FLOOD CHAPTER – STATE FLOOD DAMAGE REDUCTION PLAN

Floods are a common and widespread natural hazard in Oregon: the state has an extensive history of flooding. The National Flood Insurance Program (NFIP) identifies 260 communities in Oregon as flood-prone including locations in all 36 counties, 221 cities, and 3 tribal nations. Flooding typically results from large-scale weather systems that generate prolonged rainfall or rain on snow events that result in large amounts of runoff. Other sources of flooding include flash floods associated with locally intense thunderstorms, ice or debris jams, and much less frequently dam failures. A full list of acronyms used in this chapter is provided in Appendix 8-B.

Hazard Analysis/Characterization

History of Flooding in Oregon

Oregon has an extensive history of flooding. Tables FL-1 and FL-2 summarize major floods within the state. Oregon's deadliest recorded flood occurred in Heppner in 1903 when a June 14th storm dropped 1.5 inches of rain within a twenty-minute period. The storm was centered in the headwaters area of Willow Creek above Heppner in Northeastern Oregon. Within minutes, a five-foot wall of water and debris poured through Heppner with enough velocity to rip homes off foundations. These floodwaters claimed 247 lives.[1]

The late spring 1948 flooding is best remembered for destroying the entire city of Vanport (now Delta Park). Record flow levels on the Columbia River caused the structural failure of a dike. Much of Vanport was destroyed in minutes and was never rebuilt. Nineteen thousand people lost their homes and eighteen people lost their lives.

Many of Oregon's flood records were set in December 1964 and January 1965 during the "Christmas Flood." Damage from these floods totaled over $157 million dollars and twenty Oregonians lost their lives. From December 20 through 24, 1964, the most severe rainstorm to occur in Central Oregon and one of the most severe west of the Cascades left many areas with two-thirds their normal annual rainfall in five days. The ensuing floods destroyed hundreds of homes and businesses, forced the evacuation of thousands of people, destroyed at least thirty bridges and washed out hundreds of miles of roads and highways.

A similar flood event occurred in February 1996. Following an extended period of unseasonably cold weather and heavy snowfall in the Pacific Northwest, warming temperatures and rain began thawing the snowpack and frozen rivers throughout Oregon. On February 6, a strong subtropical jet stream or "pineapple express" reached Oregon. This warm, humid air mass brought record rainfall amounts, quickly melting the snowpack. At least twenty-five rivers reached flood stage.

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[1] See http://www.wrh.noaa.gov/pqr/paststorms/index.php for more information about the 1903 event.

Many reached flood levels comparable to those reached in the 1964 flood. Twenty-seven of Oregon's thirty-six counties were eventually covered by a Presidential major disaster declaration due to this event. Statewide, damages totaled over $280 million.

Recent severe winter storms have plagued western Oregon, in particular the coastal counties.

Table FL-1: Historic Flooding in Oregon

Date	Location	Notes
September 1861	Klamath, Willamette, and Umpqua	
June 1880	Columbia	
January 1881	Willamette Basin	
December 1882	Umatilla	
June 1884	John Day	
May - June 1894	Columbia River Basin	Rain on snowpack; highest flood stage ever recorded at Vancouver, WA (33.6 feet)
June 1903	Willow Creek	Flash flood in Heppner; 247 people killed
April 1904	Silvies and Klamath	
February 1907	Western Oregon and John Day	
November 1909	Deschutes, Willamette, Santiam, Umpqua, Coquille, and Rogue	
March 1910	Powder and Malheur	
June 1913	Columbia	
January 1923	Clackamas, Santiam, Sandy, Deschutes, Hood, and McKenzie	Record flood levels
February 1925	Malheur	
February 1927	Klamath, Willamette, Umpqua, Rogue, and Illinois	Major flooding
May 1928	Columbia	
March 1931	Umatilla, Sandy, Clackamas, and Santiam	
March 1932	Malheur, Grande Ronde, John Day, and Umpqua	
January 1933	Coquille	
November - December 1942	Willamette Basin	10 deaths; $34 million damage
December 1945	Coquille, Santiam, Rogue, and McKenzie	9 deaths and homes destroyed in Eugene area
December 1946	Willamette, Clackamas, Luckiamute, and Santiam	
May - June 1948	Columbia River	Rain on snow; destruction of the city of Vanport

Date	Location	Notes
March 1952	Malheur, Grand Ronde, and John Day	Highest flood stages on these rivers in 40 years
December 1955	Rogue, Umpqua, Coquille	11 deaths; major property damage
July 1956	Central Oregon	Flash floods
February 1957	Southeastern Oregon	$3.2 million in flood damages
December 1961	Willamette Basin	$3.8 million in flood damages
December 1964 - January 1965	Pacific Northwest	Rain on snow; record flood on many rivers
December 1967	Central Oregon Coast	Storm surge
January 1972	Western Oregon	Record flows on coastal rivers
January 1974	Western Oregon	$65 million in damages
November - December 1977	Western Oregon	Rain on snow event; $16.5 million in damages
1979 to present	Harney County	Cyclical playa flooding on Harney & Malheur lakes
December 1981	Umpqua and Coquille	
January 1982	Tillamook County	
February 1982	Malheur and Owyhee Basins	
January 1990	Clatsop and Tillamook counties	
July 1995	Fifteenmile Creek	Flash flood in Wasco County (DR-1061)
February 1996	Nearly statewide	Damages totaling over $280 million (DR-1099)
November 1996	Southwest Oregon	Flooding, landslides, and debris flows; eight deaths in Douglas County (DR-1149)
January 1997	Southwest and Northeast Oregon	(DR-1160)
May - June 1998	Crook County and Prineville	Ochoco River (DR-1221)
December 1998	Lincoln and Tillamook counties	
November 1999	Coastal rivers in Lincoln and Tillamook counties	Heavy rainfall and high tides

