Chapter 4. Natural Hazards Assessment

Chapter 4 presents hazard profiles for the Coeur d'Alene Reservation as developed from the Phase I Hazard Profile completed by the Planning Committee in 2010, plus additional items identified during the planning process. Historical hazards experienced in this region are presented, including State and Presidential Hazard Declarations in the area. The extent and location of each hazard's profile is discussed. The overview of this Chapter includes:

During the first four Coeur d'Alene Reservation Tribal Hazards Mitigation Plan Committee meetings, the attendees participated in a scoping exercise to subjectively place all relevant hazards into a matrix used to compare various hazard-importance levels, based on the potential for the hazard to occur, and its capacity to negatively affect people, structures, infrastructure, environment, the economy, and the traditional way of life on the Coeur d'Alene Reservation. This exercise helped to spark discussions about relative risks and the types of impacts commonly experienced. