often involve cost-sharing programs that facilitate USACE's support in providing technical assistance to flood control projects. Included below are several descriptions of such programs, including the Floodplain Management Services Program, the Continuing Authorities Program, and the Economy Act.

Flood Plain Management Services Program

Non-federal levee sponsors may be eligible for funds through the Flood Plain Management Services Program (FPMS) under Section 206 of the 1960 Flood Control Act PL 86-645. This program authorizes USACE to provide technical assistance and planning guidance to support effective floodplain management. USACE is authorized to perform a variety of support activities for non-federal levee sponsors through FPMS, including geotechnical investigations, hydrology and hydraulic analysis, data collection, and mapping.

In general, these FMPS funds are used to finance small-scale studies requested by a local entity, such as assistance with analyzing a specific floodplain management problem or to create a hydraulic model. It is possible however, that USACE's technical assistance and support may be used by the local sponsor to further levee certification by a private engineer. In this case, support for private levee certifications through FPMS may be 100 percent federally funded, if funds are available. Additionally, USACE can accept voluntary contributions from state and local governments to expand the scope of the project.

Though FPMS funding may prove to be a useful mechanism to support private certification for non-federal levee sponsors, funding is limited and is often utilized for other floodplain management activities. For fiscal year 2011, USACE has appropriated $8 million to the FPMS program to be distributed to all USACE districts across the country. To date, FPMS funds have not been directly used to support private levee certification determinations in Washington.

Continuing Authorities Program

The Continuing Authorities Program (CAP) of the 1948 Flood Control Act is another cost-sharing agreement where USACE is authorized to address a variety of water resource issues without specific congressional approval for each project. The total cost of the

project under the CAP is shared among the federal government and a non-federal sponsor(s), but is subject to funding limits depending on the specific program under CAP. Programs under CAP include Small Flood Control Projects Section 205, Emergency Streambank and Shoreline Protection Section 14, and Small Beach Erosion Control Projects Section 103.

Of these listed CAP programs, the Small Flood Control Projects appears to be the most applicable to levee improvement. Under Section 205 of the 1948 Flood Control Act, USACE is authorized to develop and construct small flood control projects, including improvements or construction of levees, channels, and dams. Non-federal sponsors are required to contribute at least 35 percent or up to 50 percent of the total costs for projects performed under Section 205. The sponsor is also required to contribute 5 percent of the total structural costs of the project in cash. Federal cost for Section 205 projects is not to exceed $7 million, which includes costs for feasibility studies, planning, engineering and design, and construction.

Economy Act

Although USACE offers assistance to non-federal projects in the form of their Rehabilitation and Inspection Program (discussed in following sections), USACE does not generally certify non-federally owned/operated projects, with one exception. USACE does have the authority to certify levees via the Economy Act where a local sponsor has collaborated with another federal agency. The Economy Act (Title 31, Subtitle II, Chapter 15, Subchapter III, 1535 – agreements between Federal Agencies) provides non-federal levee owners an opportunity to collaborate with other government agencies in a cost sharing agreement.

Generally, the federal partner does not have to pay a large percentage of levee certification costs. In Reedsport Oregon, the U.S. Forest Service acted as the federal partner on a levee certification performed by USACE and had to pay a minimal $4,000, while the city of Reedsport paid $44,000. In 2007, the Longview diking district in Cowlitz County agreed with Housing and Urban Development (HUD) to form a federal partnership under the Economy Act, however USACE denied the request. In the agreement, HUD would have contributed $5,000 of the estimated $35,000 for the levee certification with USACE.

Cost sharing agreements are a useful strategy for non-federal levee sponsors because they authorize USACE to either support or perform levee certification, which is generally a less

expensive alternative to private certification. Funding under these different mechanisms varies however, and relies on a vested federal interest from another agency or eligibility and available funds in the Rehabilitation Inspection Program (class 320) and the Support for Others program (class 250).

REHABILITATION FUNDING

While the various programs described thus far may be utilized for funding levee improvements and/or eventual levee certification, it should be noted that several agencies also provide rehabilitation assistance for levees and other flood control works. The following discussion illustrates funding assistance programs available through USACE, FEMA, and the Natural Resources Conservation Service (NRCS).

Flood Control and Coastal Emergencies (FCCE)

The largest and most pervasive program for levee repair associated with USACE is PL 84-99, commonly referred to as the Flood Control and Coastal Emergencies (FCCE) Act. Under this Act, USACE is authorized to undertake activities including disaster preparedness, advance measures, emergency operations, and rehabilitation of flood control works destroyed by flood. In fiscal years 2009 and 2010, USACE appropriated $41 million of its budget to the FCCE program. In 2011, it is expected this program will receive $30 million of the USACE Civil Works budget (Engineers U. A., Fiscal Year 2011 Civil Works Budget for the U.S. Army Corps of Engineers Sumary, 2010).

Under PL 84-99 and the FCCE, all funding for emergency operations and improvements are made through the Flood Control and Coastal Emergencies Appropriation 96X3125, (outlined in ER 11-1-320, Civil Works Emergency Management Programs). FCCE appropriations are divided into six major categories depending on the programs and the type of emergency assistance activities involved. Within the different categories, designated classes relate to specific appropriations for the types of assistance activities. For example, activities relating to the Rehabilitation and Inspection Program are under category 300 and the appropriation for non-federal levee sponsors is in class 320, Rehabilitation of active non-Federal flood control works. Table 4 summarizes the various programs available for assistance under the FCCE.

Table 4. Programs under the Flood Control and Coastal Emergencies Act. Applicable Programs underlined.

Category	Class	Type of Assistance	Criteria and Comments
DISASTER PREPAREDNESS	100 (Includes 110, 120, 130, 140)	• Preparation of plans for response to emergencies, development of exercises and training, etc.	Criteria for each class differs (See Appendix 2)
EMERGENCY OPERATIONS	200 (Includes 210,220,230,240,250,260)	• Emergency operations, technical assistance, etc.	Criteria for each class for each class differs (See Appendix 2)
	Class 250	• Support received from other Federal agencies in response to a flood or coastal storm emergency.	Can only be used during a flood related emergency for reimbursable under PL 84-99.
REHABILITATION AND INSPECTION PROGRAM	300 (Includes 310, 320, 330, 340, 350, 360, 370)	• Rehabilitation and inspection of federal and non-federal flood control projects and	Criteria for each class for each class differs (See Appendix 2)
	Class 320	• Rehabilitation of active non-Federal flood control works	See criteria and comments for Federal rehab, Class 310. 80% Current cost sharing, 80% Federal,/ 20% non-Federal.
WATER ASSISTANCE	400 (Includes 410, 420,430)	• Supply and transportation of emergency water, well drilling, etc.	Criteria for each class for each class differs (See Appendix 2)
ADVANCE MEASURES	500 (Includes 510, 520)	• Preventative work and advanced measures for imminent threat of flooding, etc.	Criteria for each class for each class differs (See Appendix 2)
HAZARD MITIGATION	600	• Corps participation with FEMA in hazard mitigation strategies	Criteria for each class for each class differs (See Appendix 2)

Of the six cost-sharing programs under PL 84-99 and shown in Table 2, activities for non-federal levees are most commonly attained through cost-sharing agreements as specified in the Emergency Operations, Class 250, and the Rehabilitation and Inspection Program. This 250 class incorporates support provided by other federal departments and agencies including the Federal Emergency Management Agency (FEMA) and the Department of the Interior. Funding through the Support for Others Program must be used during flood-related disasters as reimbursable work under PL 84-99.

The Rehabilitation and Inspection preprogram, class 300, provides levee owners and managers with a variety of funding streams in the event of levee damage from flooding. In addition, USACE provides initial eligibility inspections, as well as continuing inspections

of levees enrolled in the USACE RIP program. As shown in table 2, non-federal projects authorized to receive funding under class 320 must be in the RIP, be damaged in a flood or coastal storm, and be economically justified to receive rehabilitation repairs. Projects eligible for this funding are 80 percent cost shared by the federal government and 20 percent percent by the non-federal sponsor.

Natural Resources Conservation Service

Under Section 216 of the Flood Control Act of 1950, PL 81-516, and Sections 403-405 of the Agriculture Credit Act of 1978, PL 95-334, the Natural Resources Conservation Service (NRCS) has authority to assist in relieving imminent hazards to life and property from floods and products of erosion created by natural disasters that cause sudden impairment of a watershed. In line with this mission, the NRCS Emergency Watershed Protection (EWP) Program was established to provide technical and financial assistance to local sponsors coping with hazards caused by floods and other natural occurrences. When a natural disaster occurs, EMP restoration and protection practices may include procedures that restore stream channel capacity, stabilize and protect stream banks, repair or remove damaged dams, dikes, and levees, protect structures located in floodplains, and restore damaged upland areas of watersheds.

To be eligible for the NRCS's EWP program, several criteria must be met. Levees and other flood control works are eligible for repair under the EWP Program when: 1) there is a potential for loss of life or property without the repairs; 2) the benefits associated with repairing the flood control work exceed the cost of repair and other flood control costs; and 3) the owners agree to meet NRCS eligibility requirements for engineering and maintenance (FEMA 2009). Individuals are not eligible for EWP Program assistance unless represented by a project sponsor (e.g., a State government or a city, county, tribal organization, general improvement district). Additionally, levee repair or removal under the EWP Program does not apply to water-control structures maintained or owned by other Federal agencies.

Under current provisions, the EWP recovery work can be done through either Federal or local contracts. NRCS may bear up to 80 percent of the construction cost of the emergency practices (up to 100 percent for exigency); the remaining 20 percent must come from local sponsors and can be in the form of cash, in-kind services, or both. Sponsors are responsible for securing the land rights, obtaining necessary permits to

make repairs, furnishing the local cost share, and operating and maintaining the finished work.

Federal Emergency Management Agency

In addition to the NRCS and the aforementioned USACE rehabilitation programs (RIP), the Federal Emergency Management Agency also has authority to fund repairs to certain levees and other flood risk reduction works. With authority given under Sections 403 and 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), FEMA may provide assistance to flood control facilities in presidentially declared disasters for facilities that are not eligible under other programs. Specifically, if a facility is ineligible under the RIP (due to construction or repairs that have been funded from a Federal agency other than USACE) or EWP program (due to construction with Federal funding), then FEMA may provide funding assistance to repair eligible flood control works, as shown in figure 4. The following description illustrates typical assistance by FEMA in regards to levee system repairs.

Works **Eligible** for FEMA funding assistance in repairs may include:

1. Emergency repairs to levees subsequent to a Presidentially-declared disaster declaration and, in very limited circumstances, temporary repairs to restore levees that pose an imminent threat; the general policy, however, is that FEMA does not fund repairs to flood control structures.

2. The removal of debris deposited in a channel project of a flood control work, if the debris is the direct result of the disaster and presents an immediate threat to life, public health and safety, or improved property;

3. The placement and removal of flood fighting measures if such activity is necessary to eliminate a public health and safety threat, to operate the flood control work as a public facility, or to repair the facility; and

4. Dewatering of areas behind levees by breaching or pumping, if there is a threat to public health. safety, or improved property, or if dewatering is required to facilitate the initiation of a Federal repair project. Deliberate breaches made by the sponsor to accomplish such dewatering are also eligible for repair.

Works **Ineligible** for FEMA funding assistance in repairs may include the following**:**

1. Flood control works enrolled in RIP, either Active or Inactive, that are ineligible for assistance from FEMA for emergency and permanent repairs, debris removal, or flood fighting activities;

2. Flood control works that were pending an Initial Eligibility Inspection by the USACE at the time of a disaster, if the USACE determines that the structure is eligible to participate in the RIP;

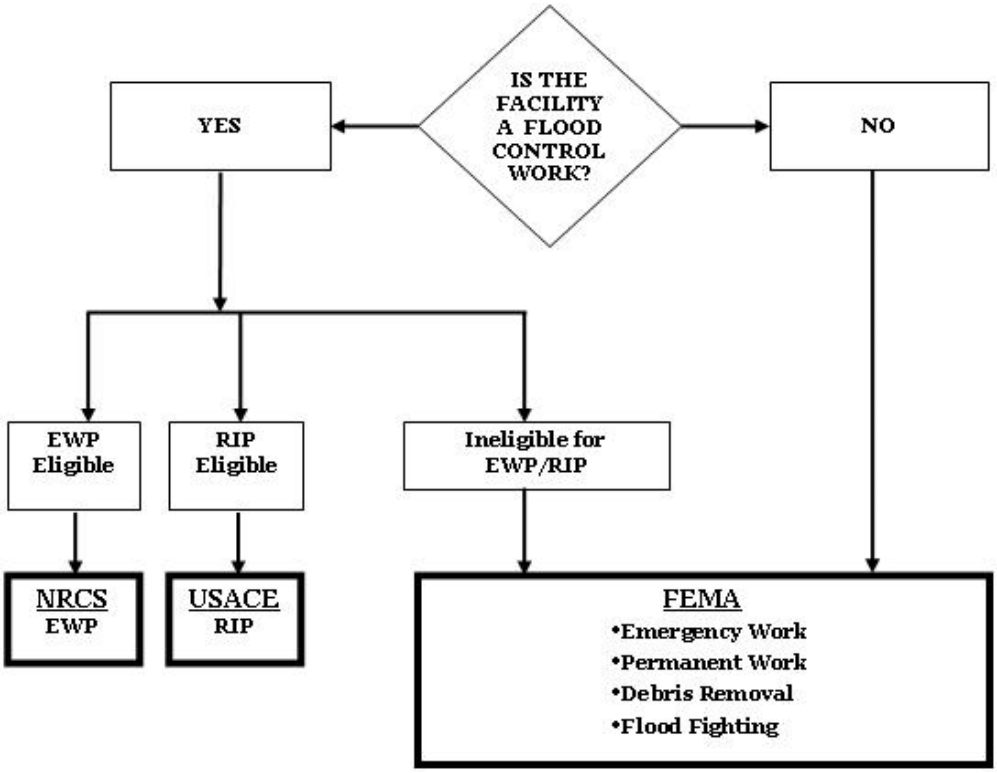
3. Flood control works that are eligible under NRCS' authority;

4. Dewatering areas behind levees for the primary purpose of drying land;

5. Secondary levees riverward of a primary levee, unless they protect human life; and

6. Generally, repairs aimed at increasing the height of a flood control work.

Figure 4. Flood Control Works Eligibility for FEMA Public Assistance in Presidentially Declared Disasters, adapted from:
http://www.fema.gov/government/grant/pa/9524_3.shtm



STATE LEGISLATURE FUNDING

A potentially significant financing source for levee improvements in Washington State is funding allocated by the State Legislature. California serves as a model for state-funded flood protection and risk reduction projects. In the past decade, California has improved levee systems through legislative action.

In a 2002 budget bill, the California State Legislature first required that the California Department of Water Resources develop recommendations regarding flood control efforts. Several years later, the Department produced a "Flood White Paper" with specific recommended strategies for protecting resources from flooding events.

During this same time, the California State Legislature became increasingly concerned with protection of the Sacramento-San Joaquin Delta. This area, which contains over 1,100 miles of levees and approximately 500,000 people, includes lands, infrastructure, and fish and wildlife resources of critical importance to the State. Additionally, the Delta provides water delivery systems serving approximately 24 million people, including the San Francisco Bay area, San Joaquin Valley, and Southern California. Levee failures, such as along the Jones Tract area, promoted an awareness of levee failure consequences during this time, and several risk management studies were consequently executed. Concurrently, flood events in late December 2005 and January 2006 gained extensive media coverage and visibility, thereby helping to convey the fragility of the flood system in California's Central Valley.

In February of 2006, after viewing the Sacramento area levees with members of Congress, Governor Schwarzenegger declared a statewide levee emergency. Twenty-four levees, identified as being in critical condition due to erosion, were found in need of immediate repair. In May of 2006, California legislature responded and appropriated $500 million dollars for immediate levee investigations, repairs, and improvements. Successively, in November of 2006, California voters approved Proposition 1E, part of a "Rebuild California" bond measure totaling $4.09 billion. Proposition 1E specified funding for levee investments and other improvements to flood-protection infrastructure. Proposition 84, also approved in November 2006, provided for the allocation of $800 million dollars for flood risk reduction projects.

In 2007, California, with strong support from Governor Schwarzenegger, passed eight bills dealing with flood issues and flood control:

- *Senate Bill 5* – requires 200-year flood protection in urban areas of the Sacramento-San Joaquin Valley and development of a Central Valley Flood Protection Plan;
- *Senate Bill 17* – renaming of the State Reclamation Board to the Central Valley Flood Protection Board and additional requirements for the Board;
- *Senate Bill 276* – includes flood control projects authorization;
- *Assembly Bill 5* – amends author for the Central Valley Flood Protection Board, mapping, reporting, and maintenance requirements;
- *Assembly Bill 70* – specifies cities and counties have a share of liability in flood-response;
- *Assembly Bill 156* – directs a comprehensive mapping of flood risks and other measures, including risk notification and improving maintenance;
- *Assembly Bill 162* – requires cities and counties to include in land use-plans annual identification and review of flood risks;
- *Assembly bill 930* – expands the definition of "flood project" to include the acquisition of easements.

As a result of voter-approved spending through these bills and bond measures, California was able to fund a combined total of $4.89 billion dedicated to flood risk reduction. Such legislative actions serve as an example for potential funding sources in Washington State, as flood protection and flood risk reduction efforts extend to include levee repairs and improvements.

VI. CASE STUDIES

In order to illustrate current policies, strategic frameworks, and problems surrounding levee certification in Washington State, multiple case studies were developed. While there are numerous levee systems in the State currently tackling issues surrounding levee certification, specific attention for this study was paid to areas where potential flood damage poses significant impacts to populations and economic security. (A preliminary prioritization tool was developed to assist in quantifying such impacts, which is described in further detail in the following section on the geospatial database.)

