3.0 FLOOD HAZARDS

Lane County is subject to flooding from several different types of flood sources, including:

1) over bank flooding from major rivers, including the Willamette, McKenzie, Mohawk and Suislaw Rivers,
2) over bank flooding from smaller creeks and sloughs such as Lake Creek which drains into the Siuslaw River, Salmon Creek near Oakridge, Flat Creek in Junction City and many others,
3) coastal storm water surge flooding, and
4) local storm water drainage flooding.

Major flooding events in Lane County generally result from large winter storms with intense rainfall, with flooding sometimes exacerbated by snowmelt runoff. These large winter storms often result in simultaneous flooding on many rivers and streams in an affected area. However, because of geographic variations in rainfall amounts and differences in drainage areas, slopes, and other watershed characteristics, the severity of flooding in any given rainfall event often varies significantly from stream to stream and location to location. Winter storms that include high winds and large wave conditions may also produce coastal flooding, especially during periods of high tides.

FEMA Floodplain Maps show areas where the Federal Emergency Management Agency (FEMA) has determined that a flood hazard exists. Throughout Lane County, many portions of these hazard areas have been developed. . Nearly all communities have at least some portion of the hazard areas, or floodplain, within their jurisdiction. . For the most part, the FEMA-mapped floodplains in Lane County include areas along the larger rivers and streams and the coastal areas , which also have significant concentrations of development and population. Throughout Lane County, there are many other localized areas that have significant flood risk but are not included in the FEMA mapped floodplains because the streams are too small and/or because the flood-prone population is too small. Thus, evaluation of flood hazards in Lane County must consider not only the FEMA-mapped floodplains, but also the localized areas of repetitive flooding outside of the mapped floodplains.

3.1 Historical Floods in Lane County

Historically, flooding has occurred in Lane County throughout the recorded history of the area, ever since the first European settlers arrived in the area in the mid-1800s.

The FEMA Flood Insurance Study for Lane County (June 2, 1999) has a brief history of major historical floods in Lane County. Major floods occurred in 1861, 1890, 1945, 1956, and 1964. The 1964 flood was the largest flood event recorded in Lane County.

In considering these past major floods in Lane County it is important to recognize that construction of large dams along most of the major rivers from the 1940s to the 1960s has substantially reduced the expected 100-year stream discharges (volume of water flowing in the rivers) and the expected flood elevations. Thus, construction of these dams has substantially reduced the overall flood potential along the major rivers in

Lane County. These reductions in flood risk are reflected in the FEMA Flood Insurance Studies for the FEMA-mapped floodplains.

Despite the reduction in flood potential from construction of the dams, portions of Lane County continue to have a significant level of flood risk from major rivers as well as from the numerous creeks and sloughs running through Lane County. The dams on the larger rivers have not reduced flood risk on these smaller streams.

3.2 The 1996 Flood

The most recent significant flood event in Lane County occurred in February 1993. Interestingly, the 1999 FEMA Flood Insurance Study for Lane County does not mention the 1996 flood. This omission may be because the 1996 flood was not of the magnitude of the extreme flood events discussed in the Flood Insurance Study or simply because old text may not have been updated for the 1999 FEMA Study. Unusually heavy rains over the four-day period from February 5th to February 8th 1996 resulted in significant flooding on numerous rivers and streams throughout western Oregon.

During this flood event, rising waters in the McKenzie River forced the evacuation of about 1,200 to 1,500 people in low-lying areas of Springfield. In the Springfield/ Thurston area along the McKenzie River about 35-40 homes were damaged, along with about 20 private roads and bridges and about 20 vehicles.

The Mohawk River crested at 22.2 feet, which was the second highest flood of record (the highest flood of record was 22.6 feet). As a result, widespread flooding occurred in the Mohawk Valley from Marcola to Springfield, with flooded homes on Sunderman Road and on Goat Road. The Springfield Golf Course suffered substantial damage with about 6 inches of silt and debris deposited on the greens and fairways.

Commercial and residential areas of Mapleton experienced major flooding from the Suislaw River. In Mapleton, flood waters rose very rapidly and at least 45 people had to be rescued by boats. Significant flooding was also experienced in Florence, with the Red Cross opening shelters to house people displaced from their homes.