Source :Various

Table FL-2 Recent Flooding in Oregon

Date	Location	Notes
July 2002	Wallowa County	Flash flood above Wallowa Lake damaged Boy Scout Camp facility
August 2003	City of Rufus	Flash flood (Gerking Canyon)
December 2005 - January 2006	Western and Central Oregon, Malheur County	Multiple heavy precipitation events on snow and/or saturated or frozen ground (DR-1672)
November 2006	Clatsop, Hood River, Lincoln, and Tillamook Counties	Heavy precipitation and wind resulted in flooding, landslides, and mudslides (DR-1672)
February 2007	Western and Central Oregon, and the Confederated Tribes of the Siletz Indians	Severe winter storm and flooding (DR-1683)
December 2007	Northwestern Oregon, Southern Coast	Heavy precipitation and wind resulted in flooding, landslides, mudslides, and tree blow down. (DR-1733)
December 2008	Tillamook County	Flooding caused by convergence of heavy precipitation and high tides
January 2009	Tillamook and Washington Counties	Severe winter storm/snow event which included snow, high winds, freezing rain, ice, blizzard conditions, mudslides, and landslide (flooding, post DR-1824)
January 2011	Clackamas, Clatsop, Crook, Douglas, Lincoln, and Tillamook Counties	Severe winter storm, flooding, mudslides, landslides, and debris flows (DR-1956)
May – June 2011	Eastern Oregon	Melting heavy Large snowpack caused riverine and playa flooding

Source: FEMA and others

Types of Flooding

Riverine – Riverine flooding is the most common flood hazard in Oregon. It is caused by the passage of a larger quantity of water than can be contained within the normal stream channel. The increased stream flow is usually caused by extensive rainfall over a period of several days. The most severe flooding conditions generally occur when rainfall is augmented by snowmelt. If the ground is saturated or frozen, stream flow can be increased even more by the inability of the soil to absorb additional precipitation. Examples of riverine events are the flooding in December 2007, February 1996, and December 1964 to January 1965.

Flash Floods – Flash flooding is caused by extremely intense rainfall over a short period of time, commonly within a single drainage. Flash floods usually occur in

the summer during the thunderstorm season. The two key contributors to flash flooding are rainfall intensity and duration. Topography, soil conditions and ground cover also impact flooding. Flash floods, because of their intensity, often pick up large loads of sediment and other solid materials. In these situations, a flash flood may arrive as a fast moving wall of debris, mud, and water.

Occasionally, floating debris or ice accumulates at a natural or man-made obstruction and restrict the flow of water. Water held back by the ice jam or debris dam can cause flooding upstream. Subsequent flash flooding can occur downstream if the obstruction suddenly releases. Areas subject to flash floods are not as obvious as a typical riverine floodplain. However, flash floods may be associated with recognizable locations such as canyons or arroyos. There is also always some potential for flash floods associated with dam failure.

The most notorious flash flood in Oregon was the June 14, 1903 event in Heppner summarized previously. More recent flash floods have occurred in Wallowa Co. (July 2002) and Rufus (August 2003).

Coastal Floods – Coastal areas have additional flood hazards. Winds generated by tropical storms or intense off shore low-pressure systems can drive ocean water inland and cause significant flooding. The height of storm surge is dependent on the wind velocity, water depth and the length of open water (the fetch) over which the wind is flowing. Storm surges are also affected by the shape of the coastline and by the height of tides.

Coastal flooding also may result from tsunamis. A tsunami is a series of traveling ocean waves generated by an earthquake or landslide that occurs below or on the ocean floor. Oregon's seven coastal counties and many coastal cities are susceptible to flood damage associated with tsunamis. Both "distant" tsunamis generated from seismic events in the Pacific basin and "near shore" tsunamis generated from activity associated with the Cascadia Subduction Zone can impact Oregon's coast. For more information, see the Tsunami Chapter of this plan.

Shallow Area Flooding – Some areas are characterized by FEMA as being subject to shallow flooding. These are areas that are predicted to be inundated by the 100-year flood with flood depths of one to three feet. Flooding events are expected to be low velocity events characterized by "sheet flows" of water.

Urban Flooding – As land is converted from fields or woodlands to roads, roofs, and parking lots, it loses its ability to absorb rainfall. This transition from pervious surfaces to impervious surfaces results in more and faster runoff of water. During periods of urban flooding, streets can become swift moving rivers, and basements can fill with water. Storm drains may back-up with yard waste causing additional nuisance flooding.

Playa Flooding – Playa flooding results from greater than normal runoff into a closed basin. Closed basin systems are those areas that have one or more rivers emptying into one or more lakes that have no outlet. In these situations, water can only leave the system through evaporation. Thus, if annual precipitation in the basin increases significantly, evaporation is not enough to reduce water levels. Lake levels rise and inundate the surrounding properties.

The best-known example of playa basin flooding in Oregon occurs at Malheur and Harney lakes in Harney County. In higher than average precipitation years, the lakes flood adjacent ranches and public roads. Malheur and Harney lakes flooded during the years 1979 to 1986, and then gradually receded. During the wetter years of 1997 to 1999, these lakes again flooded. By 2005, following a number of dry years, they had receded significantly. In spring 2011, as a result of a heavy snowpack and persistent rainfall, Harney Lake's water level increased significantly with flooding observed in low-lying areas.

PROBABILITY

Flood risk or probability is generally expressed by frequency of occurrence. The probability of flooding is measured as the average recurrence interval of a flood of a given size and is stated as the percent chance that a flood of a certain magnitude or greater will occur in any given year. FEMA's NFIP is based on the risk associated with the "base flood" occurring (see Figure FL-2). The *base flood* is a flood that has a 1% chance of occurring in any year.

Information regarding the probability of flooding at a given location is provided by Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRMs) produced for the NFIP. Many of the flood studies in Oregon were conducted in the late 1970s and early 1980s. These studies represent flood risk at a point in time and don't reflect changing conditions in the watershed. Many of Oregon's metropolitan areas have had significant development during the past twenty years. Increased development increases impervious surface resulting in greater runoff volumes and velocities.[2]

Many communities rely exclusively on FEMA FIRMs to characterize the risk of flooding and the land identified likely to flood, i.e., the floodplain. While FEMA's Map Modernization Program did result in updated FIRMs for 14 Counties in Oregon, many of these maps were produced using models from old flood insurance studies. Some jurisdictions use their own flood hazard maps in conjunction with FEMA FIRMs to better reflect their communities' true flood risks. Some communities have used aerial photos taken during the 1996 and 1997 floods to serve as a benchmark for predicting flood impacts. Others have implemented a higher regulatory standard to address changing conditions; for example Metro's balanced cut and fill requirements, and Tillamook County's and the City of Vernonia's requirement that new homes and substantial improvements to existing homes be elevated at least three feet above base flood elevation (BFE).[3] (See inset for a definition of substantial improvement.)