The following case studies were developed through investigative research and interviews with multiple parties involved in levee management, including but not limited to local government officials, federal agency employees, private consultants, public works departments, special districts, and state regulatory agencies.

Lower Puyallup River (Pierce County)

The Lower Puyallup River and its levee network typify river systems experiencing aggradation (the increase in elevation due to buildup of sediment), and the difficulties associated with pursuing certification and accreditation in such environments. Being located in a highly developed urban region between the city of Puyallup and the Port of Tacoma, the river system has significant potential for economic and human impacts from flooding. As such, levee management along the Puyallup remains a major concern for local entities like Pierce County.

The Lower Puyallup River, which extends upstream from Commencement Bay to the city of Puyallup, consists of an 8-mile reach bounded by concrete levees. Constructed between 1914 and 1924, levees line both banks of the river. The levees were accredited as 100-year levees when flood mapping was initially performed in the area in 1987. In 2007, FEMA updated NFIP maps of the area. The update revealed higher flood elevations and a broader floodplain because of increased sediment deposition in the river channel. With sedimentation reducing available levee freeboard, levees along the Lower Puyallup no longer complied with FEMA's accreditation standards for providing 100-year flood protection.

Pierce County hired a private engineering firm to initiate a study evaluating present conditions along the river and conditions in 50 years if no flood protection in undertaken. In June of 2009, the firm completed a preliminary analysis for Pierce County Public Works and Utilities Surface Water Management Division in order to assess conditions of the levees and examine ways in reducing the size of the newly mapped floodplain. Entitled *The Lower Puyallup River Flood Investigation Project*, the analysis provides an important example of the geotechnical requirements needed for accreditation, as well as the costs for studies examining levee structural integrity.

In order to assess the feasibility of obtaining FEMA accreditation in the future, *The Lower Puyallup River Flood Investigation Project* consisted of technical analyses on levee structure and conditions. Included in these analyses were aspects on hydrology (describing food characteristics and peak flows), geotechnical evaluation (describing levee construction and potential geotechnical instability, seepage, overtopping, and erosion), sediment transport and deposition (describing deposition for up to 50 years into the future) and hydraulic modeling (describing flood flows associated with levee overtopping and breaching). Interviews with staff of the Pierce County Public Works Department confirmed the total cost of this analysis to be approximately $1,000,000.

To evaluate levee conditions and integrity, the firm performed seepage, probable failure point, and slope stability analyses (in general accordance with USACE *Design and Construction of Levees Manual EM 1110-2-1913* and the *Slope Stability Manual EM 1110-2-1902)*. Results indicated a high risk of underseepage and sand boil occurrence along the levee system during elevated river stages. As such, the consultant deemed the existing levee systems to have structural deficiencies significant enough to preclude them from meeting FEMA accreditation and USACE certification standards. In addition, sediment modeling suggested that without dredging or major changes to the riverbed, the channel will progress to a higher bed elevation (up to 5 feet), which would result in rising river levels. Such accumulation of sediment raises water to the point where levee tops are no longer 3 feet above the predicted 100-year flood water levels, one of FEMA's requirements under the freeboard section of 44 CRF, Section 65.10.

Because structural insufficiencies that precluded certification and accreditation, levee managers began seeking preferred options for improving and certifying the Lower Puyallup levee systems. (Without flood management intervention, it is believed the Puyallup River basin will experience significant flooding and will not be able to qualify for

accreditation). After consideration by the Puyallup River Executive Task Force, a USACE general investigation was initiated as a possible avenue for planning levee improvements.

To assess the flooding potential for the Puyallup and White River watershed areas in a holistic manner, the United States Congress authorized a USACE General Investigation New Start (GI) on June 21, 2000. With authorization in place, funds were appropriated in 2008 and 2009 for the completion of a $100,000 reconnaissance study to investigate flood issues and determine if a Federal interest existed in continuing to a feasibility level evaluation for flood risk management.

On March 18, 2009, USACE staff completed the Puyallup River 905(b) Reconnaissance Report (performed at Federal expense). This reconnaissance study formulated and evaluated a series of alternative plans for flood risk management, concluding that sediment control and levee enhancement (raised height and flood walls) with appropriately placed setback levees have the greatest potential for implementation. Because implementation of flood risk measures reduces flood damages, lowers the risk to public health and safety, and eases recertification, USACE concluded that a federal interest existed in pursuing a feasibility phase study to plan for flood damage reduction and fish and wildlife habitat restoration of the Puyallup River Basin.

With an agreement and federal sponsor in place (USACE), local sponsor Pierce County has begun the 5-6 year preliminary feasibility study entitled *The Puyallup Basin General Investigation Study for Flood Risk Management and Ecosystem Restoration*. With a Project Management Plan drafted and agreed upon in March 2010, this feasibility project will be funded via a 50/50 cost share between USACE and Pierce County. Costs for the project are estimated at $6 million, as outlined in the Feasibility Cost Sharing Agreement (FCSA) between the two sponsors. When finished, the feasibility report will form the basis for Pierce County, USACE, and the U.S. Congress to consider approving authorization and construction of the final recommended plan.

By pursuing a General Investigation feasibility project with USACE as a federal partner, Pierce County benefits by sharing the cost of a variety of analyses and work items needed to restore the region's flood protection levels. Included in the feasibility project will be items including, but not limited, to the following:

Table 5. Examples of General Investigation feasibility costs.

MAJOR WORK ITEMS	COST
Surveys and Mapping (except Real Estate)	$600,000
Hydrology and Hydraulics Studies/Report	$500,000
Geotechnical Studies/Report	$300,000
Engineering and Design Analysis Report	$300,000
Economic & Socioeconomic Studies	$200,000
Real Estate Report	$200,000
Environmental Studies/Report	$200,000
Environmental Compliance	$200,000
HTRW Investigations/Report	$150,000
Cultural Resources Studies	$250,000
Cost Estimating	$50,000
Public Involvement	$100,000
Plan Formulation and Evaluation	$200,000
Final Report Documentation	$100,000
Technical Review	$50,000
Washington Level Report Approval (Review	$50,000
Total	$3,450,000

A given drawback to pursuing a General Investigation as a strategy for this levee system improvement and certification is that the scope and duration of the project can be long. (Construction of the preferred alternative is not scheduled to commence until at least 2015). In general terms, however, the General Investigation approach can be a viable way for local sponsors like Pierce County to procure important information on levees and flood protection levels, all the while sharing the cost with a federal entity.

HORSESHOE BEND (KING COUNTY)

The action taken to certify the city of Kent's Horseshoe Bend levee is an example of an alternate strategy for pursuing levee certification: utilization of the private sector. The three-mile Horseshoe Bend levee, a federally owned, locally operated levee that protects approximately one-third of properties within Green River Valley, required immediate action in order to ensure the safety of those living and working near this levee system. The area surrounding this levee is extensively developed, making a significant property buyout an expensive and unfeasible option. The city of Kent, with King County as the

local project sponsor, consequently prioritized the Horseshoe Bend levee for certification efforts in order to obtain FEMA accreditation.

The certification process began in the fall of 2009, with the hiring of a private engineering firm to analyze the structural integrity of the levee and compile the necessary documentation needed to certify Horseshoe Bend levee. The firm performed a stability analysis pertaining to design conditions and site conditions, as well as an overall levee analysis. Site condition analysis included examining existing conditions, proposed repairs and modifications, subsurface conditions, and design soil properties. The levee analysis documented erosion protection, internal drainage, closures, vegetation, seepage and groundwater, settlement, and slope stability. The analysis conducted followed 44 CFR 65.10; FEMA's guidelines and requirements in seeking certification. Kent was provided with validated information needed to demonstrate the levee will "meet and continue to meet the minimum design, operation, and maintenance standards" according to 44 CFR 65.10, *Mapping of Areas Protected by Levee Systems*. Structural improvements were necessary in updating the existing levee to a level that complies with FEMA's 44 CFR 65.10.

The city of Kent pursued private certification in order to expedite the certification process and bypass pending vegetation removal requirements. As a federally constructed levee, Horseshoe Bend is subject to Public Law 84-99 which provides emergency assistance and repair performed by USACE within the Rehabilitation and Inspection Program (RIP). PL 84-99 requires removal of all vegetation greater than 2 inches in diameter from levees. While a prior Seattle District variance allowed Horseshoe Bend to maintain 4 inches of vegetation, USACE is currently in the process of re-evaluating all regional variances nationwide. A final decision on regional variances is set for early 2011, with revocation going into effect six months following. Consequently, the eligibility for all Green River levees rehabilitation assistance under PL 84-99 is under review.

If Kent were to follow existing vegetation regulations set forth by USACE, the Horseshoe Bend levee would be eligible for the RIP program. The required removal of vegetation, however, posed potential third party lawsuits to the city on the grounds of violating the Endangered Species Act. (Additionally, participating in the RIP program would subject the Horseshoe Bend certification process to adhere to a USACE timeframe, and the city of Kent expressed an immediate need to seek levee certification.) The city of Kent, King

County, the Muckleshoot Tribe, and Ecology expressed concerns that removing existing vegetation within the Green River riparian zone would be detrimental to the ecological habitat and raise the water temperature of an already at-risk river system that houses three endangered species of salmon and trout. As a result, the city of Kent pursued private certification, which has allowed larger vegetation to remain on the levee while still being certified by a private professional engineer.

The Horseshoe Bend levee improvement project required securing funding from multiple sources to cover associated costs of levee construction improvements, setbacks, repairs, and property acquisition. $1 million is allocated for the Horseshoe Bend Acquisition and Setback to support acquisition work necessary for levee setbacks. While final costs for this project are yet to be determined, construction costs and buyouts have been estimated to approximate $35 million (Minnick 2009). Much of the expenses to date have been allocated for improving structural integrity of levee system. For example, a repair completed in 2009 cost $5 million to restore a section of the levee damaged from 2006 flooding (Mimnick, 2009). $10 million was appropriated to the city of Kent from the state legislature, with the acting grant manager being the Department of Ecology. These funds were aimed to address levees specifically within the Horseshoe Bend stretch of the Green River, with approximately $8 million intended for constructing setback levees and buying out specific property owners (WA Department of Ecology, 2009). King County Flood Control District appropriated $1,000,000 for the project, and it is King County's responsibility as the local sponsor to allocate these funds for levee repair and improvements, as outlined in the 2006 King County Flood Hazard Management Plan.

The city of Kent to date has spent approximately $1 million on the Horseshoe Bend levee certification package preparation, which includes a certification report on the adjacent Foster Park reach. An additional $500,000 was spent on constructing a secondary levee at the west end of Horseshoe Bend at Foster Park, which addressed issues of shoreline management and ecological restoration to prevent erosion and protect the environmental integrity of the area. This additional cost for Foster Park included an earthen berm within Horseshoe Bend that that will serve as a setback levee, providing additional protection to surrounding homes and businesses from Green River floodwaters.

The city of Kent is preparing to incur additional costs as they respond to FEMA's requests for information related to the certification package. The final cost of certification at this point in time is unknown, as future work identified in the certification package for

Horseshoe Bend has yet to be completed. The Horseshoe Bend private engineering consultant for the certification process suggests two specific areas will need improvements in order to meet minimum Federal standards. The city of Kent estimates these projects will cost an additional $6 million to $9 million and could rise to as much as $40 million, which includes a right of way acquisition.

To ensure the certification package's alignment with FEMA's accreditation requirements, Kent hired an additional consulting firm to provide ancillary review support for the Horseshoe Bend levee. This consulting firm has provided engineering analysis support and expertise in certifying levees in other parts of the country, and was able to appraise the drafted Horseshoe Bend certification package to ensure that the data and documents were submitted in complete compliance with 44 CFR 65.10. In August 2010, Kent completed Certification Reports and the Conditional Letter of Map Revision Requests for Horseshoe Bend and submitted the completed certification documentation to FEMA for accreditation approval.

Horseshoe Bend's certification through a private engineering firm may serve as an example to future levee owners of an alternative strategy for actively pursuing levee certification. The ramifications of this approach are notable, as the Horseshoe Bend levee project is one of the largest examples in the State of a federally owned levee pursuing certification by a private, non-federal entity. The Horseshoe Bend certification may convey to levee owners and communities that a viable option exists for certification from private engineering firms.

COWLITZ COUNTY

The levees in Cowlitz County provide an example of the disparities that sometimes occur between USACE and private entities during the certification process. Cowlitz County, located in southern Washington, has six diking, drainage, and flood control zone districts -- Longview, North Kelso, South Kelso, Woodland, Lexington, Willow Grove, and the city of Castle Rock. All of the levees in these districts were built in the 1920s and 30s for agricultural purposes. USACE began assuming maintenance and inspection of these non-federal levees in the 1950s. In 1980, following the eruption of Mt. St. Helens, reconstruction occurred on levees protecting located along the Cowlitz River, which included levees in Lexington and North Kelso districts, in order to provide 100 year protection.

In recent years, the diking districts of the county have pursued certification of these levee systems. In the mid2000's, USACE's Portland District estimated the cost for assisting in certification for all the levees in Cowlitz County at $250,000, but due to the stipulations in Public Law 106-541 section 211 (Thomas Amendment), USACE was not authorized to compete with private engineers for certifying non-federal levees. (The language in the Thomas Amendment prohibits USACE from providing engineering assistance for non-federal levee projects if the work is "reasonably and quickly available through ordinary business channels." However, USACE is authorized to provide technical assistance and/or certification of levees if it can demonstrate that it is "uniquely equipped" to perform services private engineers are unable to carry out.)

In 2008, due to the provisions in the Thomas Amendment, USACE backed out of the agreements with all local diking districts – including Longview, Kelso, Woodland, Lexington, and Willow Grove - for certifying levees that USACE had operated and inspected before 2007. The diking districts put out a Request of Qualifications in September 2008 to a Portland based geotechnical firm specializing in dams, seismic studies, geotechnical engineering, hydrogeology, and complex geotechnical studies. The consultant conducted the first phase of certifying Cowlitz levees by obtaining existing data on the levees from the Portland USACE district as well as local governments. The first phase included a review of certifications for levees based on a cost-per-mile from other regions around the United States. (The closest cost comparison information came from Sacramento, CA.) The consultant estimated the cost for certification of all the levees in Cowlitz County would be more than $10 million, or $150,000 per mile. The Portland USACE district estimated it could certify the 15-mile levee in Longview diking district for $35,000 per mile. In 2007, Longview signed an agreement with USACE to complete the levee certification but the agreement was later negated due to restrictions in the Thomas Amendment. Longview was given the status of a Provisionally Accredited Levee, which expired in 2010.

The one exception where USACE was authorized to certify a levee in Cowlitz County was in the city of Castle Rock. USACE was authorized to assist in the certification and repairing of the Castle Rock levee because the city was continuing structural work on the levee initiated the year before as part of the Mount St. Helens Sedimentation Control project. Nearly $2.8 million in stimulus funds from the American Recovery and Reinvestment Act was appropriated to strengthen 1,700 feet of the north end of the levee

and build a cutoff wall to block the water that had been seeping through a portion of the levee.

Other diking districts in Cowlitz County, including Longview, are currently seeking federal agencies that deem levees as critical to their interests and missions, and are thus willing to be a partnering sponsor to achieve levee certification.

COST-SHARING FEDERAL PARTNERSHIP CASE STUDIES

USACE is minimizing its role in non-federal levee system certification for FEMA accreditation and transferring the responsibility for the evaluations to the local levee sponsors. Under the new USACE guidelines, cost-sharing programs such as the Economy Act and Support for Others agreements can no longer be used for the sole purpose of USACE levee system evaluations. However, these cost-sharing agreements may be used for other projects or studies, which could support levee certification determinations from a private PE.

Diking districts in Cowlitz County provide an example of the difficulty non-federal levee owners have in finding alternative means of acquiring levee certifications from USACE, under restrictions in the Thomas Amendment. The following case studies represent non-federal levee that has successfully received a USACE certification determination under a cost-sharing federal partnership, as well as areas in Cowlitz County that are still attempting to acquire a federal partner.

Reedsport, Oregon

Cost-sharing agreements associated with federal partnership under the Economy Act were once a potential funding mechanism for levee certification, although it was rare that certifications were conducted under this act. The new policy under EC 1110-2-6067, released in August 2010, states that non-federal levees are no longer able to utilize cost-sharing agreements for the sole purpose of having USACE to perform NFIP levee system evaluations. According to Seattle, Walla Walla, and Portland USACE districts, there has never been a levee sponsor successful in certifying under this program in Washington State. However, this strategy was used successfully in Reedsport, Oregon.

The Portland USACE district, conducted a levee certification determination under the authority of the Economy Act in Reedsport, Oregon prior to the release of EC 1110-2-6067.

The city of Reedsport collaborated with the U.S. Forest Service in a cost-sharing agreement, which allowed USACE to perform the levee certification. The Forest Service contributed $4,000 for the agreement, while Reedsport contributed approximately $44,000. Once the city acquired the U.S. Forest Service as a federal partner, USACE agreed to perform the certification under the Economy Act with the understanding Reedsport would have to repair levee seepage issues before certification was completed. Since Reedsport has successfully certified its levee, it has been be able to qualify for FEMA accreditation.

City of Yakima

In some instances, federal levee systems built and owned by USACE are maintained by a non-federal entity in a Project Cooperation Agreement (PCA). The levee system in the city of Yakima is an example of a federally authorized system built by USACE, but is in agreement with Yakima County to have the county maintain the system (Engineers, U.A. Seattle 2010). The levee system remains in the PL 84-99 program and is eligible for rehabilitation costs 100 percent covered by federal funds through the Inspection of Completed Works program. If the county fails to maintain the levee system in accordance with the PCA, USACE can correct the deficiencies and bill the county. To date, however, this situation has not occurred in any other district in the country (Engineers, U.A. Seattle 2010).

Cowlitz Diking Districts

In Washington's Cowlitz County, diking, drainage, and flood control zone districts are actively pursuing a similar approach with federal partners to allow USACE to perform levee certification under the Economy Act. Cowlitz levees are maintained and operated by diking districts consolidated into six areas: Longview, South Kelso, Woodland, North Kelso, Willow Grove, and Lexington. The city of Castle Rock does not have a diking district but maintains and operates its levee. All of the levees in the aforementioned diking districts were once designated as Provisionally Accredited Levees with FEMA. However, their status as PAL's expired in September 2010. Therefore, these levees will not be accredited and included on FEMA's National Flood Insurance Rate Maps (FIRM's) unless they are privately certified.

Cowlitz County has been providing coordination between state representatives, federal agencies, and the diking, drainage, and flood control zone districts to determine potential

federal partners for USACE to perform levee certifications. Cowlitz Public Works attempted to collaborate with the U.S. Forest Service as a partner under the Economy Act. Because the U.S. Forest Service monies were not eligible to be used for purposes other than direct Forest Service activities, these funds could not be used to support levee evaluations by USACE. The county also sought out the U.S. Department of Transportation (USDOT) for a potential agreement, stating the federal roads protected by the levees justify federal interest. USDOT originally supported the partnership but was notified by Federal Highways that the funds could not be used for certification purposes.

Thereafter, the county pursued partnership with the Housing and Urban Development (HUD) for levee certification in urban diking districts; HUD had engaged in a similar certification scenario in Kentucky. HUD agreed to participate in the partnership in a stated letter to the Portland USACE district. The letter stated HUD was leaving it up to the state to make the decision as to how the state would use the agency's federal funds. USACE rejected the letter because it did not specifically include HUD had "no objection" to the state using the funds for levee certification. The county has since been coordinating with Washington Congressman Brian Baird and Senator Patty Murray to ensure that future HUD authorization letter meets USACE's requirements. If a partnership were established, HUD would have to contribute 5 percent of the overall estimated cost of $210,000 to make it possible for USACE to perform the levee system evaluation.

Cowlitz County is also investigating whether the Natural Resource Conservation Service (NRCS) can be a potential partner for levee certifications in rural diking districts, such as Woodland and Willow Grove. The county initiated funding requests from the NRCS office in Spokane, Washington to assess the potential use of the agency's Conservation Technical Assistance Funds to form a partnership. (According to Cowlitz County Public Works, the funding for partnerships in levee certification must come from such Technical Assistance Funds). The NRCS is still reviewing the potential for the partnership and availability through its Technical Assistance Funds.

Development of Regional Standard

Some levees in the Pacific Northwest are located in areas with soil characteristics that are more stable than in other locations or regions around the country. A private firm is currently working with USACE to establish a regional standard for levee certifications,

which would allow private engineers to make engineering judgments based on subsurface conditions for portions of the geotechnical analysis, such as distance between borings. There is little settling of the soils under many of the Cowlitz levees, so it may not be necessary to follow the strict guidelines of the geotechnical analysis in CFR 65.10. USACE is authorized to make these kinds of engineering judgments because the USACE geotechnical guidelines (ETL 1110-2-570) are widely accepted as going "above and beyond" 44 CFR 65.10. This explains the disparities in cost estimates between private certification and USACE certification of Cowlitz levees.

The examples listed here illustrate both success and failures associated with local jurisdictions' strategies for levee certification. Federal partnerships for USACE levee certification under the Economy Act are a possible strategy available to non-federal levee sponsors. These partnerships however, clearly are difficult to acquire unless the federal agency can demonstrate a strong federal interest associated with the certification of the levee system. As such, local levee owners and managers will likely benefit from exploring combinations of all the aforementioned resources available to them for levee improvements and certification.

VII. DEVELOPMENT OF LEVEE INVENTORY AND PRIORITIZATION

A critical task of this assessment has been to compile the first comprehensive statewide levee database for Washington State. For this study, emphasis was placed on the compilation and synthesis of existing data, rather than on the creation new spatial datasets. The database is an inventory of the location and attributes of all currently known levees at the statewide level. In line with the guiding proviso, however, particular attention was paid to levees that are accredited or have been accredited in the past as providing 100-year protection. (If levees are being considered for regulatory purposes, it is implied these levees were built or designed at the 100-year level). For the purposes of this report, we use the term "levee of focus" to refer to any levee that is 1) currently accredited or pending accreditation 2) provisionally accredited (PAL) or 3) de-accredited or pending de-accreditation.

The assembled inventory conveys the location of each levee, as represented by levee centerlines. Attached to each levee centerline is tabular data, which describes the level of protection, certification status, and accreditation status when available. Other relevant descriptive information, such as federal flood control work identification numbers, is also included. The inventory in digital form will be housed with Ecology where it can be accessed and maintained for future utilization. Additional technical information is supplied separately from this report with the submission of the full digital inventory.

The processes, sources, and methods are briefly described in this section, as well as the findings to date on the condition of Washington State levees. In addition, the section outlines the prioritization scheme developed to identify levees of concern and presents the findings.

DATA COLLECTION STRATEGY

Data for a statewide levee inventory were derived from a variety of sources. These include FEMA's National Flood Hazard Layer, FEMA Region X, USACE Portland District, USACE Seattle District, and USACE Walla Walla District, as well as previously archived FEMA levee data stored at the Department of Ecology. In addition to these sources, local levee managing agencies were contacted to provide feedback on the specific levees within their jurisdictions.

Data in raw format were collected from the regional and national managing offices at the Federal level of government. Acquired information was edited in a Geographic Information Systems (GIS) to ensure proper alignment and edited when necessary. Visual verification was done individually on each levee in the dataset using satellite imagery and USGS topographic quadrangles to identify unique levee centerlines, and ensure no unique levee centerlines were removed in the process. Associated attribute data, such as accreditation status, level of protection, and certification status, were then populated for each levee from the various sources when available. A simplified attribute table is included in table 6 below, showing accredited, de-accredited, and provisionally accredited levees. In many cases, little attribute information is available for levees at the Federal level. Levee maps and known attributes were sent out to relevant local jurisdictions for comment and review. Local validation input was incorporated wherever possible.

Table 6: Simplified Attribute table of Levees of Focus in Washington State

Levee System	**County**	**Levee Status**	**Comments**	**System Length (Miles)**
Columbia R. Coal Creek	Cowlitz	Accredited	De-accreditation pending map revision	6.29
Cowlitz 2 (Woodland)	Cowlitz	Accredited	De-accreditation pending map revision	13.23
Lexington	Cowlitz	Accredited	De-accreditation pending map revision	2.61
Longview	Cowlitz	Accredited	De-accreditation pending map revision	22.60
Moxee Drain	Yakima	Accredited	Shown as providing protection on FIRM	0.77
Pt. Townsend Bay	Jefferson	Accredited		0.50
Yakima River	Yakima	Accredited		8.54
Kelso	Cowlitz	Accredited	De-accreditation pending map revision	9.53
Auburn	King	De-accredited	PM 34 Letter	2.17
Kent	King	De-accredited	De-accredited	12.00
Lower Puyallup	Pierce	De-accredited	De-accreditation pending map revision	14.43
Cedar River	King	De-accredited	PM 34 Letter	1.33
Dungeness Meadows	Clallam	De-accredited	De-accreditation letter sent on 9/3/2009	0.71
Elwha	Clallam	De-accredited	De-accreditation letter sent on 12/18/2009	1.37
Castle Rock	Cowlitz	PAL	Certification pending review	2.75
Colfax Channel	Whitman	PAL	City of Colfax extension request 4/28/10	6.38

Upper Dungeness	Clallam	PAL	PAL process just being started	0.17
Vancouver 1	Clark	PAL Expired: De-accredited	No PAL Letter, De-accredited	1.83
North Creek	King	Pending accreditation, De-accredited	Pending CLOMR, future LOMR to accredit	2.65
Washougal	Clark	Pending De-accreditation	De-accreditation pending map revision	5.19
Startup - P	Snohomish	Previously Accredited		1.56
Aberdeen	Grays Harbor	Accredited, Transitioning to PAL Status	PAL Letter Sent, Reply Due Jan 3, 2011	4.28
Tukwila	King	Accredited and De-Accredited	Tukwila Side- Accredited, Briscoe De-Accredited	7.08

FINDINGS

For the purposes of this project, levees of focus are defined as 1) currently accredited/pending accreditation 2) provisionally accredited or 3) de-accredited/pending de-accreditation. To date, approximately 697 miles of levees are in the inventory. Approximately 125 miles of levees of focus have been identified (figure 5). Of the 697 total miles of levees in Washington State, 13 percent were found to be classified as federal, 42 percent non-federal, and 45 percent unknown (figure 6). Of all levee miles in the state, approximately 9 percent of mileage were found to be accredited (figure 7). Levees have been identified in 30 of 39 Washington Counties, with levees of focus being found in 10 of the 39 Washington Counties. Figure 8 depicts the total mileage of levees found in each Washington County, while Figure 9 depicts the actual location of levees mapped throughout the state. Figure 10 depicts the location of levees of focus throughout the state, while figure 11 illustrates the mileage of levees of focus within each county. For each of the 10 counties containing levees of focus, detailed maps were constructed and delivered with the database to show levee location of the current accreditation status. Examples of Cowlitz and King County are included in figures 12 and 13.

Figure 5: Mileage of levees of focus in Washington State

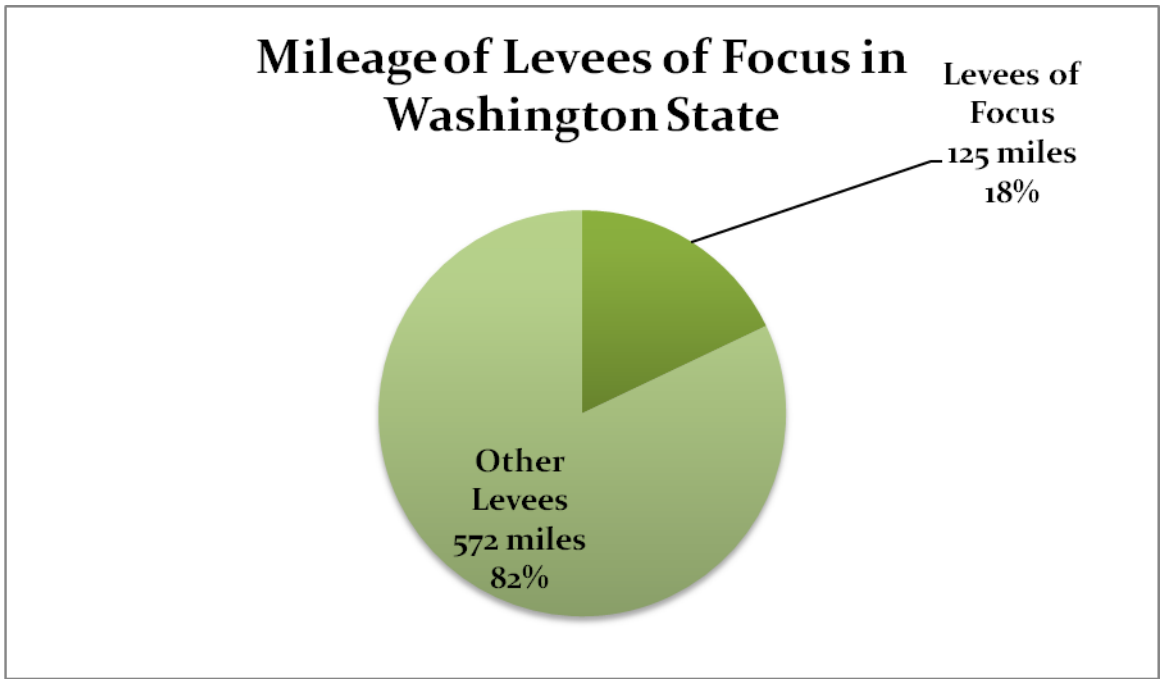


Figure 6: Mileage of federal vs. non-federal levees in Washington State

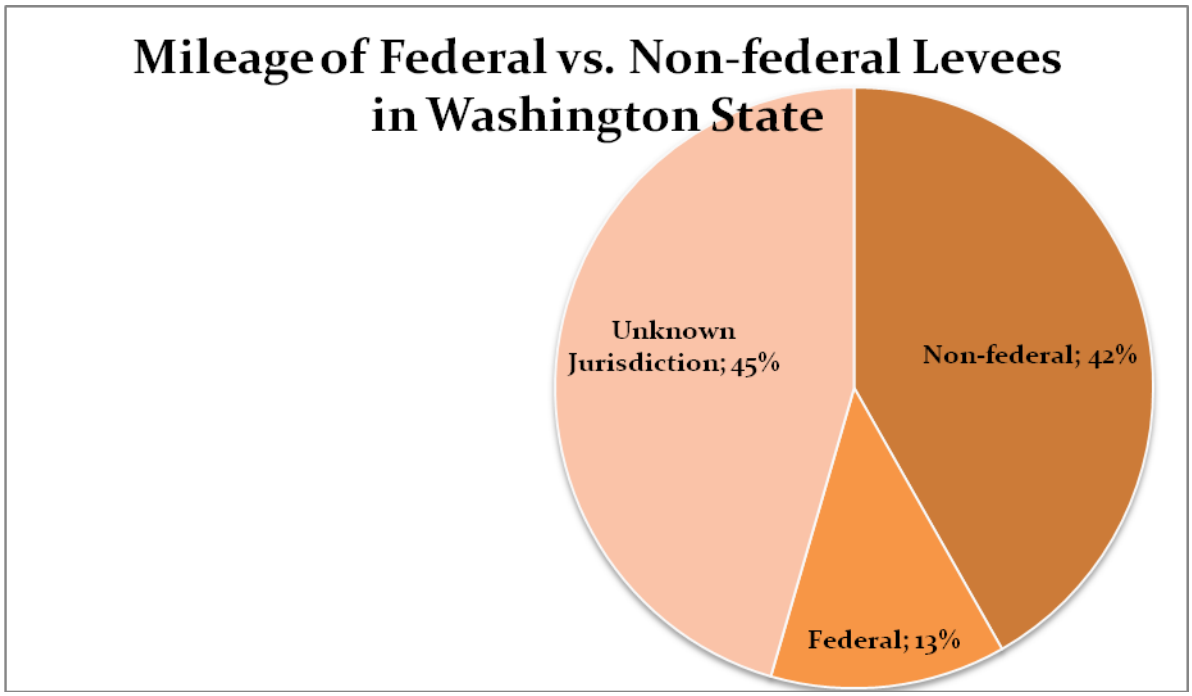


Figure 7: Mileage of accredited levees in Washington State

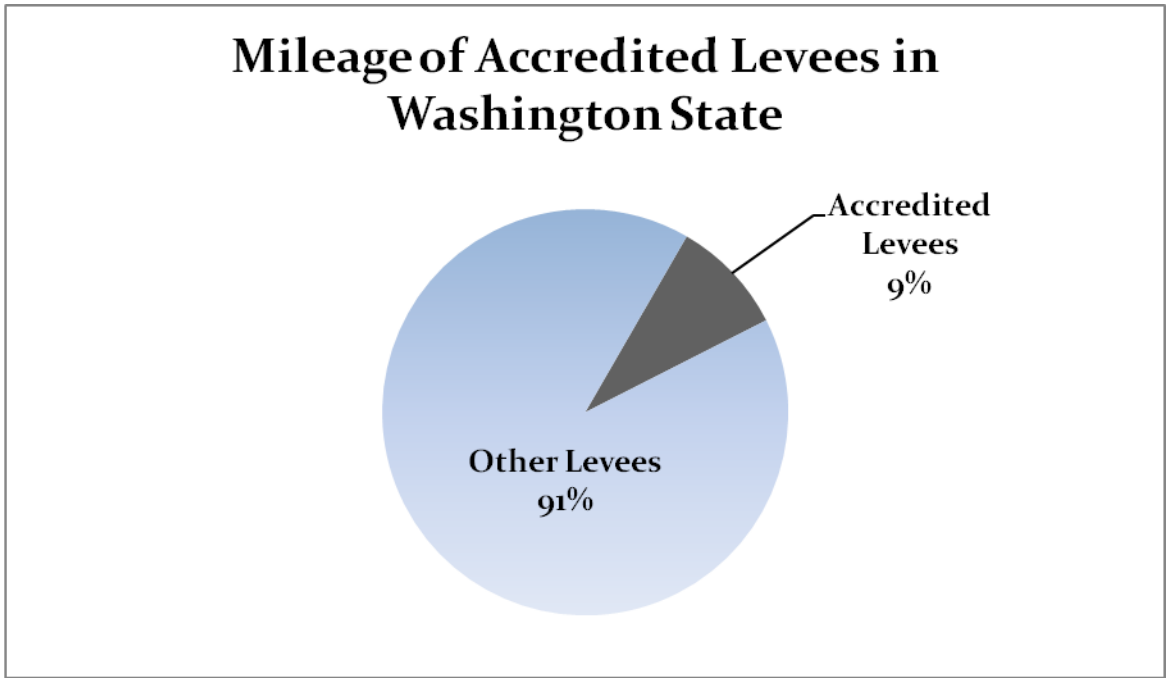


Figure 8. Miles of Levee by County.

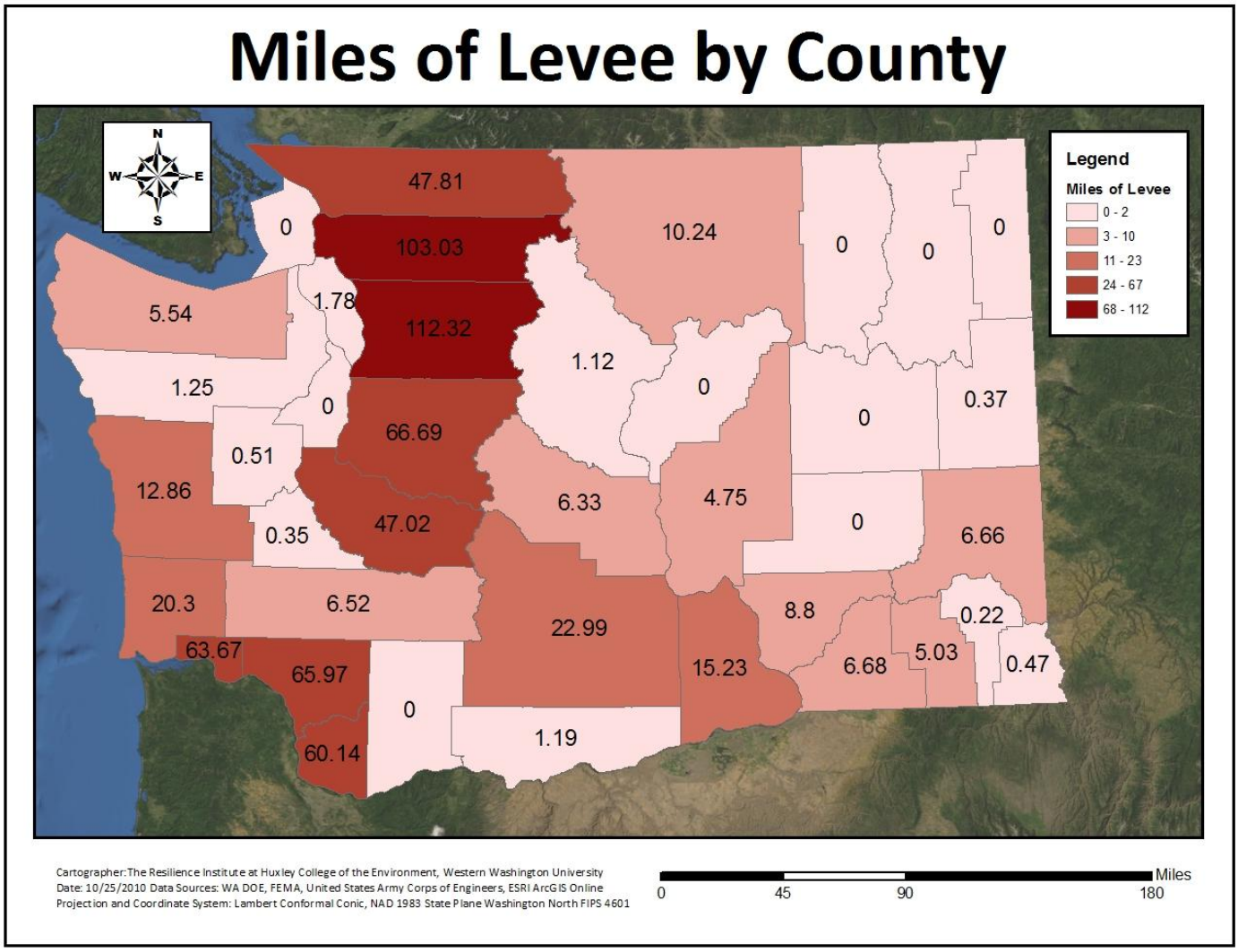


Figure 9 . Location of Identified Levees.

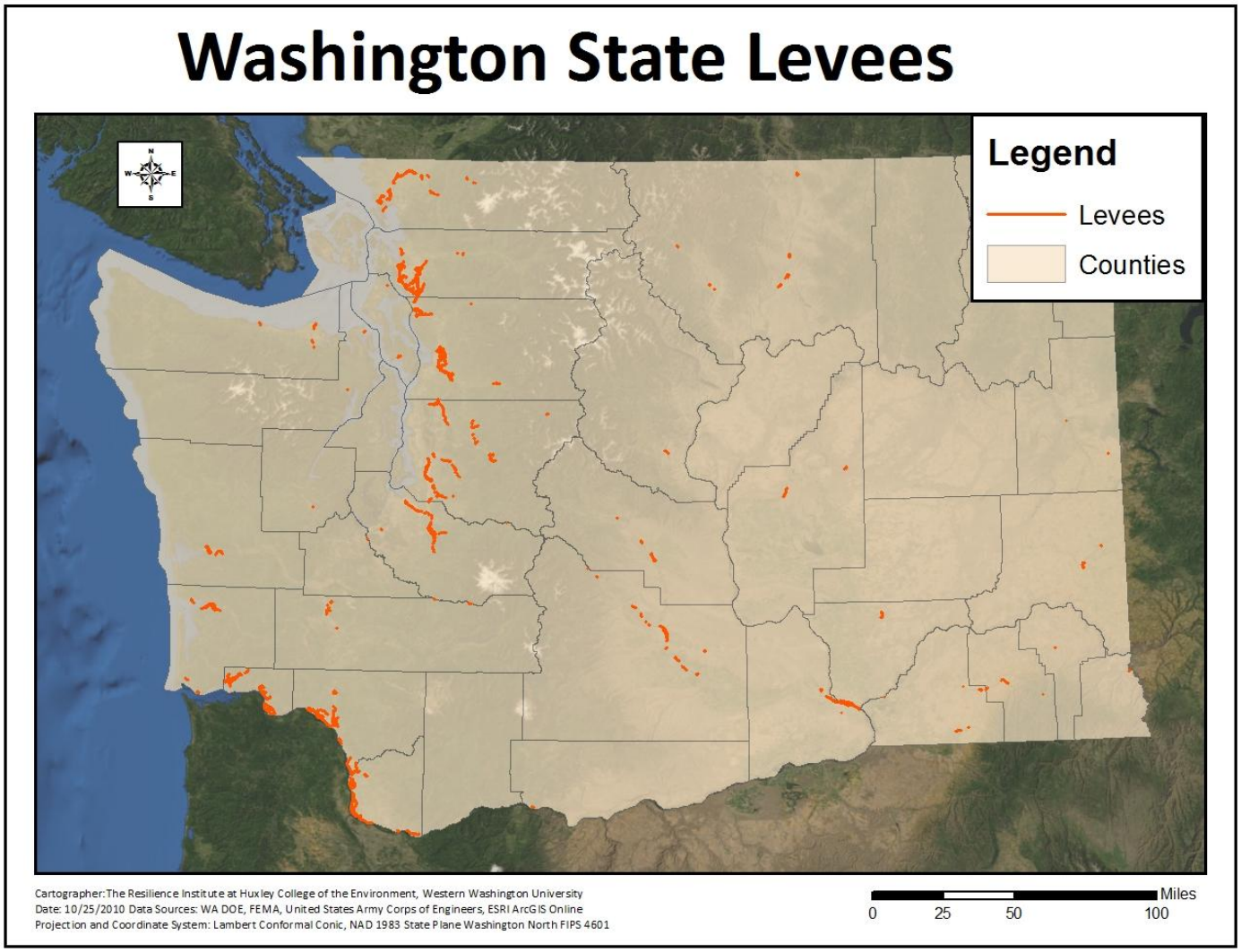


Figure 10. Levees of Focus (Accredited/PAL/De-Accredited).

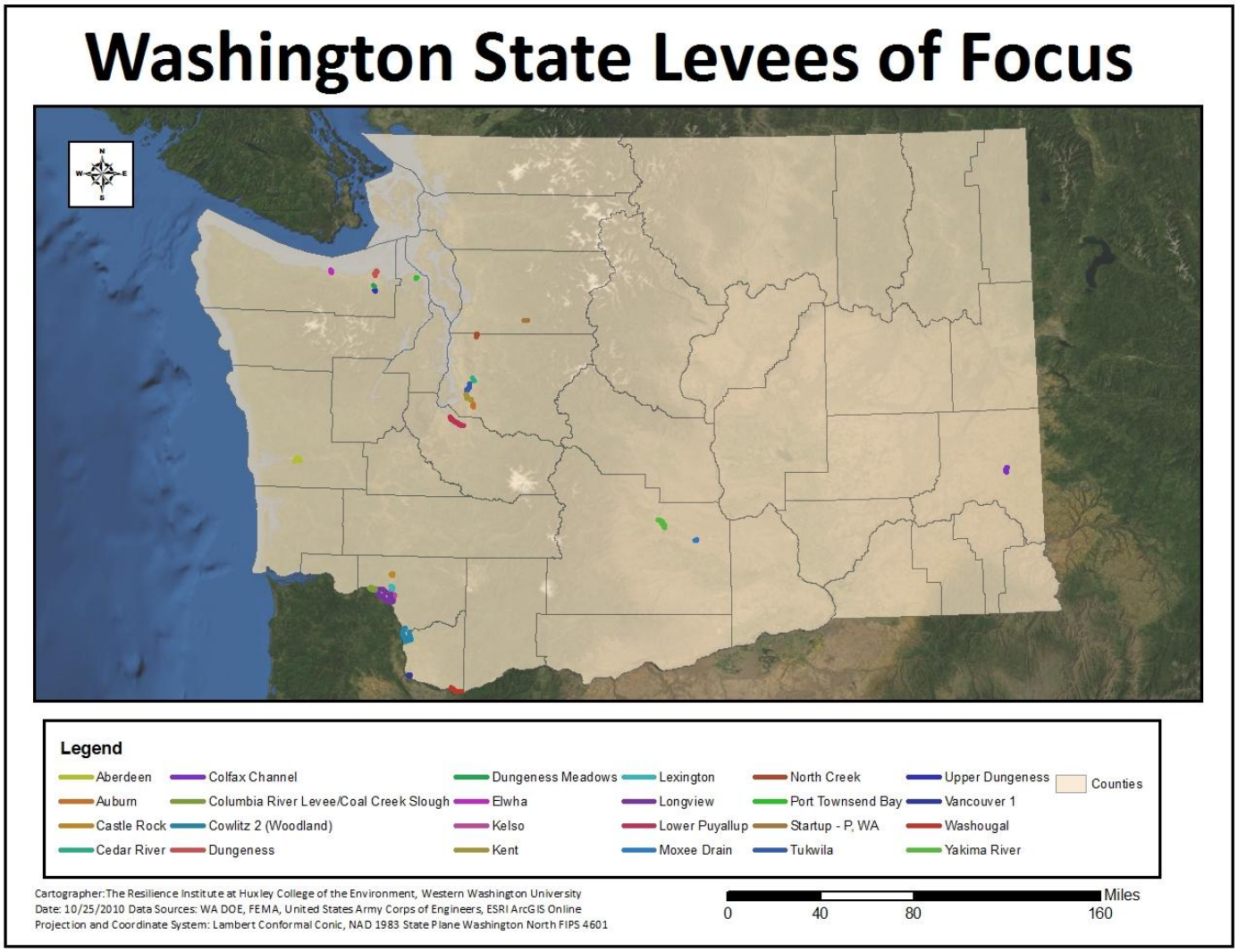


Figure 11. Miles of Levees of Focus (Accredited/PAL/De-Accredited).

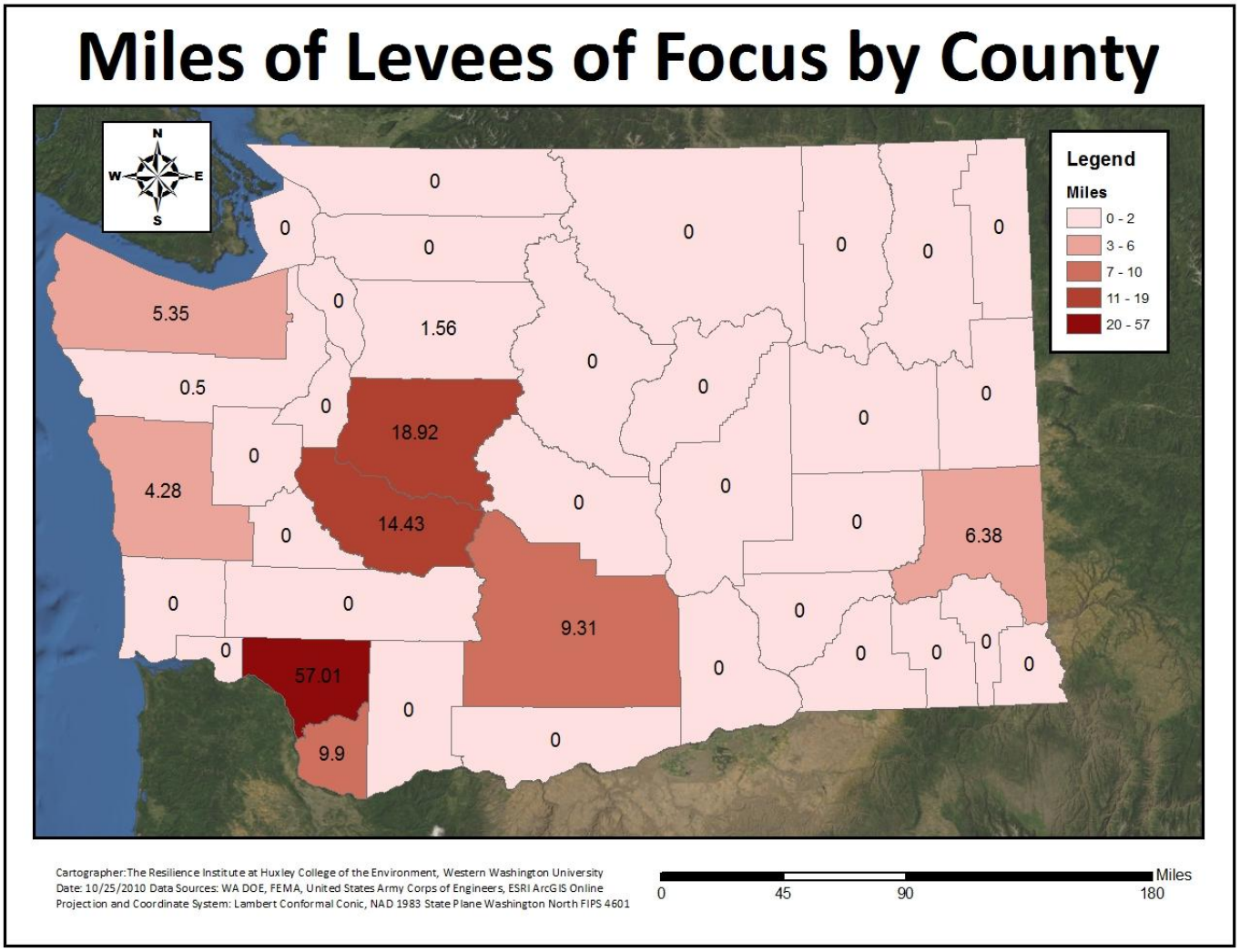


Figure 12. Example Map of Levees of Focus in Cowlitz County.