There were widespread road closures in Lane County, including Highway 126 at Noti, Highway 36 in several locations, Highway 101 north and south of Florence, the Marcola Road in the Mohawk Valley and the McKenzie Highway. Highway 5 had water flowing across it just north of Eugene near the Boston Mill Road overpass. Furthermore, there were a great many road closures, some reported and some not reported, on smaller roads throughout the County.

3.3 Flood Hazards and Flood Risk: Within Mapped Floodplains

3.3.1 Overview

Flood prone areas of Lane County include the FEMA mapped floodplains for the major rivers, including the Mohawk, McKenzie, Suislaw and Willamette (including the Middle Fork and the Coast Fork). FEMA mapped floodplains also include areas along numerous smaller creeks throughout the County and coastal areas in southwestern Lane County.

The FEMA-mapped floodplains in Lane County are shown in the following maps, which are included in the Appendix to this Mitigation Plan:

1. A county-wide Index Map, showing the three Overview Maps and over 40 Community Maps,

2. Three Overview Maps for the Northeastern, Southeastern, and Western Portions of Lane County. These maps show all of the mapped floodplains, but with relatively low spatial resolution because of the large areas covered.

3. Community Maps showing higher resolution close-ups of the mapped floodplains in over 40 communities in Lane County.

The Community Maps include the following communities:

Alavadore, Chesire
Blue River, Nimrod
Camasswale, Linxhollow
Cottage Grove, Divide
Cottage Grove, Saginaw
Coburg
Creswell
Crow
Culp Creek, Dorena
Dexter, Lowell
Dunes City, Siltcoos
Elmira, Noti
Eugene
Ferguson Creek, Highpass
Florence, Cushman
Gillespie Corners
Greenleaf
Heceta Beach, Mercer Lake
Jasper, Trent, Fall Creek
Junction City, Lancaster
Leaburg
London
Lorane
Lower Mohawk, Camp Creek
Mapleton
Marcola
McKenzie Bridge
Mosby Creek, Row River
Oakridge, Westfir
Pleasant Hill, Goshen
Rainbow
Spencer Creek
Springfield
Swiss Home, Deadwood
Triangle Lake, Blachly
Upper Long Tom, Alderwood
Veneta
Vida
Walterville
Walton
Wendling

GIS staff at the Lane Council of Government prepared all of the above floodplain maps, from the FEMA Flood Insurance Rate Maps for Lane County. These maps show mapped floodways and 100-year floodplain boundaries, along with symbols showing locations of critical facilities. These maps provide a countywide overview of the communities and areas within communities at flood risk within mapped floodplains. FEMA Flood Insurance Rate Maps showing more detailed flood plan boundaries and more detailed flood characteristics are available from FEMA for all of the communities listed above.

An important caveat in interpreting these floodplain maps is that there are additional areas of Lane County, not within the mapped floodplains, that are also at flood risk. These areas are discussed later in this chapter (Section 3.4).

In addition to flood data, the Lane County maps listed above (but not the FEMA Flood Insurance Rate Maps) also show areas in Lane County with high probabilities of debris flows and landslides, as mapped by DOGAMI (SB12 Further Review Areas). Debris flows and landslides are discussed in Chapter 8. These data are included on the Lane County flood maps for convenience and compactness.

3.3.2 Flood Hazard Data

For mapped floodplain areas, the flood hazard data included in the Flood Insurance Study (FIS) allow quantitative calculation of the frequency and severity of flooding for any property within the floodplain. Such calculations are very important for mitigation planning, because they allow the level of flood risk for any structure to be evaluated quantitatively. The example below illustrates these concepts.

For example, for the Middle Fork of the Willamette River near Westfir, the 1999 FEMA FIS includes the following data:

Figure 3.1
Flood Hazard Data
Middle Fork of the Willamette River near Westfir

Flood Frequency (years)	Discharge (cfs)	Elevation (feet)
10	24,900	1020.0
50	43,900	1024.1
100	54,600	1026.0
500	91,800	1030.2

The stream discharge data shown above are from the table on page 26 of the FIS for Lane County, for the Middle Fork of the Willamette River at the confluence with Deception Creek. Stream discharge means the volume of water flowing down the river and is typically measured in cubic feet of water per second (cfs). The flood elevation data are from the Flood Profile Graph 134P in Volume 3 of the FIS. Flood elevation data vary with location along the reach of the river and thus separate flood elevation data points must be read from the graph at each location along the river. The flood elevation data above are for the western boundary of the City of Westfir.