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[2] See http://www.oregon.gov/LCD/HAZ/localgov.shtml for a copy of the *Oregon Flood Map Modernization Business Plan* (March 2004); it includes information about the need to update and modernize FIRMs.

[3] BFE is the projected depth of floodwater at the peak of a base flood, generally measured as feet above sea level.

El Niño[4] and La Niña Events in Oregon and Relationship to Flooding[5]

One of the most prominent aspects of Oregon's weather and climate is its variability. This variability ranges over many time and space scales, from small-scale phenomena such as wind gusts and localized thunderstorms, to larger-scale features like fronts and storms, to even more prolonged features such as droughts and periods of flooding. Fluctuations occur on multi-seasonal, multi-year, multi-decade and even multi-century time scales. Examples of these longer time-scale fluctuations include an abnormally hot and dry summer, an abnormally cold and snowy winter, a consecutive series of abnormally mild or exceptionally severe winters, and even a mild winter followed by a severe winter. Human inputs into our geophysical environment are also imposing cumulative impacts with measurable changes to global climate, sea-level and even localized weather. These human inputs along with the normal climate cycles may be working together in unpredictable ways and lead to future climate scenarios that do not resemble past, historic cycles. For example, recent research suggests that a warming climate reinforces the possibility that El Niño events could be stronger and more frequent while La Niña episodes may be weaker and less frequent.

The terms El Niño and La Niña represent opposite extremes of the ENSO cycle in an otherwise continuum of global climate events, with "average" conditions generally prevailing between those extremes. In the past three decades there have been several El Niños, with the 1982 to 1983 and 1997 to 1998 events having been the strongest on record, while the period between 1990 and 1995 was characterized by persistent El Niño conditions, the longest on record. (Trenberth, 1999)

In general, the longer time-scale phenomena are associated with changes in oceanic and atmospheric circulation that encompass areas far larger than a particular affected region. At times, these persistent features occur simultaneously over vast, and seemingly unrelated, parts of the hemisphere, or even the globe, resulting in abnormal weather, temperature and rainfall patterns throughout the world. During the past several decades, scientists have discovered that important aspects of this interannual variability in global weather patterns are linked to a global-scale, naturally occurring phenomenon known as the El Niño Southern Oscillation (ENSO) cycle. A measure of this cycle is the Southern Oscillation Index (SOI), which is "calculated from the monthly or seasonal fluctuations in the air pressure difference between Tahiti and Darwin, Australia."

> Additional information regarding the relationship between ENSO – especially El Niño years – and related coastal hazards may be found in the Coastal Erosion Chapter of this plan.

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4 The cyclical warming of east Pacific Ocean seawater temperatures off the western coast of South America that can result in significant changes in weather patterns in the United States and elsewhere.

5 In large part from Impacts of the El Niño/Southern Oscillation on the Pacific Northwest, George Taylor, OCS, March 1998,

http://www.ocs.orst.edu/reports/enso_pnw.html

The ENSO cycle is caused by periodic changes in atmospheric pressure differences in the South Pacific Ocean. These changes then cause a periodic rise or fall in Pacific Ocean equatorial sea surface temperatures. The abnormal temperatures affect atmospheric conditions impacting the weather of a large portion of the world, including Oregon. The interaction of the abnormal sea surface temperatures and the atmosphere affect the position and intensity of the polar and sub-tropical jet streams, which in turn determine the intensity and track of storms.

Historical El Niño and La Niña Events In Oregon

The earliest systematic study of ENSO in the Northwest was Redmond and Koch (1991). The results were sufficiently strong that the authors suggested a cause-effect relationship between the SOI and Oregon weather. They determined that the Southern Oscillation Index (SOI) can be used as a predictor for weather, especially for winter weather. Greatest correlations between SOI and winter weather patterns occur with about a four-month time lag with summer average SOI correlating well with weather in the Northwest during the following winter. SOI values less than zero represent El Niño conditions, near zero values are average, and positive values represent La Niña conditions.

In Oregon general El Niño impacts associated with these climate features generally include warmer winter temperatures and reduced precipitation with drought conditions in extreme events.

El Niño Events	La Niña Events
1982-1983	1988-1989
1994-1995	1995-1996
1997-1998	1999-2000
2002-2003	
2004-2005	
2006-2007	2007-2009
2009-2010	2010-2012

Table FL-3:

Recent ENSO events in Oregon

What Oregonians should especially plan for and monitor, however, is La Niña. Severe flooding during the winter's of 1995-96, 1998-99, and 2007-08 are attributable largely to the combination of heavy snows and warm, intense tropical rain. During La Niña events, heavy rain arrives in Oregon from the western tropical Pacific, where ocean temperatures are well above normal, causing greater evaporation, more extensive clouds, and a greater push of clouds across the Pacific toward Oregon. During February 1996, severe flooding – the worst in the state since 1964 – killed several people and caused widespread property damage. Nearly every river in Oregon reached or exceeded flood stage, some setting all-time records. Debris flows[6] and landslides were also numerous.

Existing Strategies and Programs

At the state level, flood mitigation strategies and programs are principally the responsibility of DLCD, BCD, and OEM. In addition to state programs, the NFIP of

6 These events are typically associated with periods of heavy rainfall or rapid snowmelt on steeply sloping ground. The term "mudslide" is often used interchangeably but is poorly defined as a natural hazard. FEMA uses the terms "mudslide" and "mudflow" in the context of the National Flood Insurance Program, e.g., 44 CFR 59.1 and 206.2(a)(17).

the FEMA is designed to help minimize flood losses through local floodplain management. The NFIP relies on flood hazard mapping, flood insurance, and floodplain development standards implemented at the local level to reduce flood losses. In Oregon, 257 cities and counties and three tribal nations participate in the NFIP (total of 260 "NFIP" communities) and thus play a key role in flood mitigation.

Substantial damage, for NFIP purposes, means damage of any origin sustained by a structure whereby the cost of restoring the structure to it's before damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred.

Substantial improvement, for NFIP purposes, means any repair, reconstruction or improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure either: before the improvement or repair is started; or if the structure has been damaged and is being restored, before the damage occurred. For the purposes of this definition "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure.