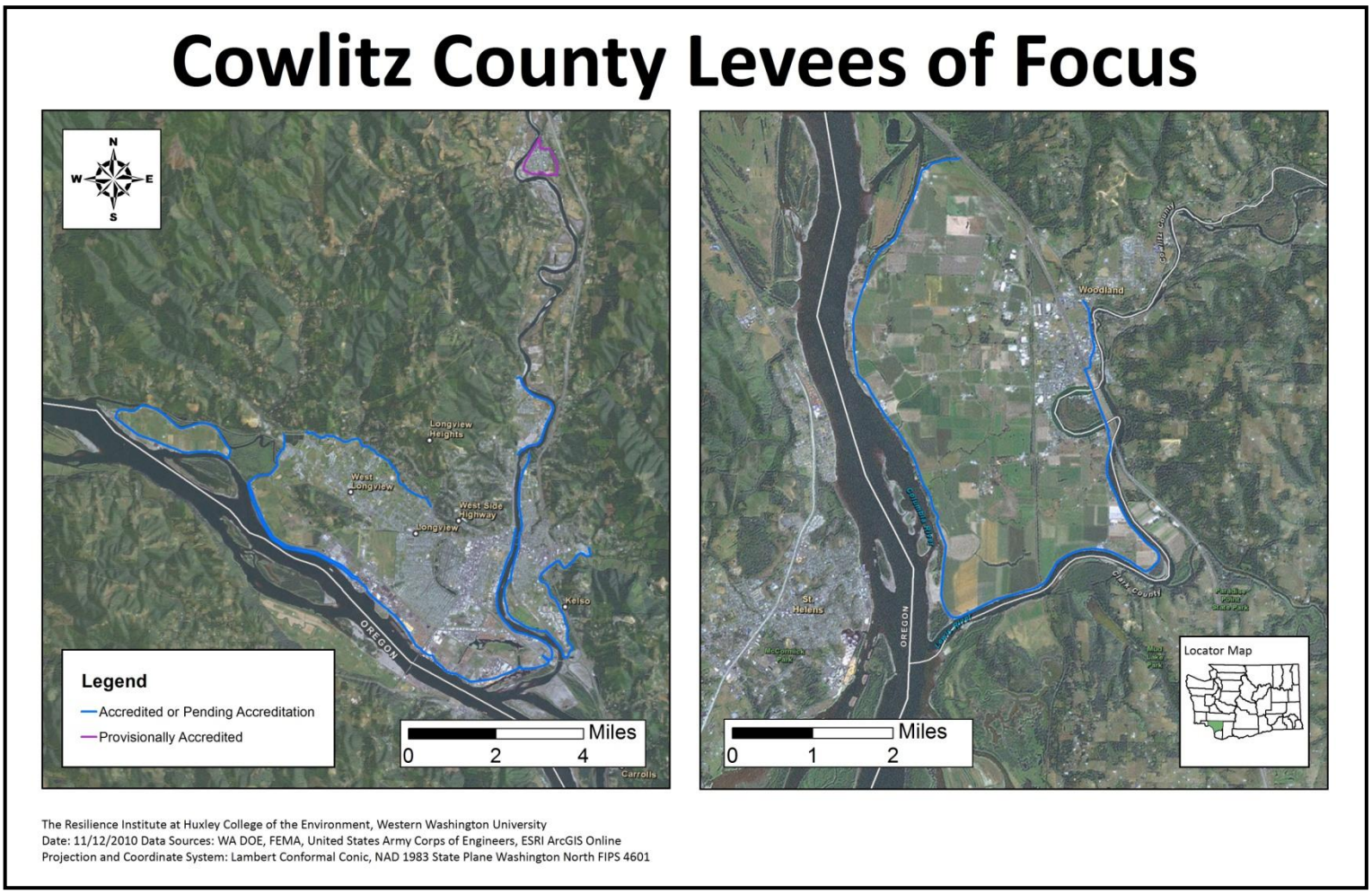
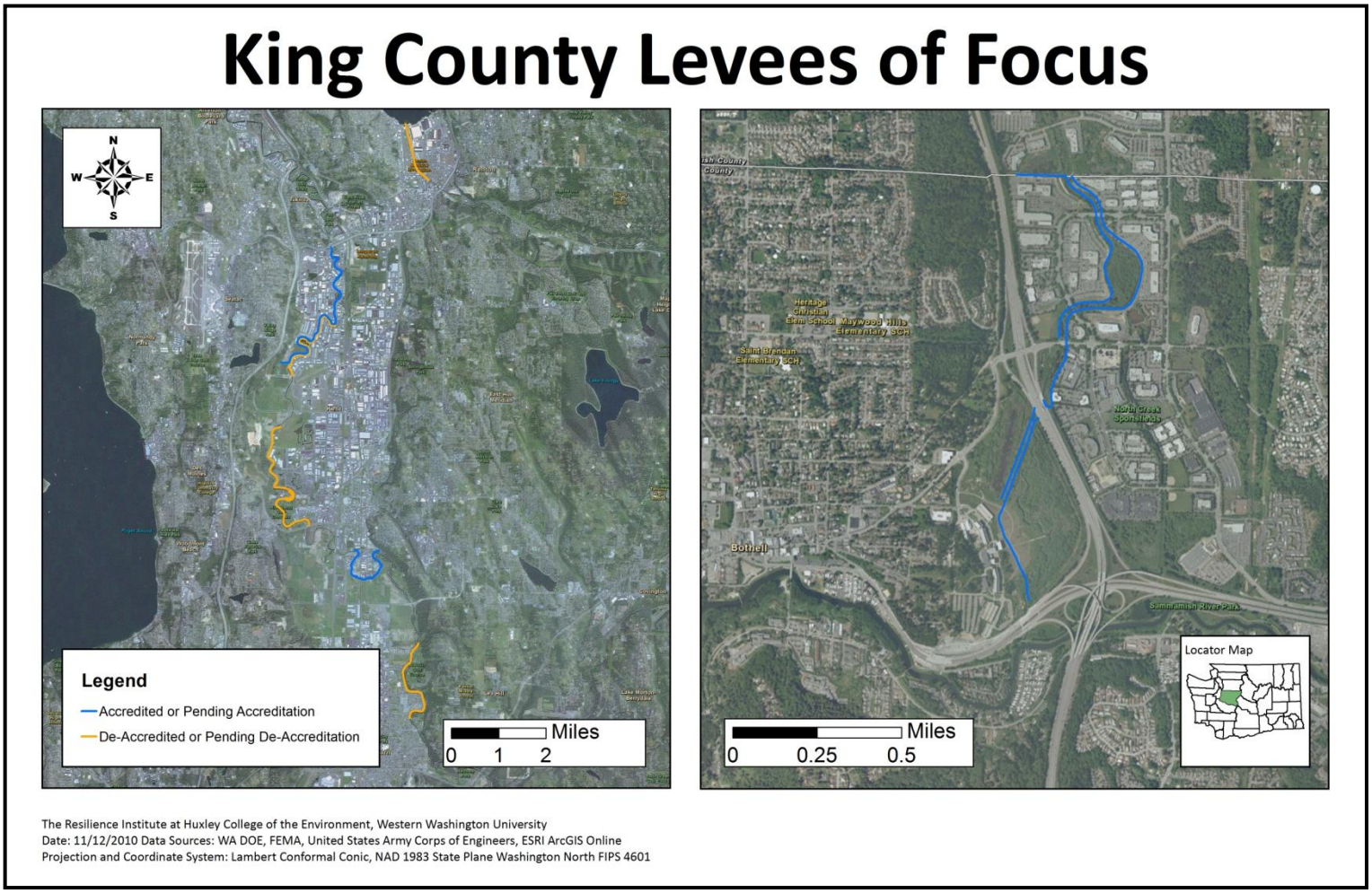


Figure 13. Example Map of Levees of Focus in King County.



SUMMARY OF LEVEE PROJECT PRIORITIZATION

Using Geographic Information Systems (GIS), a coarse-scale prioritization scheme was developed to identify levees of focus (accredited, PAL, or de-accredited) that have particularly significant implications for protected, urbanized areas. Levee segments are aggregated based on flooding source and geography. Indexes used for ranking the levee systems are potentially affected population, housing units, and jobs. Data sources for the study include USACE, FEMA and local levee managing agencies for levee information and attributes, the Washington Department of Ecology for Urban Growth Area boundaries, U.S. Census Bureau 2000 census for population and housing, and U.S. Census Bureau 2008 Longitudinal Employer-Household Dynamics for jobs/employment data.

This analysis is driven by economic and demographic proximity to levees of concern, rather than hydrologic analysis. However, it provides valuable insights on the potentially affected communities where levees of concern exist. The methodology is meant to be replicable and straightforward. First, Urban Growth Areas, which intersected levees of focus, were selected. From the selected urban growth areas, population, housing units, and job counts were then summarized (figure 14). Results presented are grouped by both flooding sources, as well as by levee system (table 7).

Figure 14. Example of prioritization methodology utilizing Urban Growth Areas.

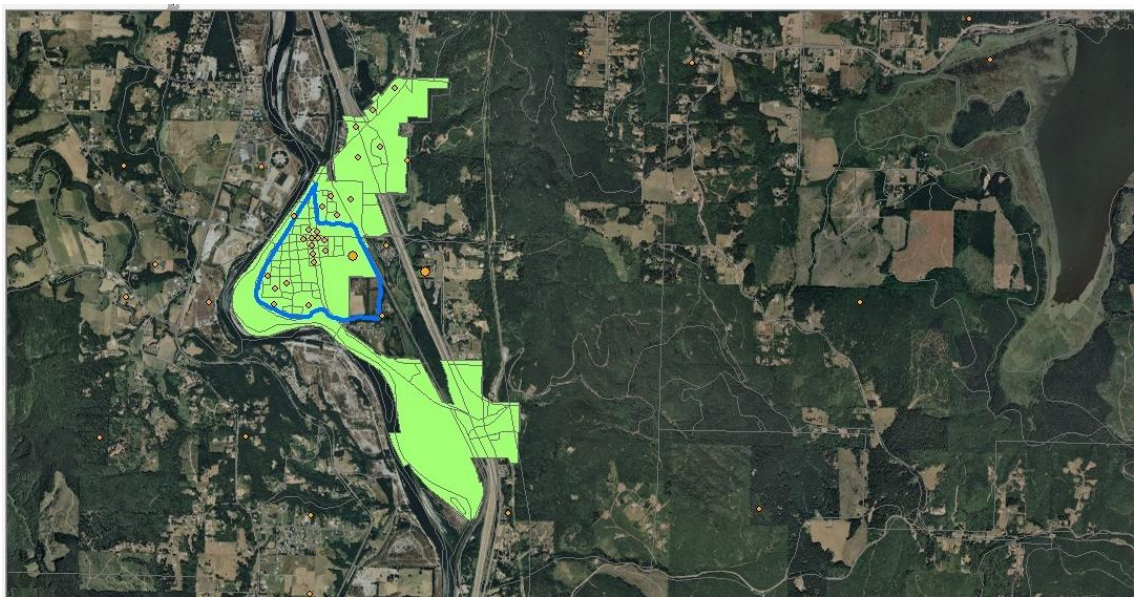


Table 7. Course scale potential impacts to areas adjacent to levees of focus (Accredited/De-accredited/PALs).

Levee System	POP	HOUSING UNITS	JOBS	Affected Area (sq. mi)	Flood Source
Castle Rock	2810	1161	892	1.43	Cowlitz River
Colfax Channel	3131	1465	1860	3.64	Palouse River & Tribs
Cowlitz 2 (Woodland)	4766	1866	3054	3.63	Lewis River
Port Townsend Bay	8409	4281	6093	6.81	Port Townsend Bay
Washougal	9624	3870	3233	6.59	Columbia River
Kelso	13944	5889	6925	8.58	Cowlitz River
Aberdeen	19306	8719	8449	12.44	Chehalis River
North Creek	22447	9378	11811	5.67	North Creek
Longview	39111	16938	19323	14.73	Columbia and Cowlitz
Auburn	58230	23040	33515	26.33	Green River
Cedar River	79106	34073	54856	22.90	Cedar River
Kent	91389	37255	62119	0.43	Green River
Yakima River	94790	37520	45490	35.81	Yakima River
Tukwila	110354	45733	104717	37.88	Green River
Vancouver 1	157480	65494	71512	48.90	Columbia River
Lower Puyallup	252566	106187	148948	72.58	Puyallup River

INVENTORY AND PRIORITIZATION ISSUES

Currently, the statewide levee database provides a snapshot of the state of knowledge on levees collected from various sources. While this inventory is the most complete picture to date of levees at the statewide level, the database may not cover all existing levees. Efforts at both FEMA and USACE are ongoing towards the end of developing a complete National Levee Database (NLD). Upon the completion of this database, a more definitive record for incorporation will likely become available.

Several issues and limitations are also presently related to the levee prioritization analysis. The levee prioritization portions of this study, while instructive, are not based on hydrologic modeling. As such, the prioritization is rather a coarse scale approach that deals primarily with populated areas near levees.

There is undoubtedly substantial flood hazard information available in the form of FIRMS, DFIRMS, and FEMA Q3 flood data. Minimal amounts of this information, however, explicitly depict the areas protected by a levee. While accredited levees will have corresponding flood zones designating "protected" areas, areas near non-accredited levees are simply mapped in the regulated flood zone. As such, it is exceedingly difficult to ascertain the protected areas without further site-specific hydrologic modeling.

Several different methods were initially attempted to assess areas protected by levees. HAZUS modeling software was employed; however, the outputs of this software are very site specific and not easily applied at the statewide scale. Similarly, other methods exist to properly model hydrologic process, but the wealth of inputs required, and their lack of availability at the statewide scale was prohibitive. To move beyond a coarse scale assessment like the one described herein, more detailed, site-specific modeling must take place to examine hydrologic connectivity and points of levee failure. Several useful examples of these local assessments exist for reference, including the HAZUS Analysis for the Green River Valley (FEMA 2009).

VIII. DISCUSSIONS AND CONCLUSIONS

Managing levees and associated flood protection is a dynamic and involved undertaking. In many cases, levees in Washington State were originally constructed without the benefit of modern engineering techniques. These older levees now provide limited protection to communities. As a result of current flood policy frameworks, communities interested in validating a levee's protection ability and becoming eligible for FEMA accreditation must take their levee systems through a two-step process of 1) certification and 2) accreditation. Accredited levees or levee systems are shown on the modernized NFIP maps as providing a community with protection from the 100-year flood. This designation has far-reaching implications for those living behind levees or in flood hazard areas; protection levels determine insurance requirements, rates, and floodplain development restrictions.

This report marks an initial step towards developing a coherent approach for managing flood control levees in Washington State. The study has initiated 1) the first state-wide levee inventory and 2) the first formalized investigation into requirements, costs, strategies, and funding options for levee certification and accreditation. In the process, several broad levee management concerns have emerged -- levee certification and their alternatives, difficulties in securing funding sources, and conflicting regulatory guidance. Each is discussed below.

Of equal importance is the fact that this study is a preliminary assessment of levee issues. As such, many limitations exist in the data obtained to date. The following section on next steps explains important work needed for improved levee management and community flood protection statewide.

LEVEE CERTIFICATION AND ALTERNATIVES FOR RESILIENCE

In a state where repeated flooding is frequent, achieving adequate flood protection is a fundamental part of building resilient Washington State communities. When floodwaters rise, a resilient community will continue to be able to provide services and livelihoods; if services and livelihoods are disrupted, a resilience community will recover rapidly, with minimal social disruption, creating new and better conditions. At the State level, it is essential for regions to be able to withstand periodic large floods, without causing far-reaching economic, societal, or ecological disorder. At the local level, a clear picture of flood risk, and viable strategies for protecting communities is needed.

When it comes to flood risk, levees are one of many important components of resilient communities. However, levees are rarely the sole solution. As seen to date, many levee-protected communities in Washington State are realizing their levees no longer provide sufficient protect. With rapid changes occurring -- including influences of climate change and development -- the ability for watersheds to store floodwaters naturally is often diminished. With constant transformations occurring in floodplains, FEMA flood maps may not always keep pace. Insurance or regulatory requirements, including the National Flood Insurance Program, may not always address the emerging conditions of the day.

While certifying and improving the structural integrity of levees may at first appear to be an ideal solution, certification is not a realistic, or appropriate, goal for all 100-year levees in Washington. As this report has shown, certification is an extremely costly and detailed endeavor. Certification requires ample financial resources and time. With hundreds of levees in the State built prior to the development of the accreditation process, many millions of dollars would be needed to make the improvements necessary for certification and accreditation of all levees. In some cases, the long-term costs of levee improvements could exceed the cost of the lands being protected. Additionally, enhancing levees may not be appropriate for areas attempting to restore hydrologic connectivity and natural ecosystem functions.

In order to improve Washington State's resilience to floods, resources need to be further prioritized. This study has produced a preliminary prioritization of areas in which significant population and economic activity coincide with levee-protected environments. While a more encompassing and comprehensive analysis is required in the near future, it

is essential that feasibility studies of both structural and non-structural mitigation alternatives be examined at a site-specific scale.

Both structural and non-structural alternatives should be considered when looking at site-specific options for mitigating flooding events. Structural measures, (including dams, levees, floodwalls, and detention basins) are designed to hold back floodwaters and change flood characteristics. Effective nonstructural measures also exist. Options like elevating structures, government buyout and removal of regularly flooded properties, and using water-resistant building materials also can reduce flood impacts. Structural and non-structural options to consider may include:

- **Setback levees**- allows channel to migrate and reconnect to wetlands, keeps structures away from higher velocity flood waters, reduces losses due to erosions, provides a riparian buffer to protect fish and wildlife habitat.

- **Lowering or removal of levees at strategic points**- reintroduces manageable flood pulses at flood-tolerant locations during peak flow of major floods, thereby lowering downstream effects. Prior agreement can be reached with landowners to use land for periodic water storage.

- **Buyout properties**- purchases properties that experience repeated insurance claims in a short time period.

- **Land use zoning and planning**- refine localized zoning requirements to restrict non-resilient development in the floodplain, thereby reducing the need for further flood protection.

- **Improve levees to certifiable conditions**- makes improvements to structural integrity of levees in vulnerable, highly developed areas where non-structural alternatives are not feasible. Improvements may include heightened freeboard, bank stabilization, vegetation maintenance, etc.

Local county governments may also create and adopt comprehensive flood management plans with the full participation of municipalities, special districts, and other

jurisdictions.[6] Following adoption by the government body, a comprehensive flood management plan can be used to prioritize funding and ensure consistent and effective floodplain management activities.

LOCAL LEVEE OWNERS AND FUNDING SOURCES

Non-federal levee owners, who are now ineligible for most federal assistance, are subject to increased levee certification costs. Enlisting a private engineering firm to conduct the geotechnical analysis, generate data, and compile the necessary documentation for certification has increased certification costs for local levee owners. Additionally, the repair, maintenance, and improvements necessary for levee certification add significant costs, based upon the size of the project.

Local entities operating and maintaining non-federal levee systems often lack the resources to cover the extensive costs associated with certification. As illustrated in the case studies above, the certification process requires that levee owners secure large amounts of funding from limited existing sources. Levee owners and managers often have to utilize several funding sources for certification. However, in some cases, a multitude of sources may not even cover the costs of completing a technical review for certification, For instance, non-federal levee owners often seek funding from local sponsors, such as drainage or diking district, or a flood control zone districts through a tax assessment on property. However, in areas of decreasing property value or a limited tax base, it is especially difficult to secure funding.

If a local entity is eligible for USACE assistance to improve and update levees for certification, then it is subject USACE timeframe. Certification through USACE can often takes ten or more years. Because certification can lead to FEMA accreditation – with benefits ranging from increase property values, enhanced flood protection, and reduced flood insurance costs – communities often want certification completed in the short term.

[6] RCW 86.12.200 Comprehensive flood control management plan — Elements and RCW 86.12.210, Participation of local officials — Arbitration of disputed issues legislatively authorizes county governments to adopt a comprehensive flood management plan to establish a scheme of flood control protections and improvements in areas subject to periodic flooding.

Tensions between certification and securing insurance coverage have significant implications for the economic vitality of highly developed areas. Some Non-federal levee owners are facing a difficult choice between either paying to certifying their levee systems, or pay a higher insurance premium if they do not. In certain circumstances where a levee is not certified, surplus insurance carriers are pulling out of the area.

FEDERAL REGULATIONS AND POLICIES REGARDING VEGETATION

Non-federally operated and maintained levee sponsors are caught between two conflicting federal regulations: risk violating Endangered Species Act (ESA) regulations for preserving vegetation in critical habitat, or meeting USACE requirements for vegetation management. In the Pacific Northwest, these conflicting federal regulations are more prevalent because of the species of fish, critical habitat, and the nature of rivers and floodplain development in Washington.