Quantitative flood hazard data, such as shown above, are very important for mitigation planning purposes because they allow quantitative determination of the frequency and severity (i.e., depth) of flooding for any building or other facility (e.g., road or water treatment plant) for which elevation data exist. For example, a building located in Westfir (Table 3.1 above), with a first floor elevation of 1020 feet is expected to flood once very 10 years, on average. 50-year, 100-year, and 500-year flood events would result in about 4 feet, 6 feet and 10-feet of water above the first floor, respectively. Thus, such a structure is demonstrably at extremely high flood risk.

Such quantitative flood hazard data also facilitate detailed economic analysis (benefit-cost analysis) of mitigation projects to reduce the level of flood risk for a particular building or other facility. Further details and examples of how such data are used are given in the Appendix (Mitigation Project Examples).

3.3.3 Interpreting Flood Hazard Data for Mapped Floodplains

The level of flood hazard (frequency and severity of flooding) is not determined simply by whether the footprint of a given structure is or is not within the 100-year floodplain. A common error is to assume that structures within the 100-year floodplain are at risk of flooding while structures outside of the 100-year floodplain are not. Some importance guidance for interpreting flood hazard is given below.

A. Being in the 100-year floodplain does not mean that floods happen once every 100 years. Rather, a 100-year flood simply means that the probability of a flood to the 100-year level or greater has a 1% chance of happening every year.

B. Much flooding happens outside of the mapped 100-year floodplain. First, the 100-year flood is by no means the worst possible flood. For example, for flooding along the Middle Fork of the Willamette River near Westfir, the 500-year flood is 4.2 feet higher than the 100-year flood (cf. data in Table 3.1 above). Thus, floods greater than the 100-year event will flood many areas outside of the mapped 100-year floodplain. Second, many flood prone areas flood because of local storm water drainage conditions. Such flood prone areas have nothing to do with the 100-year floodplain boundaries.

C. The key determinant of flood hazard and flood risk for a structure or other facility is the relationship of the elevation of the structure or facility to the flood elevations for various flood events. Thus, homes with first floor elevations below or near the 10-year flood elevation have drastically higher levels of flood hazard and risk than other homes in the same neighborhood with first floor elevations near the 50-year or 100-year flood elevation.

6.3.4 Caveats for Lane County Flood Insurance Study

The Flood Insurance Study (FIS) for Lane County is relatively recent (1999). Nevertheless, flood hazard data change with time as channels and watersheds evolve with increasing development and other changes. Overtime, the accuracy of an FIS typically diminishes and any FIS should be redone periodically to ensure that data are accurate and up to date for flood zoning and mitigation planning purposes.

Simply because an FIS is old, does not necessarily mean that a FIS is obsolete or inaccurate. However, the older a study is, the more likely it is that channel or watershed conditions have changed over time. Therefore, as time passes, care should be taken in interpreting and using data from the FIS, especially in reaches of rivers or streams where substantial channel changes are documented or flood control measures have been added.

3.4 Flood Hazards and Flood Risk: Outside of Mapped Floodplains

Section 3.3 above applies only to the limited portions of Lane County that are within the FEMA-mapped floodplains of the major rivers and portions of some of the smaller streams and sloughs. For mitigation planning purposes, it is very important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Many other portions of Lane County outside of the mapped floodplains are also at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

For example, in the Westfir area, there are numerous creeks too small to be mapped by FEMA, including: Dell Creek, Deception Creek, Chilly Creek, Spot Creek, Gray Creek, Stone Ridge Creek, McClane Creek and Buckhead Creek. In Lane County as a whole there are literally hundreds of such small creeks with unmapped floodplains.

Many areas of Lane County outside of mapped floodplains are subject to repetitive, damaging floods from local storm water drainage, separate from overbank flooding from creeks too small to be mapped. In many cases, local storm water drainage flooding simply occurs along unnamed gullies or simply in low spots. There are probably hundreds of such flood prone sites in Lane County; many of these sites have experienced repetitive flooding over many years. The following map shows about 60 sites identified by Lane County as having significant repetitive flood problems; most of these sites are road locations subject to flood-related road damage or closures.

Storm water drainage systems vary markedly within Lane County. In urban areas and some smaller communities, storm water drainage consists of drains and an underground pipe system. In lower population density areas, storm water drainage systems are generally open drainage ditches. In rural areas, storm water drainage systems are typically hit or miss, with culverts or other drainage infrastructure built only in limited locations with repetitive flooding episodes.