Oregon's strategy is to build local capacity in developing and implementing risk reduction activities through plan development support, technical assistance and training, partnership development and resources sharing. The state currently does not have a set of criteria used to prioritize local planning assistance, however, the following factors may be considered:

- Community engagement and buy-in;
- Top population centers without plans; and
- High risk communities, especially those facing severe repetitive losses.

To achieve this objective, our approach fosters partnerships among agencies, communities, academia and community organizations to determine needs, identify issues and resources, and develop both short-term and long-term risk reduction strategies. An example of this coordination and sharing of resources is illustrated by vulnerability assessments and other baseline information collected at the state and regional level that are then made available to local governments and organizations planning for natural hazards. Mitigation action items and implementation measures are most effective at the community level as local considerations drive the planning process. A number of projects have already been completed and evaluated in Oregon using the coordinated partnerships approach.

Repetitive Flood Loss

The State's strategy for selecting properties for flood hazard mitigation projects is four-fold. It prioritizes projects that 1) are geographically balanced 2) are in communities with a FEMA-approved local hazard mitigation plan, 3) address properties with sustained substantial damages or repetitive losses, 4) provide communities with information and/or tools to evaluate properties suitable for mitigation, and to develop mitigation projects.

Repetitive flood loss (RL) properties (those which have experienced multiple flood insurance claims) have been identified as high priority hazard mitigation projects by the NFIP. Nationwide, 40% of all flood insurance claims are paid on just 2% of insured properties. In Oregon, repetitive loss properties represent about 1% of all insured properties, and account for about 14% of all claims paid (19% of the dollar amount paid). Most (80%) of Oregon's repetitive loss properties pre-date the FIRMs. These properties are referred to as "pre-FIRM"; they were built in floodplains before FEMA FIRMs became available. Because of this, the property owners do not pay the true, actuarial cost of flood insurance that reflects the increased risk of flooding for these properties. The RL lists provided by FEMA can have value for hazard mitigation planning because their locations may be indicative of persistent flood or drainage problems that may or may not be reflected on a FIRM.

The state, working with local jurisdictions, will verify the FEMA-provided repetitive flood loss information at least once during this plan's term and establish a priority ranking for properties that would benefit most from hazard mitigation by means of acquisition, relocation, elevation, or demolition. The state will maintain and review this list annually as a basis for selecting and funding hazard mitigation projects that directly benefit homeowners and businesses. The review of the repetitive lost list is tied to the FMA Program guidance that is updated annually along with the state grant funding allocations. Following a major disaster declaration, these properties could be pre-approved by FEMA for hazard mitigation to include post-disaster mitigation funding from the Hazard Mitigation Grant Program that can oftentimes be expedited.

Once the repetitive loss list is verified, DLCD and OEM will analyze and summarize the information in a geographical information system to discover spatial patterns associated with repetitive losses. Results will be shared with jurisdictions in which repetitive loss structures are located, with the recommendation that the loss areas be addressed in local hazard mitigation plans as potential mitigation action items (in concept but not by specific property address). DLCD will provide NFIP communities that contain RL properties with the information necessary for them to identify and pre-qualify potential mitigation project opportunities that are cost-effective, environmentally sound and technically feasible. OEM will work with these communities in turning qualified potential projects into sub-grant applications.

The Severe Repetitive Loss (SRL) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the National Flood Insurance Program (NFIP). As of May 2011, there are nine identified SRL properties in Oregon, eight of which are insured with the NFIP. The State has been working closely with the owner of the property with the highest number of losses (7) to mitigate against future loss. This mitigation project is projected to come to completion in 2012 using SRL grant funds (pending FEMA approval). DLCD and OEM will develop a plan for addressing the remaining SRL properties based upon experience with the 2012 mitigation project. Cost effectiveness of mitigation must be proven for SRL properties and unfortunately the dollar losses suffered by the remaining SRL properties in

Oregon may not allow mitigation to be funded using the SRL grant program (or Federal mitigation grant programs). FEMA's Greatest-Savings-to-the-Fund (GSTF) calculation does not provide sufficient benefits to mitigate any of Oregon's SRL properties. Mitigation costs will likely exceed the GSTF calculation in all cases. Consequently, DLCD and OEM will evaluate the remaining SRL properties, including conducting screening benefit-cost analysis, to determine whether the remaining SRL properties qualify for priority ranking for mitigation action. Results will be shared with FEMA and local jurisdictions. Any decision to move forward will be made in consultation with local jurisdictions and property owners. Lessons learned from the SRL grant application process to date indicate there is a significant investment of staff time to develop an approvable application which was not necessarily expected at the onset and initial offering of the program to the state.

DLCD prepared a spatial database in 2011 of all RL properties in Oregon. As part of that project DLCD requested that each jurisdiction having RL properties verify the addresses and mitigation status of each property. Returns from our survey are still being received, but preliminary results indicate a significant number of errors in FEMA's RL database. DLCD will notify FEMA of these errors by submitting the NFIP Repetitive Loss Update Worksheets we have received. Once the database is cleaned, DLCD will be performing spatial and economic analysis to prioritize properties for further consideration.

In 2004, the Oregon Partnership for Disaster Resilience and Oregon Emergency Management established a statewide Pre-Disaster Mitigation (PDM) planning program. The PDM planning program systematically provides technical assistance and funds (primarily through FEMA grants) to local governments for the purpose of developing or updating existing local natural hazards mitigation plans. Assistance is targeted annually to physiographic, natural hazard planning regions identified by Oregon Emergency Management. Oregon's statewide mitigation planning strategy is to build local capacity in developing and implementing risk reduction activities through plan development/plan update support, technical assistance and training, partnership development and resource sharing. This strategy extends to communities with severe repetitive loss properties that elect to participate in the mitigation planning process. To assist SRL communities in the development of local mitigation plans, Oregon fosters partnerships among local jurisdictions, agency partners, academia, and community organizations to determine needs, identify issues and resources, and develop both short-term and long-term risk reduction strategies.

Implementation of the NFIP

FEMA plays an integral role in assisting Oregon and its local and tribal governments in reducing damage from future floods. Besides establishing minimum standards that govern development in the floodplain, FEMA provides to each local government technical information and mapping of local areas prone to flooding. FEMA also publishes numerous booklets and brochures designed to educate professionals in the construction trade and citizens about building in areas prone to flooding. Most of these publications can be found on the Internet.