To remain eligible for rehabilitation funds through PL 84-99, levees sponsors are required to follow USACE guidelines for vegetation management. Under USACE policy for vegetation management (ETL 1110-2-571), trees located on levees pose a potential risk to levee integrity. Root structures may penetrate and weaken the levee or overgrown vegetation may hide visible signs of slope instability or seepage issues. USACE's primary concerns for vegetation on levees include:

- Root structures penetrating or weakening levee walls
- Overgrown vegetation covering potential slope failures or seepage issues
- Vegetation inhibiting access to the levee for inspections and repair

All levees systems in the Levee Safety Program undergo routine inspections and periodic inspections, where USACE officials conduct a site visit to determine if there are any deficiencies in the levee's structural integrity.

To follow USACE guidelines for vegetation management potentially opens levee sponsors up to litigation under the ESA. Vegetation on earthen levees cools the temperature of the water providing critical habitat and cover for fish and other riverine species. Without prior authorization, removal of trees and other vegetation considered as critical habitat

for ESA-listed-species is prohibited under Section 7 of the ESA, Consultation and Biological Assessments.[7]

To address these federal regulations, USACE issued a 1997 vegetation variance policy that levee sponsors can request and implement, upon approval from their local USACE district.[8] Seattle district USACE has successfully utilized the variance in the past. The Seattle USACE district permitted the variance for three levees rebuilt in Kent and one in Tukwila in 2009. In fall 2009, USACE spent nearly $500,000 planting 10,000 trees along rebuilt levees in Kent and Tukwila. However, the new national USACE policy[9] for vegetation management, set to take effect in the early spring of 2011, could require all of these trees to be removed. The new policy is a revision of the vegetation variance request process and is directed at implementing agency-wide approaches, including:

- Conducting broader flood risk management planning
- Applying procedures consistently on a national basis
- Managing levees on a system-wide basis
- Ensuring Levee Safety Officers are part of the review process
- Using Agency Technical Review (ATR) to ensure quality, consistency, and credibility
- Documenting technical decisions consistently
- Sharing best practices and lessons learned nationally

Under this new variance request process, all existing variances must be reapproved by USACE, be submitted by December 30, 2010, and be supported by ESA and other environmental compliance documentation. The new USACE policy on vegetation variance has significant consequences to many non-federally maintained levees in

[7] This regulation requires a federal agency to consult National Marine Fisheries Service or the United States Fish and Wildlife Services if the agency is proposing action that could affect a listed species or its habitat.
[8] In 1997, USACE issued the vegetation variance policy to implement Section 202 (g) of the Water Resources Development Act, which mandated USACE allow levee sponsors in PL 84-99 to seek a variance from USACE standards to allow vegetation on or near levees if the vegetation would protect, preserve, or enhance natural resources.

[9] On February 9, 2010, USACE proposed to revise its policy for the variance, effectively ending the vegetation variance. This would require all levee sponsors that want to remain in the PL 84-99 program to comply with ETL 1110-2-571, Engineering and Design: Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures.

Washington State. These local levee sponsors have utilized the vegetation variance to avoid violating vegetation requirements for ESA and rehabilitation funds through PL 84-99. These concerns include:

- Local levee sponsors are mandated to meet ESA requirements and face legal repercussions if in violation of ESA.
- USACE's original vegetation standards create high vegetation maintenance cost for small community-based districts with limited funding.
- Deviation from USACE's vegetation standards means communities risk losing federal support for needed rehabilitation funding in the event of flood related damage to levees.

Levees that are a part of the PL 84-99 program and subject to the variance would face severe cost implications if the new USACE policy eliminating the variance takes effect or the existing variance is not approved in the revision process. The cost for non-federally operated and maintained levees for meeting USACE maintenance requirements for vegetation, which is to mow down any vegetation greater than 4 inches in diameter, would be significantly more expensive than not participating in the PL 84-99 program.

Local levee sponsors with limited funds for operation and maintenance will likely risk not having support from federal rehabilitation funding through PL 84-99 to avoid any litigation associated with violation of ESA requirements. Since USACE proposed the policy revision, local entities, environmental groups, and government officials in Washington have sent letters to USACE requesting the agency to reevaluate its proposed elimination of the vegetation variance. These entities include Flood Control Districts, People for Puget Sound, Olympic Environmental Council, and local, county, and state government officials.

IX. NEXT STEPS

Given the broad levee management issues discussed in the previous section, this section provides possible future steps for improving levee management in Washington State. While not meant to be all-inclusive, these proposed steps are designed to provide a starting point for discussion on how to reduce flood risk and further State resilience.

PRIORITIZATION DATABASE

A robust study to link current levees certification status to the social and economic impacts of failure may be useful for prioritizing future funding for flood protection enhancement. A robust study would be able to develop a dataset that, at the statewide level, assesses all areas affected by the presence of a levee. Once protected areas have been identified, social and economic data could be selected or created for affected geographies and integrated into a prioritization scheme.

King County's Flood Control District Capital Project Evaluation of 2010 could serve as a template for a statewide assessment of future levee projects. King County includes several implementation factors, which are weighted separately. Emphasis is given to the severity and potential consequences of a flooding event. These implementation factors include readiness, leverage of existing funds with external resources or funding, ability of project to support multiple floodplain objectives, long term maintenance needs, presence of existing NFIP regulations and level of participation, proponents participation in FEMA's Community Rating System, and the presence of an Capital Improvement Program (CIP) fund, as well as an active operation and maintenance fund.

In addition to the Flood Control District Capital, King County uses a checklist called the King County flood Control District Project Prioritization Criteria. The criteria help prioritize flood control district projects, based on "the imperative to complete each project from a flood risk/vulnerability perspective only." The weighted criteria included sections on current land use in affected areas, severity and consequences of potential impact of non-action, extent of impact (regional, severe, moderate, or localized) of non-action, and how soon the impact could occur (urgency).

The development of such a statewide framework could help inform future actions and expenditures for flood management. In particular, this scheme could be support the

evaluation of site-specific options for and alternatives to levee certification and accreditation (e.g. levee improvements, setback levees, buyouts, decertification, or levee removal, etc.).

GIS CLEARINGHOUSE

With the completion of the most complete inventory of Washington State levees, there is still significant future work. The database developed through this study is, at best, a snapshot of levee conditions. Due to the evolving nature of Federal levee inspections, the continual rollout of new NFIP Rate Maps, as well as the changing nature of site-specific levee conditions, the status of individual levees is subject to change. Moreover, the presence of conflicting data on individual levees points to a need for increased interagency communication between the Federal government, state, and local levee managers.

The presence of a regularly maintained and updated GIS clearinghouse is needed based on this initiated statewide levee inventory. Such a GIS clearinghouse could be housed in an existing state agency, but would involve significant communication between state, local, and Federal agencies involved in levee issues.

FUNDING DATABASE

A levee funds database could be established to help local, non-federal levee owners secure funding for levee management. This database could display information on a county-by-county basis, as each county has different available funding sources for levee improvements and repairs. Paired with a prioritization effort, the database could allow levee owners make informed decisions on whether to seek certification, or simply improve levee systems to a level that the community sees as an acceptable risk to a flooding event. Table 1 and the section in this report on funding sources could serve as an initial baseline from which to build such a database.

STATE ASSISTANCE

Currently, no formalized framework exists for state assistance to non-federal levee sponsors. These localized operators and managers often operate with limited funds and frequently are caught in the middle of conflicting federal regulations over levee

management. Further efforts are needed in developing a framework where the state can assist in facilitating levee accreditation and management issues. Some avenues for state assistance may include:

- Mediation between conflicting regulations and the agencies involved.

- Continued support for maintaining the vegetation variance from USACE standards of vegetation management. Assistance as a mediator for local non-federal levee sponsors seeking to achieve a vegetation variance.

- Providing local entities with regulatory assistance, in order to maneuver through federal requirements and regulations associated with certification. The Office of Regulatory Assistance may be an existing agency that could support these kinds of efforts.

- Facilitate communication between various government agencies and groups weighing in on certification efforts. This communication could take the form of scheduled inter-agency round table discussions that would increase collaboration between federal agencies, state entities, and local governments. Promoting communication between all federal agencies, where missions and points may conflict, could improve the process and increase ease for local entities seeking certification.

- Targeted funding to local entities through existing programs, such as FCAAP, for supporting flood risk reduction projects. FCAAP is one of the few state grant programs in the country specifically for flood management planning and implementation actions. As such, FCAAP is an existing mechanism that can provide much needed funding for specific flood risk reduction projects, such as acquisition of at-risk properties. It should be noted local governments generally agree FCAAP funds may not be best spent on supporting certification or accreditation endeavors. Funding levels required for bringing levees back into accreditation at the state level far exceed traditional FCAAPP funds, and favoring certification submittals may increase rather than decrease flood risk around the state.

- Provide incentives for flood protection improvements that rely upon appropriate mixes of structural and non-structural improvement options (e.g. elevating structures, wet proofing, purchasing, or relocating repeatedly flooded homes, buildings and other structures).

- Lobby Congress to support studies and flood reduction projects that could provide technical support, data, and modeling for local entities trying to determine the best levee management options.

ASFPM AND NATIONAL COMMITTEE ON LEVEE SAFETY

The Association of Floodplain Managers (ASFPM) and the National Committee on Levee Safety (NCLS) are two organizations with significant influence over policies and recommendations for establishing levee safety standards for the National Levee Safety Program. This program was established under the National Levee Safety Act of the Water Resources Development Act of 2007. NCLS and ASFPM consist of diverse groups of professionals from federal, state, local/regional governments and the private sector. Together they work to broaden the interests and goals in national levee safety. Both ASFPM and NCLS have made recommendations to achieve levee safety goals by creating sustaining levee safety programs in all states. Local government entities have suggested Washington State should support associated state roles that may come to fruition in the future.

The following NLCS and ASFPM recommendations emphasize key concepts designed to create a broader flood risk management approach and sound levee safety standards. The recommendations include:

- Leadership through a National Levee Safety Commission that encourages state delegated programs, coordinating environmental and safety concerns, risk communication, and designing national technical standards
- Expand and maintain a National Levee Database of critical safety issues, true costs of good levee stewardship and the state of individual levees inform priorities and provide data for risk-informed assessments and decision-making.
- Develop and adopt National levee safety standards as well as tolerable risk guidelines to facilitate an understanding of how to reduce risk, better inform levee construction/enhancement decisions, and weigh non-structural alternatives to flood risk management in a risk informed context.
- Subject levee certification determinations under FEMA's NFIP to peer review, so as to encourage confidence in technical determinations of compliance.
- Build strong levee safety programs within all states, which provide oversight, regulation, and critical levee safety processes.

- Design and delegate program responsibilities to states to assist state and local governments in developing effective levee safety programs focused on continual and periodic inspections, emergency evacuation, mitigation, risk communication, etc.
- Mandate purchase of risk-based flood insurance to reduce economic flood damages and increase understanding of communities and individuals that levees do not eliminate risk from flooding.

X. REFERENCES

Agency, F. E. (2009, January). *Estimating the Value of Partner Contributions to Flood Mapping Projects "Blue Book".* Retrieved October 2010, from FEMA: http://www.fema.gov/library/viewRecord.do?id=2473

American Society of Civil Engineers (ASCE) 2009. Report Card for America's Infrastructure. Retrieved July 26, 2010: http://apps.asce.org/reportcard/2009/grades.cfm

Association of State FloodPlain Managers (ASFPM), 2007. National Flood Policy Challenges- Levees: The Double-Edged Sword. Retrieved August 10,2010: http://www.floods.org/PDF/ASFPM_Levee_Policy_Challenges_White_Paper_021907.pdf

Code of Federal Regulations, 2005 - Title 44: *Emergency Management and Assistance* (December 2005). Chapter 1, Section 65.10 Retrieved June 10, 2010: http://edocket.access.gpo.gov/cfr_2007/octqtr/pdf/44cfr65.10.pdf

Coffey, B. (2010, August 2). Civil Works Program Director. (C. Huxford, Interviewer)
Engineers, U. A. (2005). *EC 1105-2-406 DISTRICT ENGINEERS PRESENTATION OF FINAL DECISION DOCUMENT.* Washington DC: US Army Corps of Engineers.

"Comparison of Flood Control Districts with Flood Control Zone Districts," *Municipal Research and Services Center of Washington (MRSC)*, February 2009, http://www.mrsc.org/subjects/governance/spd/spd-flooddist.aspx.

Cook, David. *Yakima County Annual Department of Property Assessment Report*. Rep. Yakima County Department of Property Assessment. Web. 19 Aug. 2010.

Council, O. E. (2010, March 8). *National Wildlife Federation.* Retrieved September 2010, from Levee Standards Comment Letter: http://online.nwf.org/site/DocServer/Levee_Stds_Comment_Letter_to_Corps-Final.pdf?docID=13342

Department of Commerce, "Washington State Public Works Board," Government, *Public Works Board (PWB)*, August 5, 2010, http://www.pwb.wa.gov/.

Ecology, D. o. (2010, July 9). Flood Control Assistance Account Program . (R. Institute, Interviewer)

Ecology, W. S. 2007. *2007-2009 Grant Application Guidelines for FCAAP.* Retrieved August 2010, from Washington State Deparment of Ecology : http://www.ecy.wa.gov/programs/sea/grants/fcaap/pdf/FCAAP_Guidelines_FINAL.pdf

Engineers, U. A. 1992. *ER 1140-1-211 SUPPORT FOR OTHERS: REIMBURSABLE WORK.* Washington, DC: US Army Corps of Engineers.

Engineers, U. A. 1994. *ER 1110-2-1150 Appendix F Engineering and Design for Civil Works Projects.* Washington, DC: US Army Corps of Engineers.

Engineers, U. A. 1996. *RISK-BASED ANALYSIS FOR FLOOD DAMAGE REDUCTION STUDIES.* Washington, DC: US Army Corps of Engineers

Engineers, U. A. 1997. *Geotechnical Activities in Support of Levee Certification for Federal Emergency Management Agency Flood Insurance Purposes* . Washington, DC: US Army Corps of Engineers .

Engineers, U.A. 2000. *Design and Construction of Levees- EM* 1110-2-1913. Retrieved June 2010, from US Army Corps of Engineers: http://140.194.76.129/publications/eng-manuals/em1110-2-913/toc.htm

Engineers, U. A. 2001. *EP 500-1-1 Appendix B Inspection Guide For Flood Control Works.*

Engineers, U. A. (2004, June). SMALL FLOOD CONTROL PROJECTS Section 205, Flood Control Act of 1948, as amended. Retrieved August 2010, from US Army Corps of Engineers: http://www.nab.usace.army.mil/whatwedo/civwks/CAP/205.pdf

Engineers, U. A. 2005. *EM 1110-2-2100 Stability Analysis of Concrete Structures.* Washington, DC: US Army Corps of Engineers.

Engineers, U. A. (2006). *Levee Owner's Manual for Non-federal Flood Control Works.* Retrieved 2010, from National Flood Risk Management Program: http://www.nfrmp.us/docs/USACE_NonFed%20Levee%20Owner%27s%20Manual_Mar06.pdf

Engineers, U.A. 2006. Levee Certification for the National Flood Insurance Program (NFIP) USACE Fact Sheet. Retrieved July 1, 2010: http://www.nfrmp.us/docs/USACE%20Levee%20Certification%20Fact%20Sheet_Oct06.pdf

Engineers, U. A. 2006. *Authority and Funding Guidance for USACE Levee Certification Activites.* Retrieved June 2010, from National Flood Risk Management Program: http://www.nfrmp.us/docs/USACE%20Levee%20Certifcation%20Authority%20and%20Funding%20Guidance_15%20Aug06.pdf

Engineers, U. A. 2008. *Geotechnical Levee Practice.* US Army Corps of Engineers Sacremento District. Retrieved June 5, 2010: http://is09000.spk.usace.army.mil/docs/REFP10L0.pdf

Engineers, U. A. 2008. *EC 1110-2-6001 Seismic Analysis of Dams and Levees.* Washington, DC: US Army Corps of Engineers.

Engineers, U. A. 2008. *EM 1110-2-1100 Coastal Engineering Manual - Part II* . Retrieved July 2010, from Engineering manual publications: http://140.194.76.129/publications/eng-manuals/em1110-2-1100/PartII/PartII.htm

Engineers, U. A. 2009. *Guidelines for Landscape Planting and Vegetation Management- EM 1110-2-571.* Retrieved June 2010, from Engineering and Design: Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures: http://140.194.76.129/publications/eng-tech-ltrs/etl1110-2-571/entire.pdf

Engineers, U. A. (2009). *ETL 1110-2-571: Engineering and Design: Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures.* Washington, D.C.: HQUSACE.

Engineers, U. A. (2010). *EC 1110-2-6067: USACE PROCESS FOR THE NATIONAL FLOOD INSURANCE PROGRAM (NFIP) LEVEE SYSTEM EVALUATION* . Washington D.C.: HQUSACE.

Engineers, U. A. (2010). *Questions and Answers:Requesting a Variance from the Corps Vegetation Standards for Levees and Floodwalls.* Retrieved September 2010, from US Army Corps of Engineers: http://www.usace.army.mil/LeveeSafety/Documents/vegstd_faq.pdf

Engineers, U. A, Seattle (2010). Personal correspondence with Design Branch personnel at the Seattle District Office of U.S. Army Corps of Engineers.