A complete inventory of Lane County's storm water drainage system is beyond the scope of this mitigation plan. Individual communities can provide information about their specific local drainage system. In general, however, storm water drainage systems, including those in Lane County, are almost always designed to handle only small to moderate size rainfall events. Storm water systems are sometimes designed to handle only 2-year or 5-year flood events, and are rarely designed to handle rainfall events greater than 10-year or 15-year events.

For local rainfall events that exceed the collection and conveyance capacities of the storm water drainage system, some level of flooding inevitably occurs. In many cases, local storm water drainage systems are designed to allow minor street flooding to carry off storm waters that exceed the capacity of the storm water drainage system. In larger rainfall events, flooding may extend beyond streets to include yards. In major rainfall events, local storm water drainage flooding can also flood buildings. In extreme cases, local storm water drainage flooding can sometimes result in several feet of water in buildings, with correspondingly high damage levels.

Storm Water Problem Locations in Lane County

Insert Map

Unlike FEMA-mapped floodplains for larger rivers and creeks, areas subject to storm water drainage are not systematically mapped. The approximately 60 sites with repetitive storm water drainage shown in the above map are predominantly sites subject to road damage and road closures. Although it is possible that repetitive storm water drainage flooding affects a few critical facilities in Lane County, no such sites have been identified at the present time.

3.5 Inventory Exposed to Flood Hazards in Lane County

3.5.1 Overview

As noted above, each of the rivers and streams for which there are mapped flood plains includes developed areas where streets and buildings are at risk for flood damages. There are also quite a few critical facilities with footprints within the mapped 100-year flood plains.

As shown on the community flood plain maps in the Appendix, all of the major cities in Lane County, including Eugene, Springfield, and Florence have significant areas located within the mapped floodplains. Of the smaller communities, those listed below in Table 3.2 have significant fractions of their total building stock within the 100-year floodplains. Communities not listed below all have some buildings within the 100-year flood plain, but lower fractions of total building stock than those listed in Table 3.2.

Table 3.2
Smaller Communities with Significant Fractions of Total Building Stock Within the 100-Year Floodplain

Blue River - Nimrod	Lower Mohawk - Camp Creek
Cheshire	Mapleton
Coburg	Marcola
Cottage Grove - Saginaw	McKenzie Bridge
Creswell	Mosby Creek - Row River
Culp Creek - Dorena	Noti
Deadwood	Pleasant Hill - Goshen
Dexter	Rainbow
Greenleaf	Triangle Lake
Jasper - Trent - Fall Creek	Vida
Junction City - Lancaster	Walton
Leaburg	Waterville
London	Westfir

These communities include incorporated cities, unincorporated communities and other areas with populations in mapped flood plains as shown on the community maps in the Appendix.

The community maps also include an inventory of critical facilities: 911 communication centers, hospitals and urgent care centers, schools, fire stations, jails and police stations, public water treatment or storage facilities, and wastewater treatment plants. Table 6-2 summarizes available data on such critical facilities located within mapped 100-year flood plains, or extremely close to the flood plain boundary. These data were compiled by LCOG and appear to be fairly complete, but are probably not 100% complete. Furthermore, there are additional critical facilities outside the 100-year flood plains, but still subject to flooding in flood events larger than the 100-year flood.

Table 3.3
Critical Facilities Within Mapped 100-Year Floodplains

Community	Schools	Fire	Water	Wastewater
Cottage Grove - Saginaw		1	1	1
Dexter		1		
Eugene	1	2		
Junction City - Lancaster				1
Lowell				1
Lower Mohawk - Camp Creek		2		
Mapleton		1		
Marcola		1		
Mosby Creek - Row River	1			
Springfield		2	1	1
Upper Long Tom - Alderwood		1		
Walterville		1		
Walton		1		
Westfir	1			

As shown above, there are 3 schools, 13 fire stations, 2 water facilities, and 4 wastewater treatment plants in Lane County within or extremely close to the FEMA-mapped 100-year flood plain boundaries. According to the LCOG inventory of critical facilities, there are no hospitals, police stations or jails, or 911 communications centers within mapped 100-year floodplains in Lane County.