Oregon is located within FEMA Region X, located in Bothell, Washington. FEMA Region X is active and willing to help state and local governments that are interested in reducing flood-related damage. FEMA Region X staff is available to answer questions about NFIP requirements. Also, FEMA Region X shares responsibility with DLCD to conduct and complete assessments of local floodplain programs. These assessments or evaluations are known as community assistance visits. The basic requirements of the NFIP program begin with definitions of floodplain and floodway. The floodplain is composed of the floodway and the floodway fringe. Together they form the area subject to the base flood, i.e., the area that would be inundated by a flood having a 1% chance of occurring in any give year. See Figures FL-2 below.

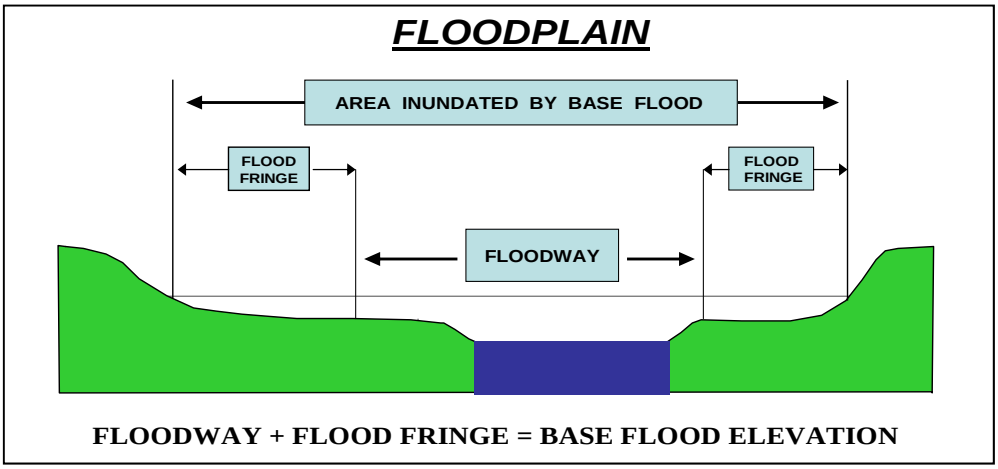

Figure FL-1: floodplain schematic (image courtesy of DLCD)

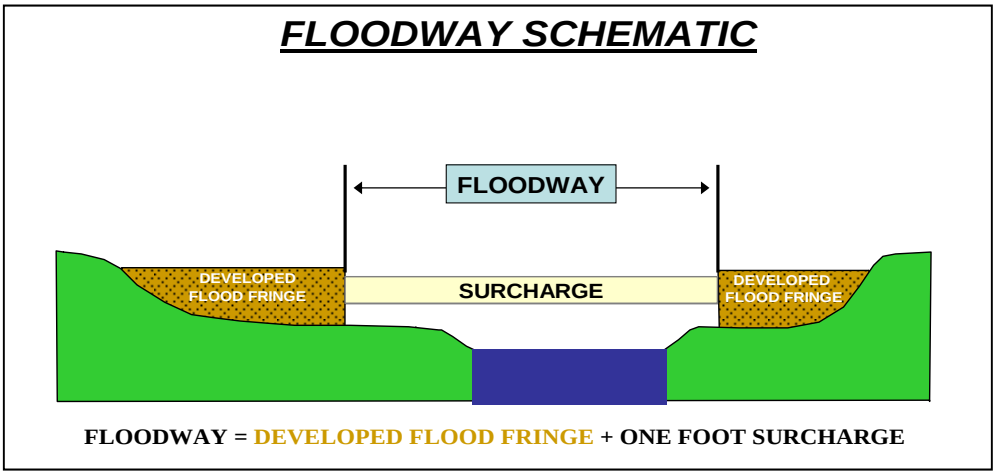

Figure FL-2: floodway schematic (image courtesy of DLCD)

FEMA's definition of floodway is "the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a

designated height." See Figure FL-3. FEMA and the State of Oregon discourage development in floodways.

Development in floodways is allowed only under limited circumstances. The NFIP requires a demonstration of compliance with a no-net rise (also called zero-rise) standard. To satisfy the no-net rise standard, there must be no increase in the flood elevation at the site or downstream as a result of alterations supporting the development. Before any development in the floodway can be permitted, a thorough analysis by a qualified professional must take place that concludes that no increase in the BFE will occur and thus, the no-net rise standard has been met. FEMA is serious about adherence to the no-net rise standard as are Oregon's local NFIP communities

Development may occur in the "fringe" areas of the floodplain. In Oregon, residential development must be elevated at least one-foot above the BFE. Of course, as development, including fill, occurs in the floodway fringe, the area or channel available during a flood to disburse floodwaters shrinks. FEMA's calculations used to determine the floodway and floodplain already presume that some development in the floodway fringe will occur.

Land Use Planning

DLCD serves as the state coordinating agency for land use planning and the NFIP. Pursuant to ORS Chapter 197, the Department follows direction provided by LCDC, which has statutory authority to adopt statewide planning goals and other land use policies, and to require that local governments incorporate these policies into locally adopted comprehensive plans and implementing regulations. Statewide planning Goal 7, adopted by LCDC in 1974 and amended in 2001, requires local governments to adopt comprehensive planning programs (i.e., inventories, maps, policies, and implementing ordinances) to address natural hazards; this includes riverine and coastal flood hazards. Local governments are deemed to comply with Goal 7 for flood hazards if they adopt and implement local floodplain programs that meet the minimum NFIP requirements. However, Oregon's cities and counties are strongly encouraged by Goal 7, and thus, by DLCD, to consider measures that exceed the NFIP requirements. DLCD also continually works to provide technical assistance to Oregon's NFIP communities to support sound floodplain management at the local level.[7] Over the course of this plan the following floodplain management outreach will be implemented by DLCD:

- Continued training to surveyors, building offices, real estate agents, planners and local floodplain managers,
- Two Public Service Announcements (PSAs) per year, and

[7] The DLCD publication *Technical Resource Guide* (TRG), 2000, is an example of a technical assistance tool for land use planners. See the Flood Chapter of the TRG at http://www.oregon.gov/LCD/HAZ/docs/floods/04_flood.pdf

- Completion and distribution of a Floodplain Management Administrative Procedures Guidebook articulating roles and responsibilities of local communities.