Engineers, U. A. (n.d.). *Certification of levee systems for the National Flood Insurance Program* . Retrieved June 2010, from FAQs_ETL570: http://www.nfrmp.us/docs/FAQs_ETL570.pdf

Engineers, U. A. (n.d.). *Continuing Authorities Program*. Retrieved August 2010, from US Army Corps of Engineers: http://www.nab.usace.army.mil/whatwedo/civwks/cap.htm

Engineers, U. A. (n.d.). *Emergency Assistance Under PL 84-99.* Retrieved July 2010, from USACE PL 84.99 cheatsheet: http://www.spd.usace.army.mil/cheatsheet.htm

FEMA Inter-Agency Levee Policy Committee, 2006. The National Levee Challenge: Levees and the FEMA Flood Map Modernization Initiative. Retrieved October 1, 2010: http://www.fema.gov/library/viewRecord.do?id=2677

FEMA, 2008. *Fact Sheet - Meeting the Criteria for Accrediting Levees on FEMA's Flood Maps: How-to-Guide for Floodplain Managers and Engineers.* Retrieved June 5: http://www.fema.gov/library/viewRecord.do?id=2517.

FEMA, 2008. *Requirements of 44 CFR Section 65.10: Mapping of Areas Protected by Levee Systems.* Retrieved June 6 from: http://home.fema.gov/library/viewRecord.do;jsessionid=3BEC52F071BBF0DC1DB2AFD10C82C6EA.WorkerLibrary?action=back&id=2741

FEMA, 2008. Provisionally Accredited Levees (PAL) Brochure. Accessed on June 9, 2010 http://www.fema.gov/library/viewRecord.do?id=1987.

FEMA 2009. HAZUS Analysis for the Green River Valley, FEMA Region X Mitigation Division. Retrieved July 28, 2010: http://your.kingcounty.gov/dnrp/library/water-and-land/flooding/green-river-valley-hazus-report-1009.pdf

FEMA, 2009. Rehabilitation Assistance for Levees and other Flood Control Works http://www.fema.gov/government/grant/pa/9524_3.shtm June 15 2010.

FEMA 2010. *Procedure Memorandum 64 - Compliance with the Endangered Species Act (ESA) for Letters of Map Change.* Washington, DC: US Department of Homeland Security

FEMA, 2010. *Overview of Levee Vegetation Management and Army Corps Funding Eligibility in King County*. Rep. Seattle: King County, 2010. http://your.kingcounty.gov/dnrp/library/waterand/flooding/kcfzcd/Overview_Levee_Vegetationboard_042610.pdf

FEMA, 2010.Pre-Disaster Mitigation Grant Program." *FEMA | Federal Emergency Management Agency*. 20 Aug. 2010. Retrieved Nov 1. 2010. <http://www.fema.gov/government/grant/pdm/>.

FEMA 2010. Declared Disasters by Year or State. Retrieved October 1, 2010: http://www.fema.gov/news/disaster_totals_annual.fema

Floodplain Management Association 2010. FMA Spring News. http://www.floodplain.org/cmsAdmin/uploads/newsletters/Spring_2010_Newsletter_Final.pdf

Glenn, S. J. 1994. *Bill Summary & Status 103rd Congress (1993-1994) S.1587.* Retrieved July 2010, from The Library of Congress: http://www.law.cornell.edu/usc-cgi/get_external.cgi?type=pubL&target=103-355

Hara, Lloyd. *Assessed Valuations and 2010 Taxes*. Rep. King County Department of Assessments. Web. 19 Aug. 2010.

Ludwick, L. (2010, August 9). Cowlitz County Public Works. (C. Huxford, Interviewer)

McLaughlin, Terry. *Annual Report; 2009 Assessment Year for Taxes Payable in 2010*. Rep. Cowlitz County Washington Department of Assessments & GIS. Web. 18 Aug. 2010.

Meyer, M. Jo10, July 12. Senior Engineer Cornforth Consultants Inc. interview.

Merkely, J. (2010, May 18). *Merkley_WRDA EPW Submission Letter.* Retrieved August 2010, from Oregons Senator Jeff Merkely: http://merkley.senate.gov/imo/media/doc/Merkley_WRDA%20EPW%20Submission%20Letter.pdf

Minnick, Benjamin 2009. "Agencies Attempt to Flood-proof the Valley." *Daily Journal of Commerce* 15 Dec. 2009.

Municipal Research and Services Center, *Washington State Local Improvement District Manual, Sixth Edition*, October 2009, http://www.mrsc.org/Publications/lid-rid09.pdf.

Natural Resources Conservation Service 2004. Emergency Watershed Protection Program- Final Programmatic Environmental Impact Statement 10 Aug. 2010. http://www.nrcs.usda.gov/programs/ewp/finalchapter2.pdf

Otak, I. (2009, November 17). *City of Redmond Final Comprehensive Flood Hazard Management Plan.* Retrieved August 2010, from city of Redmond Public Works Department: http://www.redmond.gov/insidecityhall/publicworks/stormwater/floodplan/pdfs/FinalCFHM091117.pdf

Pete Kremen, W. C. (2010, March 1). *Corps Levee Rules Letter.* Retrieved September 2010, from Bellingham Herald: http://media.bellinghamherald.com/static/images/downloads/JaredPaben/Corpsleveerulesletters.pdf

Public Works, city of Kent, "Local Improvement Districts," 2010, http://www.ci.kent.wa.us/content.aspx?id=5092

Reclamation, U. D. 2003. *Dam Safety Risk Analysis Methodology* . Washington, DC: US Army Corps of Engineers.

Staff, S. 0. (2010, April 13). Retrieved August 2010, from Committee on Transportation and Infrastructure: http://transportation.house.gov/Media/file/water/20100415/SSM_WR.pdf

States, 1. C. 2000. *Public Law 106-541 Water Resources Development Act*. Retrieved July 2010, from The National Academies: http://www7.nationalacademies.org/ocga/laws/PL106_541.asp

Stone, K. 2010. Cowlitz County Public Works interview.

Streyer, J. 2010, July 12. District Manager of Longview Diking District Cowlitz County, WA. (R. I. CJ Huxford, Interviewer)

Tetra Tech, 2009. *Lower Puyallup River Flood Protection Investigation: without-project analysis for Pierce County Public Works and Utilities Surface Water Management.* Digital copy available from: http://www.co.pierce.wa.us/pc/services/home/environ/water/cip/lpuyrivleveeinvest.htm

Vollendorff, Bill. *Walla Walla County 2010 Tax Year Levy Information*. Rep. Walla Walla County. Web. 19 Aug. 2010.

Washington, DC: US Army Corps of Engineers. Department of Commerce, "Washington State Public Works Board," Government, *Public Works Board (PWB)*, August 5, 2010, http://www.pwb.wa.gov/.

Washington State Legislature, "Chapter 86.09 Revised Code of Washington (RCW): Flood Control Districts — 1937 Act," http://apps.leg.wa.gov/rcw/default.aspx?cite=86.09.

WA Department of Ecology 2009. *Department of Ecology's Preparation and Response Plan for Green River Flooding*. Publication no. 09-06-028.

Washington State Legislature, "Chapter 86.15 Revised Code of Washington (RCW): Flood Control Zone Districts," http://apps.leg.wa.gov/rcw/default.aspx?cite=86.15&full=true.

Welch, Craig 2009. *Decaying Levees Magnify Green River Flood Risk*. Seattle Times. 29 Dec. 2009. Retrieved July 14 2010: http://seattletimes.nwsource.com/html/localnews/2010618727_levees29m.html

Willnauer, Keith M. *Statement of Assessed Valuations, Tax Rates, and Taxes Levied Within the Various Taxing Districts of Whatcom County*. Rep. Whatcom County Assessor. Web. 18 Aug. 2010.

XI. APPENDICES

APPENDIX A: LIST OF ACRONYMS

A

ASFPM Association of State Floodplain Managers: An organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning, and recovery.

B

BFE Base Flood Elevation: Base flood is a term used by FEMA to describe a flood of having a one percent chance of meeting or exceeding during any given year. Flood Insurance Rate Maps depict Base Flood Elevations.

C

CAP Community Assistance Program: A cost-sharing agreement where USACE authorizes a variety of water resource issues without specific congressional approval for each project.

CFR Code of Federal Regulations: The codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government

CRS Community Rating System: a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements.

CTP Cooperating Technical Partners (Program): Creates partnerships between FEMA and NFIP communities, State agencies, tribes, and universities that are interested in increased involvement in FEMA's flood hazard mapping program.

CWRB Civil Works Review Board

D

DEM Digital Elevation Model: A digital representation of ground surface topography or terrain.

DFIRM Digital Flood Insurance Rate Map: FEMA's hazard maps that indicate flood protection level for insurance purposes.

E

EWP Emergency Watershed Protection (Program): Established by the Natural Resources Conservation Service, EWP provides technical and financial assistance to local sponsors coping with hazards caused by floods and other natural occurrences.

EC Engineer Circular: A technical document published and issued by the U.S. Army Corp of Engineer.

EM Engineer Manual (USACE): Comprehensive technical document issued by the U.S. Army Corp of Engineers, outlining procedures and tools necessary to design, construct, and maintain a variety of projects.

ETL Engineering Technical Letter: A concise document providing guidance as to U.S Army Corps of Engineers procedures and guidelines for various technical projects.

F

FCAAP Flood control Assistance Account Program: A Washington grant program administered by the Washington State Department of Ecology, which allocates funds intended to support flood hazard management plans, emergency repairs to flood control structures, and maintenance of flood control structures.

FCCE Flood Control and Coastal Emergencies Act: A program issued in accordance with U.S. Army Corps of Engineers PL 84-99, which authorizes USACE to undertake activities including disaster preparedness, advance measures, emergency operations and rehabilitation of flood control works destroyed by flood.

FCW Flood Control Works: As classified by U.S. Army Corps of Engineers, FCW are structures designed and constructed to have dependable effects in preventing damage due to rising water levels.

FEMA Federal Emergency Management Agency

FIRM Flood Insurance Rate Map: A product of FEMA's Flood Insurance Study (FIS), determining an area subject to a one percent chance flood.

FIS Flood Insurance Study: FEMA administered study determining associated flood protection level for Flood Insurance Map Rates.

FPMS Floodplain Management Services: A program administered by U.S. Army Corps of Engineers provides technical guidance services to support effective flood plain management, including; General Technical Services, General Planning Guidance, and Guides, Pamphlets, and Supporting Studies.

G

GI General Investigations: U.S. Army Corps of Engineers assists in water resources problems where federal legislation gives USACE the authority to conduct a study with a non-federal sponsor, and if proven to be feasible, to construct the project.

GIS Geographic Information System: Integrates software, hardware, and data to capture, manage, analyze, and display geographically referenced information.

H

H&H Hydrologic and Hydraulic: An analysis pertaining to hydrology and hydraulics according to U.S. Army Corps of Engineers, mainly for risk uncertainty purposes.

HUD U.S. Department Housing and Urban Development

I

ICW Inspection of Completed Works: A U.S. Army Corps of Engineers program

ITR Independent Technical Review: U.S. Army Corps of Engineers is required to perform an ITR of the Levee Certification Report.

L

LCR Levee Certification Report: Completed by U.S. Army Corps of Engineers, the LCR details the basis for a certification determination, and includes complete information, assumptions, documentation of data, and an explanation for the determination.

LID Local Improvement District: Authorized through RCW 35.43, LIDs assist properties in financing improvements by forming special assessment districts.

M

MLI Mid-Term Levee Inventory: Focusing primarily on levees providing a one-percent-annual-chance flood protection, FEMA's MLI is intended to capture all levee data and compliment U.S. Army Corps of Engineers NLD.

N

NAFSMA National Association of Flood and Storm Water Management Agencies:

NFIP National Flood Insurance Program: FEMA manages the NFIP, under the Flood Insurance and Mitigation Administration, providing flood insurance, floodplain management, and flood hazard mapping.

NLD National Levee Database: U.S. Army Corps of Engineers' national inventory of all levees.

NLSE NFIP Levee System Evaluation: New terminology for USACE certification determinations for levees in the NFIP **NRCS** Natural Resources Conservation Service: Under Section 216 of the Flood Control Act of 1950, PL 81-516, and Sections 403-405 of the Agriculture Credit Act of 1978, PL 95-334, NRCS has the authority to assist in relieving imminent hazards to life and property from floods and products of erosion created by natural disasters that cause sudden impairment of a watershed

P

PAL Provisionally Accredited Levee: Designates FEMA has previously accredited a levee as providing one-percent-annual-chance protection on Flood Insurance Rate Maps, and is currently waiting for data to prove compliance with 44 CFR 65.10.

PE Professional Engineer

PL Public Law

PM Procedure Memorandum (FEMA)

PWB Public Works Board: A governmental entity under the jurisdiction of the Washington State Department of Commerce, which provides infrastructure financing for special purpose districts, local governments, and private water systems.

PWTF Public Works Trust Fund: Administered by the Public Works Board, this state fund is financed by local taxes and loan repayments that allows cities, counties, and special purpose districts to submit an application to repair, replace, rehabilitate, reconstruct, and improve eligible infrastructure systems.

R

RIP Rehabilitation and Inspection Program: A U.S. Army Corps of Engineers' program that provides inspection of flood control projects and the rehabilitation of Federally authorized and constructed protection projects; inspections occur under Public Law (PL) 84-99.

Risk MAP Risk Mapping, Analysis, and Planning: A FEMA strategy that combines flood hazard mapping, risk assessment tools, and Mitigation Planning into one program.

S

SFO Support for Others: A program authorized by U.S. Army Corps of Engineers that provides services to state and local governments in connection with civil works projects.

U

USACE U.S. Army Corps of Engineers

USGS U.S. Geological Survey

APPENDIX B: GUIDING DOCUMENTATION 44 CFR SECTION 65.10

FEMA requires compliance with the specifications outlined in 44 CFR 65.10 in order to receive FEMA accreditation. The regulation is laid out in five sections, all of which must be met in order for levee accreditation, and the resulting area protected by the levee to be mapped as "dry." When this is accomplished, structures in the protected area with federally backed loans will be free from requirements to purchase flood insurance through the National Flood Insurance Program (NFIP). While accreditation does grant some degree of confidence in a levee system, it does not imply that the levee will never fail, be overtopped, or otherwise provide protection in all scenarios. Accreditation speaks only to protection from a 1 percent chance of annual-base flood events. The five sections of 44 CFR 65.10 are summarized below, with a concluding section on certification requirements. The information below has been adapted from FEMA documentation listed in the reference section.

1. General Criteria

For purposes of the NFIP, FEMA will only recognize in its flood hazard and risk mapping effort those levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with the level of protection sought through the comprehensive floodplain management criteria established by Section 60.3 of the NFIP regulations. Section 65.10 of the NFIP regulations describes the types of information FEMA needs to recognize a levee as providing protection, namely that a levee system provides protection from the flood that has a 1-percent chance of being equaled or exceeded in any give year (base flood). A community or other party seeking recognition of a levee system must provide this information to FEMA when a study or restudy is conducted, a map revision is sought under Part 65 of the NFIP regulations, and when the Administrator requests the information during the review of previously recognized structures. The FEMA review is for the sole purpose of establishing appropriate risk zone determinations for NFIP maps and does not constitute a determination by FEMA as to how a structure or system will perform in a flood event.

2. Design Criteria

Per section 65.10(b) of the NFIP Regulations, for levee systems to be accredited by FEMA, evidence must be provided that show adequate design, operation systems, and maintenance systems are in place to provide reasonable assurance of protection from the base flood. The following requirements must be met:

Freeboard: A minimum freeboard is required of 3 feet above the Base Flood Elevation (BFE) all along length of a levee, and an additional 1-foot within 100 feet of structures (such as bridges) or wherever the flow is restricted. An additional 0.5 foot at the upstream end of a levee is also required.

Exceptions to the minimum riverine freeboard requirements above may be approved if the following criteria are met:

a. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard is submitted, and
b. The material presented evaluates the uncertainty in the estimated base flood elevation profile and includes, but is not necessarily limited to:
    i. An assessment of statistical confidence limits of the 1-percent-annual-chance discharge,
    ii. Changes in stage-discharge relationships, and
    iii. Sources, potential, and magnitude of debris, sediment, and ice accumulation.

Coastal levees have special freeboard requirements described in Paragraphs 65.10(b)(1)(iii) and (iv). The coastal levee freeboard must be established at 1 foot above the height of the 1-percent-annual-chance wave or the maximum wave run-up (whichever is greater) associated with the 1-percent-annual-chance stillwater surge elevation at the site. Exceptions for the minimum coastal freeboard requirements above may be approved if the following criteria are met:

a. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard is submitted, and
b. The material presented evaluates the uncertainty in the estimated base flood loading conditions. Particular emphasis must be placed on the effects of wave attack and overtopping on the stability of the levee.

Under no circumstances will a freeboard of less than 2 feet above the 1-percent-annual-chance stillwater surge elevation be accepted.

Closures: All openings must be provided with closure devices that are structural parts of the system during operation and designed according to sound engineering practice.

Embankment Protection: Engineering analyses must be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability.

Factors to be addressed in such analyses include, but are not limited to:

- Expected flow velocities (especially in constricted areas),
- Expected wind and wave action,
- Ice loading,
- Impact of debris,
- Slope protection techniques,
- Duration of flooding at various stages and velocities,
- Embankment and foundation materials,
- Levee alignment, bends, and transitions, and
- Levee side slopes.

Embankment and Foundation Stability Analyses: Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided must evaluate expected seepage during loading conditions associated with the base flood and must demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in the U.S. Army Corps of Engineers (USACE) Engineer Manual 1110–2–1913, Design and Construction of Levees, (Chapter 6, Section II), may be used.

Factors to be addressed in such analyses include:

- Depth of flooding,
- Duration of flooding,
- Embankment geometry and length of seepage path at critical locations,
- Embankment and foundation materials,
- Embankment compaction,
- Penetrations,

- Other design factors affecting seepage (e.g., drainage layers), and
- Other design factors affecting embankment and foundation stability (e.g., berms).