To quantify the level of flood hazard for buildings, other facilities or infrastructure, within mapped floodplains, it is necessary to determine the elevations of these structures. Only by determining the elevation of each potentially flood-prone structure, can the level of flood hazard (frequency and severity of flooding) be calculated accurately. Similarly, acquiring elevation data for additional structures within the 500-year flood plain as well as for structures in other flood-prone areas outside of mapped floodplains would greatly increase the accuracy of hazard, inventory, and vulnerability assessments for floods in Lane County area. Compiling and interpreting such elevation data, especially for critical facilities is encouraged as a high priority action item.

The best structure elevations (first floor elevations) are those determined accurately by surveying. Flood insurance certificates generally include survey elevation data. Absent survey data, however, useful estimates of elevations for structures can often be made by reference to elevations of nearby structures or public infrastructure with surveyed elevation data.

In addition to elevation data, quantifying the level of risk faced by these structures requires basic data about each structure, including building data (square footage, number of stories, with or without basement), and information on the type and importance of function (residential, commercial, public).

As noted above, many localized areas of Lane County, outside of the mapped floodplains, are also subject to relatively high levels of flood risk (cf. the map of about 60 storm water problem locations which follows page 6-6 above). To quantify the level of flood risk posed by these areas, historical data should be systematically compiled to include documentation of the frequency and severity of flooding. Severity of flooding can include dollar estimates of past damages, if available, and/or simple narratives reporting whether the flooding in a given area is limited to minor street and yard flooding only, or whether flooding is severe enough to produce road damages, road closures, or damages to other infrastructure or buildings as well.

3.5.2 Flood Loss Estimates

For the FEMA-mapped floodplains, the digital FEMA maps (Q3) provide one basis to quantify the flood risk throughout Lane County, when combined with inventory data on buildings and infrastructure within the mapped floodplains. The following paragraphs present summary flood loss estimates from the modeling of flood risk in Lane County, from the Regional All Hazard Mitigation Master Plan for Benton, Lane, Lincoln, and Linn Counties (Phase One, 1998). See the Phase One Plan for further details of these calculations.

The FEMA Q3 digital flood maps for Lane County show the geographic areas within mapped floodplains for 100-year and 500-year flood events. The geographic extent of these mapped flood plains is tabulated below in Table 3.4.

Table 3.4
100-year and 500-year Floodplain Data for Lane County

County	Area (sq. km)	Area in 100-year floodplain (sq. km)	Percent in 100-year floodplain	Area in 500-year floodplain (sq. km)	Percent in 500-year floodplain
Lane	11,946	211	1.77%	230	1.93%

The data in Table 3.4 show that about 1.77% and 1.93% of the total geographic area of Lane County are located in the 100-year and 500-year floodplains, respectively. These data are for the entire county; separate data are not available for urban and rural areas. However, the percentages of land area within the mapped floodplains appear approximately similar for the larger cities and the smaller communities of Lane County.

Although the data in Table 3.4 are informative, what is really desired for planning purposes is the percentage of the built environment (buildings plus infrastructure) that are subject to flood hazards. That is, what is the level of flood risk? To assess the level of flood risk, the inventory of buildings and infrastructure must be overlain onto the mapped flood plains.

We conduct a Level One Risk Assessment on a countywide basis, using census tract data and other nationally available data sources as outlined in the Phase One Plan.

These default data sources generally contain data sorted by census tract and do not sort data as to whether or not the inventory is within the mapped floodplains. For this Level One Risk Assessment, we make the simple approximation that the fraction of buildings in a given census tract that are located within the mapped floodplain is the same as the percentage of roads in the census tract that are located within the mapped floodplain. This approximation appears reasonable, since the location of buildings is well correlated with the location of roads, albeit certainly not exact. With these assumptions, the estimated numbers of buildings in each county located within the 100-year and 500-year floodplain are as shown in Table 3.5. The 500-year floodplain data are inclusive of the 100-year data; the difference between the 500-year and 100-year data indicates the estimated number of buildings (2,545) outside of the 100-year floodplain, but within the 500-year floodplain.