Under Oregon's land use planning system, once local plans are "acknowledged" as being in compliance with the statewide planning goals, local and state agencies must comply with local plan requirements and implementing ordinances. Where development does occur in identified flood hazard areas, potential damages are avoided or minimized through compliance with local floodplain development standards and permit conditions designed to mitigate potential flood damage.

Other aspects of the statewide land use planning program, adopted under OAR, indirectly support floodplain management in Oregon. For example, statewide planning Goal 5 - Natural Resources, promotes local conservation of wetlands, riparian areas, natural areas, scenic rivers, and wilderness areas throughout the state (see OAR 660, Div. 23). Also, Goal 15 - Willamette River Greenway promotes, among other values, the natural, scenic, agricultural and recreational values of the Willamette River (see OAR 660, Div 20). The state also adopted Goal 17 - Coastal Shorelands and Goal 18- Beaches and Dunes that protect coastal resources, address potential hazards from ocean and riverine flooding, and restrict development in potentially hazardous locations.

Oregon also has one of the better agricultural and forest lands protection programs in the nation under ORS Chapter 215 and statewide planning Goal 3 – Agricultural Lands and Goal 4 – Forest Lands. Agricultural lands in particular are often within floodplains and in Oregon zoned for exclusive farm use. This means that very little residential or commercial development could occur in these areas. Rural residential development is generally not allowed on lands zoned for agriculture and forest uses, which comprise approximately 90% of the lands in Western Oregon (west of the Cascade Mountains) and 97% of the lands in Eastern Oregon.

Building Codes

The Building Code Division (BCD) administers state building code programs for residential structures, manufactured homes, and non-residential structures. Local governments are required to apply the state building codes through local building permit programs. The BCD provides technical assistance to local governments regarding implementation of the state codes. The state codes generally meet NFIP standards and in some cases exceed NFIP requirements. For example, the state codes for residential structures, including manufactured homes, require that the lowest living space in a dwelling be elevated at least one foot above the BFE. The codes reference the FEMA FIRMs and address development in the flood fringe and floodway. The state has not adopted all elements of the international code provisions for floodplain development such as appendices that include standards for non-structural floodplain development and erosion control. This is because BCD does not generally have legislative authority to adopt state codes for non-structural development activities.

Grant Management and Coordination

OEM is involved in many areas that help mitigate the effects of flooding such as administering project and planning grant programs offered by FEMA, coordination with other federal programs such as those offered by the USACE and the NRCS, and state agency collaboration facilitated through the State IHMT and OPDR.

FEMA's HMA grant programs, including HMGP, FMA, and PDM, are administered by OEM as the grantee of the federal funds that benefit local governments, citizens and businesses to develop mitigation plans and implement projects to reduce flood risk. OEM also co-sponsors and participates in training and workshops in support of local mitigation planning, project development, benefit-costs analysis, and grant application development. OEM and DLCD have access to NFIP policy and claims data that are used to help identify properties most in need of mitigation treatments, particularly those that have incurred repetitive losses. OEM's participation in the OPDR initiative is intended to leverage resource opportunities (funding and personnel) in support of local mitigation planning and project implementation.

Flood Warnings

The NWS is the federal agency in charge of hydro-meteorological forecasts and warnings for the nation, including flood forecasts, watches and warnings. For Oregon, the NWS accomplishes this mission through the Northwest River Forecast Center and also forecast offices located in Medford, Pendleton, and Portland, Oregon, and in Boise, Idaho.

Flood forecasts are developed in conjunction with information from USGS stream gauging stations and information from gauges operated by WRD. USGS and WRD each have approximately 200 stream gauges in Oregon. Real time stream data is available on line for many of Oregon's larger river basins including the Columbia and Willamette. Many of these gauges are available real time on the Internet. Most historical data can also be accessed via the Internet.

Flood watches are issued when there are weather conditions favorable for flooding, providing advanced notice (up to 48 hours) of the possibility of flooding. Flood warnings are issued when flooding is imminent or occurring and generally refer to flood levels that will be a number of feet above "flood stage." In general, flood stage is the water surface level at which water begins going over the banks.

As part of its warning and response capabilities, the Oregon Emergency Response System notifies local public safety agencies and keeps them informed of potential and actual flood conditions so preventive and damage reduction actions can be taken. In the event conditions warrant require further response and state assistance, OEM coordinates state resources per ORS 401. Should there be imminent, damaging flooding, OEM works closely with the USACE and local governments to implement advance measures and flood fight protocols.

Local Floodplain Management

Local floodplain programs are built upon statewide requirements for land use planning and implementation of building codes. Local governments implement

flood damage prevention ordinances, through floodplain development permits, and the state building codes via local building permits. Local governments are required by the state (Goal 7) to meet the minimum NFIP standards, and the state building codes – in some cases – require local governments to implement higher standards (e.g., elevation to one-foot above the base flood elevation). Many local governments in Oregon have also adopted higher regulatory standards into their flood damage prevention ordinances. For example, some jurisdictions require two or three feet of freeboard, regulate an area larger than the floodplain shown on FEMA FIRMs, require balanced cut/fill in the floodplain, etc.

Local governments are encouraged to join the NFIP Community Rating System (CRS), which is a federal program that provides incentives to local governments that implement floodplain measures that exceed the NFIP minimum requirements. The CRS also provides an important avenue for Oregon's NFIP communities to obtain recognition for their local floodplain programs. The CRS offers reduced insurance rates to property owners in jurisdictions that have received a CRS rating of 9 or lower because their flood management programs exceed the NFIP requirement. Currently, 31 of Oregon's NFIP communities participate in the CRS program. The state continues to work with ISO, FEMA Region X, and Oregon's NFIP communities to educate local governments about the CRS program and to promote community participation.

Each year DLCD conducts community assistance visits in an average of five NFIP communities. During this process, qualified jurisdictions will be encouraged to participate in CRS and/or strengthen CRS ratings. DLCD will also create a "pathway to CRS" schedule for each jurisdiction for which it conducts a community assistance visit.

MAPLETON HOME ELEVATIONS PROJECT

Three damaging flood events occurred in Mapleton, Oregon during 1996-1997. Beginning in late 1997, 23 homes were elevated above the 100-year base flood elevation in a project that brought together homeowners, county government, a local consulting engineer, several contractors, and a regional bank.