Settlement Analyses: Engineering analyses that assess the potential and magnitude of future losses of freeboard as a result of levee settlement must be submitted and it must demonstrate that freeboard will be maintained. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition, detailed settlement analysis using procedures such as those described in USACE Engineer Manual 1110–1–1904, Soil Mechanics Design— Settlement Analysis, must be submitted.

Settlement analysis must address:

- Embankment loads,
- Compressibility of embankment soils,
- Compression of foundation soils,
- Age of levee system, and
- Construction compaction methods.

Interior Drainage: An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than 1 foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.

Other Design Criteria: In situations where the levee system has relatively high vulnerability, FEMA may require that other design criteria and analyses be submitted to show that the levees provide adequate protection. In such situations, FEMA will base its determination on sound engineering practice. FEMA will also provide the rationale for requiring this additional information.

3. Operation Plan

Per paragraph 65.10(c)(1) of NFIP Regulations, for a levee system to be recognized as accredited, operational criteria are also applied. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operation manual, a copy of which must be

provided to FEMA by the operator when levee or drainage system recognition is being sought or when the manual for a previously recognized system is revised in any manner. All operations must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP. The operation plan must also have a flood warning system, plan of operation, and regular testing of closure operations.

Closures:

Flood Warning System: Documentation must be provided of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities. The document must further demonstrate that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.

Plan of Operation: A formal plan of operation must be provided and include specific actions and assignments of responsibility by individual name or title.

Periodic Operation of Closures: The operation plan must also include provisions for periodic operation, at not less than one-year intervals, of the closure structure for testing and training purposes.

Interior Drainage Plan:

Per paragraph 65.10(c)(2) of the NFIP Regulations Plan, interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan:

Flood Warning System: Documentation must be provided of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities. The document must further demonstrate that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.

Plan of Operation: A formal plan of operation must be provided and include specific actions and assignments of responsibility by individual name or title.

Manual Backup: Provision for manual backup for the activation of automatic systems must be provided.

Periodic Inspection: Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes must be provided. No more than 1 year is allowed to elapse between either the inspections or the operations in the periodic inspection plan.

Other Operation Plans and Criteria: FEMA may require other operating plans and criteria to ensure that adequate protection is provided in specific situations. In such cases, FEMA will base its determination on sound engineering practice.

4. Maintenance

Per paragraph 65.10 (d) of the NFIP regulations, for levee systems to be accredited by FEMA, the maintenance plan must be as described and meet certain criteria.

Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner.

All maintenance activities must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance.

This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, the plan must specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.

5. Certification Requirements

Per paragraph 65.10 (e) of the NFIP regulations, data must be submitted to support that a given levee system complies with the structural requirements set forth in "Design Criteria" (Paragraphs 65.10(b)(1) through (7) of the regulations and must be certified by a

Registered Professional Engineer. Certified "as-built" plans of the levee must also be submitted. Certifications are subject to the definition given in Section 65.2 of the NFIP regulations. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection from the base flood.

APPENDIX C: PROVISIONALLY ACCREDITED LEVEES

Procedure Memorandum No. 43 (PM 43) defines the concept of Provisionally Accredited Levees, thus serving as a guidance tool for levee managers who require additional time to "compile and submit the data and documentation required to show compliance with 44 DFR Section 65.10." PM 43 describes five scenarios as to whether a levee or levee system qualifies as a PAL. The following five scenarios serve as a reference to the application of PM 43 levee owners:

Scenario A. A levee or levee system that is not in the USACE Federal System is shown on the effective flood map as providing protection from the 1-percent-annual-chance flood. Two different possibilities exist:

A**i.** The community or levee owner believes that the levee meets 44 CFR 65.10 requirements at that time.

A**ii.** The community or levee owner believes the levee meets 44 CFR 65.10 requirements, except for maintenance deficiencies.

Outcome A. FEMA will send a letter describing PAL option, as well as additional information regarding the two different possibilities within Scenario A.

Scenario B. The levee or levee system is in the USACE Federal System and is shown on the effective flood map as providing 1-percent-annual-chance flood and there is no information that indicates the levee does not provide this level of protection.

Outcome B. If full data and documentation outlining the requirements listed in 44 CFR 65.10 are not available within 30 days, the levee owner should submit a PAL Application Package.

Scenario C. The levee or levee system is in USACE Federal System and is shown on the effective flood map as providing 1-percent-annual-chance flood and there is no information that indicates the levee does not provide this level of protection. However, USACE has determined that the levee's recent inspection ratings are "Fair," Poor," or "Unacceptable." Two different possibilities exist:

Ci. USACE has determined that the project status in their Rehabilitation and Inspection Program (RIP) has been switched from active to inactive, and USACE has not provided a 1-year maintenance deficiency correction period for the levee.

Cii. The levee was in an active status in the USACE RIP prior to September 30, 2005; and USACE has since offered a one-time-only, 1-year "maintenance deficiency correction period" to remedy the maintenance deficiencies of the levee.

Outcome C. FEMA will be in direct contact with USACE district offices to either evaluate existing data, in the Ci case, or send a letter informing the levee owner of maintenance deficiencies that will need to be addressed in 1 year, in the Cii case.

Scenario D. The levee or levee system is in the USACE Federal System and is not shown on the effective flood map as providing protection from the 1-percent-annual-chance flood. There is no issue with how to map the area behind the levee because it previously has been determined that the levee does not provide 1-percent-annual-chance flood protection. The flood map will continue to show the levee as not providing protection unless it is determined that the levee actually does provide this level of protection.

Outcome D. Under the circumstances listed in Scenario D, these levees are ineligible for designation as a PAL.

Scenario E. The levee or levee system is in the USACE Federal System and is shown on the effective flood map as providing protection from the 1-percent-annual-chance flood. However, the USACE has determined, and FEMA has validated, that the levee does not meet an adequate level of protection. Although the levee inspection rating is not listed as fair, poor, or unacceptable, the levee may have failed or experienced overtopping by less than the 1-percent-annual-chance flood.

Outcome E. These levees are ineligible for designation as a PAL.

APPENDIX D. TECHNICAL EVALUATION STRATEGIES

The following evaluation guidelines (outlined by sub-section) are used by USACE to determine flooding hazards and include components relevant to assessing if the system can contain a 1 percent chance of exceedance flood. These sections define the methodology USAC uses to judge if a system is certifiable.

Operation and Maintenance

Close review of the Operation and Maintenance (O&M) procedures is performed in the final stages of certification evaluations to determine if procedures are adequate to ensure overall integrity and functionality of the levee such that the levee will contain base flood. The system should have an official operation and maintenance manual detailing specific actions and procedures and include information on frequency and assigned responsibility of O&M activities.

NFIP Levee System Evaluation Field Inspections

A team of disciplines, similar to those that conduct periodic inspections under the Inspection of Completed Works (ICW) program, carries out levee field inspections. The purpose of the field inspection is to verify documentation and collect relevant information for the certification determination or identify areas needing further analysis. The Routine Inspection under the RIP may not substitute the NFIP levee system evaluation field inspections, though may guide the focus or areas of concern.

Risk and Uncertainty Analysis

USACE has begun to incorporate a probability and uncertainty analysis framework for all engineering elements in the levee certification determinations, especially for the hydrologic and hydraulics analyses. Probability of exceedance and uncertainty-based methodologies are under development for structural and geotechnical applications for certification determinations. New Orleans Corps District is utilizing probability and uncertainty analysis for determining levee certifications in complex situations where flood hazard is dictated by waves and storm surge. These approaches -- outlined in ETL 1110-2-570 Appendix D, *Toward a Probability and Uncertainty-Based Approach for Characterizing the Flood Hazard Associated with Storm Surge, Wave, and Overtopping of Levees* -- also apply to river and lake

systems where wind-driven water levels are a factor in levee design and certification.

Hydrology, Hydraulics in Riverine and Coastal Environments

Risk-based methods attempt to provide a probabilistic assessment of water levels and waves and their uncertainty for riverine and coastal environments. The analysis must include an event (such as elevated discharge due to snowmelt, local or far-field precipitation), by itself or in combination with another type of event, to produce a level of flooding that can be compared to a 1 percent chance of exceedance flood. In addition, this analysis must consider whether the events can be treated as statistically independent of other events. These risk based methodologies for riverine levees are described in EM 1110-2-1619, *Risk Based Analysis for Flood Damage Reduction Studies.*

The engineer certifying the levee must determine if existing data assesses the performance of the levee for current conditions and does not exclude major events that occurred since the hazard was last characterized. Sensitivity analysis can be used to check the performance of the levee. If the levee meets certification criteria with existing hydrologic and hydraulic data, as well as conservative assumptions for how data have changed, the levee can be certified.

For levee systems that are sufficiently long, USACE must complete an analysis on wave conditions that may accompany increased water levels. Review of the levee system design identifies whether considerations for wave overtopping were included. If not, this is addressed as part of the certification determination. Specific procedural guidelines for addressing wave overtopping for levee certification are detailed in ETL 1110-2-570.

Assessment for levee certification must also consider the effects wave action has on levee erosion. The determination must include analysis of the possibility of erosion due to waves, duration of the wave action, and the possibility that erosion could degrade the levee from the 1 percent chance of exceedance water level. Methods to predict erosion of sand embankments by wave action or increased water levels are described in EM 1110-2-1100, part V, chapter 4.

If waves are present, USACE must perform structural analysis, determining loads and related stresses, deformations, and stability conditions for the levee system. Levees that contain flood walls or other structures need to have considerations for dynamic wave loading when determining certification. Specific strategies for establishing the connection between wave characteristics and structural response are detailed in EM 1110-2-1100.

USACE also performs an analysis of the interior drainage to determine if the location of the levee impedes drainage of storm water from floodplains by the presence of the levee on the line-of-protection. Flooding that occurs from the water impeded by the levee must be analyzed and reflected on the flood insurance rate maps for the floodplain in question.

Assess System Weaknesses and Vulnerabilities

Certification evaluations carefully examine potential weaknesses in the flood protection system to identify critically weak locations. Specific consideration is given to how water may infiltrate low spots in a levee or weaknesses in the soil, which could compromise the structural integrity of the levee as a whole. USACE uses high-resolution LIDAR and other survey data, as well as visual data sources, to thoroughly identify any critically weak locations in the levee system. An assessment of these finding are included in the Levee Certification Report (LCR).

Structural Technical Evaluation Guidance and Site Visit

Certification determinations require an assessment of the existing levee structures by reviewing documentation of the Periodic and Annual Inspection Reports and collected instrumentation data. This part of the evaluation includes a site visit to visually assess structural elements and review any corrugated metal pipe (CMP) condition assessments. The original design analysis is reviewed and compared with current USACE guidance to verify whether the structures meet current design requirements.

Analysis of the structural integrity of the levee must show that existing structures (floodwall monolith – T-wall, I-wall or L-wall; closure gates; closure monoliths; pump stations; and gate wells) meet the criteria detailed in EC1110-2-6058, *Stability Analysis of Concrete Structures.* The analysis must include a determination whether the structure(s) under review are defined as “critical” or “normal.”

Appendix H of EC 1110-2-6058 provides guidance for making this determination. (All levee systems attempting FEMA accreditation are considered critical because they protect human settlements.) USACE then determines if the site information available is "Well Defined", "Ordinary", or "Limited," as defined in EC 1110-2-6058. For structures classified as "Limited," certifications cannot be completed until additional information is obtained. USACE uses the above criteria in determine the factors of safety for all levee structures in question.

Geotechnical Evaluation Guidance:

After a review of existing information and inspection reports, USACE conducts a site visit to verify documentation and assess the conditions of the levee and maintenance procedures. Past flood performance is critical. If the system under review has withstood prior flood events of 1 percent annual chance of exceedance, records of the system's performance is important to the certification evaluation process. Information on levee performance can also be found in reviewing flood fight records from interviews with witnesses with first-hand experience. The engineer identifies locations along the levee with any seepage-induced issues, such as, soft spots, pin boils, or sand boils, and determine if these features could worsen with each additional flood event. If the geotechnical engineer cannot determine the capability of the levee can withstand a 1 percent exceedance event, the engineer requests additional information or completion of further analyses. These analyses may require a new field exploration, soil testing, and/or surveying to help distinguish existing conditions.

The geotechnical engineer identifies all potential modes of failure when scoping or prioritizing additional analysis or investigations of the existing conditions. Examples of modes of failure include issues with piping, uncontrolled seepage through the foundation, through the levee, or seepage through the levee into the foundation. Review of the existing levee structures inspection reports is performed to locate conditions or performance problems in regards to the listed modes of failure.

Levee systems located in areas of intense ground motion from seismic activity are also analyzed for seismic stability. The peak ground acceleration (PGA) for a 10 percent chance of a 50-year earthquake is determined using the United States Geological Survey ground-motion database. No evaluation is required if the PGA is

0.15g. If the PGA is greater than 0.15g, the levee and its foundation is analyzed for liquefaction potential discussed in EC 1110-2-6001 *Seismic Analysis of Dams and Levees (2008).* If liquefaction is indicated, the geotechnical engineer performs a post-earthquake limit equilibrium stability analysis. The engineer uses an estimate of un-drained residual strength for liquefied soils based on published empirical correlations. If the factors of safety for the post-earthquake analysis are greater than 1.2,no further evaluation is needed. If factors of safety are less than 1.2, the geotechnical engineer is required to perform a more detailed seismic deformation analysis to assess the levees performance in a seismic event.

Levee systems with indications of widespread liquefaction, and an inadequate factor of safety rating in the post-earthquake analysis, cannot be certified unless a more robust seismic study reveals the system will provide the required level of protection. The probability of the earthquake occurring the same time as the flood is also determined if parts of the levee are identified as being unstable during a seismic event. The ability for repairs from earthquake damage to occur prior to the next flood event must be taken into consideration for the certification process if problems of liquefaction and/ or sliding are identified.

Geotechnical analysis for levee certification determinations is widely based on deterministic analyses using factors of safety against inadequate performance, engineering judgment and experience. The geotechnical engineer can use risk analysis to provide context of the vulnerability of the various components in the system.

<u>Electrical and Mechanical</u>

Failure of electrical or mechanical components of the levee system can prevent water from collecting in designated areas or being pumped out of protected areas and may result in flooding or damages to the levee structures.

Condition assessment methods are to determine modes of failure for pump stations and drainage structures. EP 500-1-1 Appendix B, *Inspection Guide For Flood Control Works,* outlines the process for determining these modes of failure under the initial and continuing eligibility inspections procedures. The levee system is not likely to be certified if an "Unacceptable" rating is given for any of the components that may directly contribute to one or more of the modes of failure. Corps framework for determining

failure modes from interaction of different components in a levee system is guided by a Failure Mode Analysis (FMA), described in *Dam Safety Risk Analysis Methodology* (Reclamation, 2003).

Appendix E: USACE Technical Analysis

A major component of the federal levee certification process is the initial review and technical review process, as summarized above and in Figure 2. USACE technical analysis for levee system evaluations is guided by EC 1110-2-6067, *USACE Process for the National Flood Insurance Program (NFIP) Levee System Evaluation.* This Engineering Circular is a condensed report clarifying USACE authority and terminology for evaluating levee systems for FEMA accreditation.

USACE conducts an initial screening of the levee systems. This initial screening places the levee or levee system into one of three categories, based on the completeness of the data and documentation collected: *Likely to Meet or Exceed NFIP Levee System Evaluation Requirements, Likely to Not Meet NFIP Levee System Evaluation Requirements,* and *systems requiring additional study*. This initial screening of levee systems includes a preliminary probability of failure and uncertainty of levee overtopping analysis.

- ***Likely to Meet or Exceed NFIP Levee System Evaluation Requirements*** have full documentation of the data listed above, and can demonstrate, with a significant margin of error, the system has the capability of containing a 1 percent chance of exceedance flood with 90 percent assurance. USACE will verify the documentation by performing a field inspection, and conducting a hydrology and hydraulic uncertainty risk analysis to verify the height of the levee is appropriate for 1 percent chance of flood with 90 percent assurance. USAC will then complete the NLSER, perform the required reviews, and prepare the NLSER to send to FEMA and the local sponsor.

- ***Likely to Not Meet NFIP Levee System Evaluation Requirements*** display significant or critical deficiencies in any particular area of the projects performance, system design performance, or structural conditions. The process USACE undertakes for investigating levee systems likely not to meet the NLSE requirements is the same as those categorized likely to meet the requirements, though, any deficiencies and negative findings in the process of the evaluation are documented in the NLSER and sent to FEMA and the levee sponsor.

- Systems categorized as ***requiring additional study*** have partial or no documentation to demonstrate the levee system can contain a 1 percent chance of exceedance flood with the assurance level requiring additional information.

For systems placed in the first two categories, the initial screening is followed by a technical review to determine flooding hazards and assess if the system can contain a flood with a 1 percent chance of exceedance. The technical review includes consideration of the operations and maintenance of the system, field inspections, risk and uncertainty analysis, an assessment of system weaknesses and vulnerabilities, a technical evaluation of the levee structure(s), and a geotechnical evaluation.

Investigating levee system evaluation can vary widely depending on the age of the project, the original design intent, and the completeness of the documentation. This process requires compiling all existing data including, but not limited to:

- Performance reports,
- Engineering and design documents (assessment of the flood hazard, structure components, interior drainage components, geotechnical configuration and placement),
- As-built drawings,
- Surveys of top of protection levels,
- Flood Insurance Study text and maps,
- Operations and maintenance manuals,
- Current hydraulic models,
- Flood-fighting, maintenance, repair, modification, and rehabilitation records,
- Annual and after-event inspection documentation, and,
- Permits for utility crossings.

Appendix D provides further detail about the USACE's technical review strategy, including a brief description about how data are incorporated into the evaluation.