Table 3.5
Estimated Number of Buildings in Mapped Floodplains
(assuming same percentages as roads in each census tract)

County	**Total Number of Buildings**	**Buildings in 100-year Floodplain**		**Buildings in 500-year Floodplain**	
		Percent	Number	Percent	Number
Lane	96,281	7.11%	6,845	9.75%	9,390

These rough estimates may somewhat overestimate the percentages of buildings located in the floodplains, for two reasons. First, there is probably some degree of risk aversion; that is, people are probably less likely to build buildings in the floodplains, than not, at least in recent decades. Second, many structures may have first floors elevated somewhat above grade level. Thus, although a structure’s footprint maps into the 100-year or 500-year floodplain, a 100-year or 500-year flood may not actually flood the structure itself. These caveats notwithstanding, the above estimates of the approximate numbers and percentages of buildings located within the mapped floodplains are at least a useful starting point for planning purposes.

With the above approximations, using Census data on the number, size, and function of buildings (residential, commercial, industrial, agriculture, public) and using default data on the breakdown of types of buildings, we then use FEMA depth-damage tabulations flood damages to estimate the vulnerability of the inventory as a function of flood depth.

To model flood risk accurately, it is necessary to have elevation data on structures. In the absence of such data on a regional basis, we make the following approximations:

1. For the major rivers, maximum flood depths for 100-year and 500-year flood events are assumed to be 5 and 7 feet, respectively. This assumption applies to about 80% of the flood-prone inventory.

2. For smaller rivers/streams in mountainous areas, maximum flood depths for 100-year and 500-year events are assumed to be 12 and 15 feet, respectively. This assumption applies to about 20% of the flood-prone inventory.

3. In each case we assumed that the flood-prone inventory is linearly distributed between the maximum flood depth and the minimum flood depth (0') at the edge of the 100-year or 500-year floodplain boundary.

With the above assumptions, we estimate the total flood losses to buildings and contents in 100-year and 500-year flood events. We recognize that it is highly unlikely that all flood-prone areas in an entire county will experience 100-year or 500-year events at the same time. Nevertheless, such estimates are useful as an upper bound on potential flood losses to buildings in major floods. These estimates are shown in Table 3.6

Table 3.6
Estimated Building Damages in Mapped Floodplains

County	100-year Flood	500-year Flood
Lane	$325,600,000	$434,200,000

The building damages shown above are based on a replacement value of $100/sf, which roughly considers both buildings and typical contents. As discussed above, these estimates probably overestimate flood losses. However, in addition to building damages within mapped floodplains, there will also be building damages outside of mapped floodplains. Furthermore, there will also be damages to infrastructure, not included in the tabulations above.

The loss estimates shown above are approximate and should not be interpreted literally, but rather as indications that flood damages in major floods in Lane County could reach into the hundreds of millions of dollars. That is, concurrent flooding of several major rivers with floods around the 100-year severity level could result in damages up to several hundred million dollars.

As noted earlier, the construction of major dams on most of the major rivers in Lane County has substantially reduced the level of flood risk for most communities in Lane County. Absent these dams, a recurrence of major floods experienced in the 19th century (e.g., 1861 or 1890) would likely result in damages in the billions of dollars (as opposed to hundreds of millions of dollars), with major portions of many cities and smaller communities under many feet of floodwaters.

Finally, these estimates of potential flood damages are for the FEMA-mapped floodplains only. Although the FEMA-mapped floodplains include much of the flood-prone inventory of buildings and infrastructure in Lane County, there are additional flood-prone areas outside of the mapped floodplains (cf. map of storm water drainage problem areas after page 6-6 above).

3.6 Estimating Flood Losses and Flood Risk

More accurate flood loss estimates for specific areas of Lane County can be made by obtaining more detailed inventory information, including elevations of flood prone structures. Then, the economic impacts of floods can be estimated more completely using the approaches outlined below.

For most residential structures and many similar commercial and public structures, the likely amount of building damage from floods of any given depth can be estimated approximately using FEMA depth-damage tables. These depth damage tables are derived from Federal Insurance Administration flood insurance claims data for several million properties and thus represent typical damage levels for typical structures. Although actual damages will vary somewhat from structure to structure, depending also on flood conditions such as duration, velocity, and degree of contamination, these typical values represent a good starting point to estimate flood damages for typical structures and thus to help quantify the level of flood risk. Current FEMA depth-damage data for typical structures are given in the Appendix – Example Mitigation Projects.

In estimating flood losses or evaluating flood risk (for a structure or a whole community) it is very important to recognize that the economic impact of floods includes not only damages to buildings and contents but other economic impacts as well, including:

1. damages to yards, vehicles, and outbuildings (not in depth damage data above),
2. displacement costs for temporary quarters while repairs are made,
3. loss of business income,
4. loss of public services.