Topography of the community places essentially all develop-able land in the floodplain or floodway. Outside the flood-plain, the hillsides are too steep for development and are even of greater hazard as a result of recurring debris flows. The consulting engineer provided evaluations of cost-effective, specific construction techniques for each home, taking into account the past flooding in the community. With the help of the Lane County emergency services and planning departments, many homeowners are very grateful that they were able to participate in the Hazard Mitigation Grant Program to elevate their homes.

Subsequent floods in 1998 and 1999 were a test for the recently elevated homes, and none of the homes elevated through the HMGP sustained water damage. In 1998, the Siuslaw River at Mapleton was more than nine feet above flood stage. People along Riverview Avenue, where the Siuslaw spilled over its banks, used shovels and squeegees to scrape mud from driveways, garages and doorsteps. Despite the dirty job, most residents expressed relief that the homes that had been raised escaped with essentially no damage.

Towards Oregon NHMP Goal:

GOAL 1 - Protect life and reduce injuries resulting from natural hazards.

GOAL 2 - Minimize public and private property damages and the disruption of essential services from natural hazards.

Pre-2012 Oregon NHMP Actions Met: FL-LT6

Lead Agency: OEM

Project Cost: $754,349

Funding Sources: HMGP

Project Benefits: By choosing elevation as their mitigation alternative, the cost of future damages will be reduced, not only minimizing the need for further disaster assistance, but also eliminating repetitive damage and suffering to the residents of Mapleton

Photo Credits: Lane County & OEM

RESIDENTIAL ELEVATIONS ALONG THE SILETZ RIVER

For a very long time, floods along the Siletz River in Oregon have destroyed homes, and caused major disruption to peoples' lives. After the floods of 1996 and 1998, Oregon Emergency Management (OEM), the Federal Emergency Management Agency (FEMA), and Lincoln County started a program to elevate homes in harm's way. The combination of two FEMA funding sources and money from the participating homeowners has significantly reduced the possibility of future flood damages to these homes.

Lincoln County experienced damaging floods in February 1996, December 1998, and November (Thanksgiving Day) 1999. Many of the homes located on the Siletz River were built before flood maps were developed and were built well below the base flood elevation.

Also, prior to the 1996 flood event, many homeowners did not have flood insurance. This was a major oversight by home-owners because flood insurance is the only sure way to obtain enough money to repair your home and put your life back together. After the '96 and '98 events, many more homeowners purchased flood insurance and became eligible for additional funds to elevate homes if they were substantially damaged in the future.

On behalf of effected homeowners, Lincoln County applied for two separate FEMA Flood Mitigation Assistance Program grants for $143,370 and one post-disaster grant via FEMA's Hazard Mitigation Grant Program totaling $1,315,452 in order to elevate 51 homes. Depending on the situation, participating homeowners provided personal funds to match 25% of the grant funding value.

Via Increased Cost of Compliance, those homeowners who had a National Flood Insurance Program policy and were substantially damaged also received an additional $15,000 with their flood insurance payment, which could be used to offset their 25% share of the cost for elevating their homes.

Towards Oregon NHMP Goal:

GOAL 1 - Protect life and reduce injuries resulting from natural hazards.

GOAL 2 - Minimize public and private property damages and the disruption of essential services from natural hazards.

Pre-2012 Oregon NHMP Actions Met: FL-LT6

Lead Agency(ies): OEM, FEMA, Lincoln County

Photo Credit: OEM

Project Cost: $1,315,452

Funding Sources: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Private funds Project Benefits: This project has been a success for both homeowners and the government agencies that assisted. Having these homes elevated and out of harm's way will certainly reduce the amount of property losses as well as insurance payments in the future. Perhaps more important, as Matt Spangler, Lincoln County Planning Director points out, "These homeowners will not have to repeat the anguishing experience of losing their homes and belongings in the next flood." It is estimated that by elevating these 51 homes, more than $1 million will be saved in future flood damages.

JOHNSON CREEK FLOODWAY ACQUISITION

Seven major floods have occurred on Johnson Creek during the past 35 years. While only 6% of Portland's 100-year floodplain is associated with Johnson Creek, 78% of the City of Portland's repetitive loss claims come from there.

Floods during Feb. '96 on Johnson Creek totaled $4.7 million in damages, including loss of revenue to businesses. In 1997, as part of a changing national trend to avoid risk in floodplains, the Portland Bureau of Environmental Services (BES) developed the Johnson Creek Willing Seller Land Acquisition Program. The program's goal is to help move people and property out of harm's way to minimize repetitive losses.

Willing sellers are offered the real market value for their property and are under no obligation to sell. Once the City purchases the properties and structures are removed, many are converted to constructed wetlands, floodplain terraces, and open space for flood management, habitat, and passive recreation purposes.

Towards Oregon NHMP Goal:

GOAL 1 - Protect life and reduce injuries resulting from natural hazards.

GOAL 2 - Minimize public and private property damages and the disruption of essential services from natural hazards.

GOAL 3 - Increase the resilience of local, regional, and statewide economies.

GOAL 4 - Minimize the impact of natural hazards while protecting and restoring the environment.

Pre-2012 Oregon NHMP Actions Met: FL-LT6

Lead Agency: City of Portland Bureau of Environmental Services (BES)

Figure FL-3: Johnson Creek Watershed Willing Seller Acquisition Program; Lents Target Area Map

Project Cost: $9,951,250

Funding Sources: BES Capital Improvement Program, HUD Community Development Block Grant, FEMA Hazard Mitigation Grant Program, Portland Parks and Recreation Bond Measure 26-26 (local share), and Metro Bond Measure 26-26 (regional share)

Project Benefits: Through the Johnson Creek Willing Seller Land Acquisition Program, 69 properties have been purchased since 1997, totaling 126 acres. The program has assisted 52 households in moving out of flood-prone areas, with FEMA funding 15 residential "buy-outs." The BES program has also led to the development of a successful land acquisition team consisting of multiple local agencies with acquisition funds focused on Johnson Creek. In 1997 BES constructed Brookside Wetland, the first floodplain restoration project on Johnson Creek. The 14-acre wetland can store up to 20 million gallons of floodwater. The wetland also provides habitat for fish, amphibians, reptiles, birds, and small mammals.

Floodplain Restoration (2011 Update): Using funding from a Pre-Disaster Mitigation grant, Portland has returned the floodplain to performing its natural functions which helps not only minimize damages and impacts to remaining improvements but also supports habitat restoration initiatives.

SMALL COMMUNITY DISASTER RECOVERY PROGRAM IN VERNONIA

Two flooding events on the Nehalem River (1996, 2007), that resulted in major disaster declarations, caused significant damage to the City of Vernonia. Lessons learned in 1996 equipped the community in 2007 with the vision to assemble the necessary administrative capacity and to quickly organize and commence a broad range of recovery projects. Recovery in Vernonia has been built upon a highly organized web of local, county, state and federal relationships committed to cost-effective mitigation and long-range recovery.

Vernonia responded to flooding in 1996 by crafting a "homegrown" recovery system to track the needs of flood victims and resources available to meet those needs. In 2007 the City enhanced this administrative structure and refocused its strategy on mitigation and long range planning. Vernonia committed to do more than just rebuild--they wanted to "fix the problem this time". Successful elements within this approach include: data collection, community engagement and relationship building.

From the first day, the City and County brought the Community Action Team (CAT), a local nonprofit with development capacity, into the project. CAT staff recognized the value of collecting volunteer hours, donations, information on people and property impacted and other types of data necessary for funding eligibility during future phases of recovery. CAT engaged their distressed community by organizing volunteer teams to assess damages, rehabilitate and build homes, write grants, assist with victim advocacy, manage projects and much more.

Vernonia knew that data and volunteers alone were not enough to rebuild. Key political drivers were needed to make rebuilding economically viable. Governor Kulongoski, State Senator Betsy Johnson, US Sens. Wyden and Merkley, and County Commissioners committed federal, state and local support, including an Oregon Solutions Team made up of "heavy hitters" appointed by the Governor's Office.

To date, $32 million have been raised for mitigation projects including residential and commercial elevations, property acquisitions, floodproofing and project development. The community worked closely with FEMA, OEM and DLCD to acquire roughly $13 million in Flood Mitigation Assistance (FMA) and $7.5 million in Hazard Mitigation Grant Program (HMGP) funding, both requiring a 25% match. The community then raised the additional 25% ($6.6 million) in HUD Community Block Development Grants(CBDG) and NFIP Increased Cost of Compliance (ICC) funds. An additional $16 million was collected through NFIP insurance claims.

The remaining recovery funds were raised by the community from other public entities and the private sector. In total, over $90 million in public and private funds have been raised and this number continues to grow as they move through the long-term recovery process.

Funding applications, procurement, distribution and management required a great amount of organizational and administrative capacity at the local level. A local volunteer lay committee, the Unmet Needs Committee, was created by the County to govern all recovery projects through a transparent and equitable process.

The Unmet Needs Committee understood the need to pace rebuilding efforts to match funding cycles. The first three years of recovery were primarily funded by volunteers and the private sector. Accessibility to public funds began a year and a half after the event, and had a cutoff date of 4-years. The Unmet Needs Committee preserved funds raised early in recovery as seed money for long term efforts, and managed rebuilding efforts to align with funding availability.

The project most illustrative of Vernonia's commitment to mitigation and long range planning is the schools projects. Despite land use restrictions, the City chose to relocate its public schools campus uphill and clearly out of harm's way from future flooding. In the words of the Vernonia School District "our schools are synonymous with the town, not only the largest employer, but also the only place for the community to gather in the event of a

disaster." To date $30.6 million have been raised for this project, and a capitol campaign to raise another $9 million is underway. OEM and FEMA were key in helping Vernonia acquire FMA funding for this project. Political will and public funding earned through efforts by local officials, CAT and the Unmet Needs Committee boosted local confidence that fixing the problem was actually possible- as was realized in 2009 when voters passed a $13 million bond for the schools project.

Vernonia's recovery program offers insight for other small communities in flood-prone areas. Instituting the motto "The question isn't what will we do *if* it floods, the question is what will we do *when* it floods?" is the first step toward long-range recovery. Focusing on "fixing the problem" will guide a community toward mitigation. Creating the relationships and plans needed to assure early collection of data and the partnerships to provide the development capacity to secure funding and manage projects are the backbone for a comprehensive program. Building relationships with local, state and federal actors creates the political will needed to build confidence among foundations and private funders to take the risk to rebuild. Understanding funding cycles, processes and timelines helps communities temper local expectations, communicate tradeoffs and invest wisely in time and resources.

Towards Oregon NHMP Goal:

GOAL 1 - Protect life and reduce injuries resulting from natural hazards.

GOAL 2 - Minimize public and private property damages and the disruption of essential services from natural hazards.

GOAL 3 - Increase the resilience of local, regional, and statewide economies.

Pre-2012 Oregon NHMP Actions Met: FL-ST-15, FL-LT-6

Lead Agency(ies): OEM, FEMA, DLCD, OPDR, Columbia County, City of Vernonia, CAT, Governor's Office

Project Cost: Varies

Funding Sources: FEMA FMA, HMPG; HUD HOME, CSBG; OHCS; JTPA; private donations

Project Benefits: Investments in flood mitigation will reduce future risk for Vernonia homeowners, businesses and schools. The relocation of the school campus signals to developers and planners the community desire to live high and dry, and provides security of jobs, education and the town's emergency shelter.

Lessons learned in Vernonia give warning to other flood-prone communities about the level of institutional capacity and political will necessary to shift from a post-disaster program focused primarily on rebuilding to a comprehensive long-term recovery program focused on mitigation and resiliency. These include:

1. Staffing the recovery effort from day one and documenting critical data allows a community to back their recovery goals and funding requests with necessary quantitative facts;
2. Coordination between city and county government provides support for the overwhelmed disaster-struck community and the incentive to cooperate, rather than compete, with each other;
3. A comprehensive local administrative structure married with key political drivers enables a community to maximize federal funds for individuals and agencies;
4. Collaboration with a local nonprofit development partner(s) provides the skills, operating capital and entrepreneurial approach needed to empower a grassroots recovery program that has staying power, can stay focused on local priorities and keeps the local community in the driver's seat to recovery.

Figure FL-4: Mitigation projects in Vernonia (Photo Credit: Community Action Team, Inc.)