In some cases, these economic impacts of floods can be a significant fraction of building and contents damages, or even larger, especially for critical facilities or critical infrastructure. FEMA's publication *What is a Benefit? Draft Guidance for Benefit-Cost Analysis* provides an excellent primer, along with typical values and simple economic methods, to place monetary values on the loss of function of buildings, critical facilities, roads and bridges, and utility systems.

3.7 Flood Insurance Data for Lane County.

The National Flood Insurance Program (NFIP) maintains a database of all flood insurance policies in the United States. NFIP data for Lane County are summarized below in Table 3.7. As shown below, there are over 3500 flood insurance policies in place in Lane County as a whole, with about two-thirds of these outside of the larger cities. Of these properties with current (as of 2003) flood insurance policies, 320 properties have had flood loss claims. Of these properties with flood loss claims, 24 are on FEMA's national repetitive loss list.

For reference, we note that the approximate calculations presented above in Table 3.5 estimated about 6,800 buildings with footprints within the 100-year floodplain. The number of flood insurance policies in Lane County is about 50% of this estimate. The lower number of policies most likely results from a combination of factors, including buildings not required to have flood insurance or not having insurance whether required or not as well as buildings whose footprint is in the 100-year flood plain but whose first floor elevation is above the 100-year flood elevation.

Table 3.7
NFIP Data for Lane County[2]

Jurisdiction	Policies	Claims	Repetitive Loss
Springfield	145	25	4
Lane County[1]	2127	261	19
Eugene	775	16	0
Coburg	31	3	1
Cottage Grove	80	10	0
Creswell	38	0	0
Florence	88	3	0
Junction City	225	1	0
Lowell	1	0	0
Oakridge	14	0	0
Veneta	8	1	0
West Fir	3	0	0
Lane County[2]	**3535**	**320**	**24**

[1] Lane County outside of listed cities
[2] Lane County (entire)

FEMA's repetitive loss list includes all insured properties that have experienced two or more insured losses of at least $1,000 for which the flood events were at least 10 days apart but not more than 10 years apart. The FEMA repetitive loss list provides one indication of properties that may be at high risk for future flooding. However, because these claims data do not consider the severity or frequency of the flood events causing the flood loss claims, the repetitive loss list is not mathematically rigorous. For example, some properties on the list may have simply been unlucky and have experienced two flood events with low probabilities (e.g., 100-year or greater events) within a short time period. Thus, the properties on the repetitive loss list may be at relatively high flood risk or they may not. Correspondingly, there are almost certainly other properties within Lane County at equal or higher levels of flood risk that are not on the FEMA repetitive loss list. These properties may not have flood insurance or simply may have been lucky over the relatively short reporting period for the NFIP repetitive loss list (data since 1978).

Despite these limitations of FEMA's repetitive loss list, properties within Lane County on the repetitive loss list may be good targets of opportunity for flood mitigation. Most of FEMA's mitigation programs list repetitive loss properties as high priorities for mitigation and thus obtaining FEMA funding for properties on the repetitive loss list may be more likely than for properties not on the list.

3.8 Summary of Flood Risk for Lane County

The flood hazard, vulnerability and risk data and analyses presented above are summarized in the following table.

Table 3.8
Summary of Flood Risk for Lane County

Question	Commentary
What is the source and type of the flood problem?	
a. overbank flooding from rivers and streams	Affects over 40 communities in Lane County as shown on community maps in Appendix
b. coastal storm surge communities	Affects Florence and other coastal communities
c. storm water drainage flooding	Affects many communities and roads, see Map following page 6-6
What is the geographic area affected by the flooding?	
a. FEMA-mapped floodplains	About 1.77% and 1.93% of Lane County is within the mapped 100-year and 500-year floodplains, respectively
b. areas outside of FEMA-mapped floodplains	Numerous locations affected by storm water drainage and flooding on smaller, unmapped streams; complete inventory of flood prone sites not yet available
What inventory of buildings and infrastructure are at risk?	
a. Buildings	About 7% and nearly 10% of buildings in Lane County have footprints within the 100-year and 500-year floodplains, respectively
b. Critical facilities	13 fire stations, 3 schools, 2 water facilities, and 4 wastewater treatment plants within 100-year floodplain, based on LCOG inventory data
b. Roads and other infrastructure	Percentage of flood prone road mileage is somewhat higher than for buildings because of roads outside of mapped-floodplains subject to frequent flooding
How frequent is the flooding problem?	
a. roads	Road closures and road damages almost every year
b. buildings	Relatively few buildings appear to be at extremely high flood risk (10-year floodplain or lower), but many buildings are at risk from flooding in larger less frequent flood events
How serious is the flooding problem?	
a. frequent flooding (annual or every few years)	Very frequent flooding appears to impact primarily roads and relatively few buildings and other facilities
b major floods (25-year, 50-year, 100-year etc. events)	Increasingly major floods affect increasingly large fractions of the population, building stock and infrastructure of Lane County. A widespread 100-year flood event could result in several hundred million dollars of damages and directly affect several thousand buildings and over ten thousand people.

3.9 Common Flood Mitigation Projects

Potential mitigation projects to reduce the potential for future flood losses cover a wide range of possibilities.

For either major rivers or the creeks, it would be theoretically possible to reduce future flood losses by building levees or floodwalls. In practice, however, such projects are often very expensive and have a host of environmental and other regulatory hurdles.

For the smaller creeks, channel improvements to improve water conveyance capacity and removal of flow-restriction obstructions may be desirable. Another possibility for some of the smaller creeks would be to construct detention ponds upstream to temporarily store water during high rainfall periods. Detention ponds are basically leaky dams, designed to be dry during normal conditions. Detention ponds typically have restricted outlets with controlled flow rates. Thus, during periods of high inflow into the pond, water is stored temporarily and then gradually released. The effect of detention ponds is to lower peak discharge values and thus to lower peak flood elevations.

For areas of Lane County subject to flooding from storm water drainage, various storm water drainage system improvements may be desirable. Typical improvements include upgrades to the size of drainage ditches or storm water drainage pipes and upgrades to pumping capacity (for pumped portions of drainage systems). Another possibility for some areas may be construction of local detention ponds.

For critical facilities at low elevations with high flood risk, such as the water and wastewater treatment plants, construction of berms or floodwalls to protect the facilities may be desirable.

For residential, commercial or public facilities at high flood risk, elevation of structures or, for structures at very high flood risk, acquisition and demolition are potential mitigation options. Elevation and acquisition (especially) are expensive mitigation options that are generally not cost-effective unless the levels of flood hazard and flood risk are rather high. That is, these mitigation options are most attractive for structures deep in the flood plain (i.e., with first floors below the 10-, or 20-, or 30-year flood elevations). For structures outside of mapped floodplains, elevation or acquisition would likely be cost-effective only for structures with a strong history of major, repetitive flood losses.

For structures near the fringe of the 100-year flood plain, near the 100-year flood level, or with some history of repetitive flood losses, various small-scale flood loss reduction measures such as elevation of furnaces and utilities may be desirable.

The following table contains flood mitigation action items from the master Action Item table in Chapter 4.

Table 3.6
Flood Mitigation Action Items

Hazard	Action Item	Coordinating Organizations	Timeline	Ideas	Plan Goals Addressed: Public Awareness	Life Safety	Protect Property Minimize Losses	Partnerships & Implementation	Emergency Services	Protect Environment
Flood Mitigation Action Items: Within FEMA-Mapped Floodplains										
Short-Term #1	Compile data and prepare GIS maps for structures within the 100-year floodplains.		Ongong	pg. 4-2 pg. 6-11	X		X	X		
Short-Term #2	Consult with property owners and explore mitigation actions for the 24 Lane County properties on FEMA's national repetitive loss list		1 year	pg. 4-2 pg. 6-11						
Long-Term #1	Survey elevation data for structures within the 100-year floodplain		1-2 Years	pg. 4-2 pg. 6-11	X					
Long-Term #2	For structures within the 100-year floodplain and especially for structures deep in the floodplain, explore mitigation options with property owners		1-2 Years	pg. 4-2 pg. 6-11	X	X	X	X		X
Flood Mitigation Action Items: Outside of FEMA-Mapped Floodplains										
Short-Term #1	Complete the inventory of locations in Lane County subject to frequent storm water flooding		Ongoing	pg. 4-3 pg. 6-11	X					
Long-Term #1	For locations with repetive flooding and significant damages or road closures, determine and implement mtigation measures such as upsizing culverts or storm water drainage ditches		Ongoing	pg. 4-3 pg. 6-11	X	X	X	X		X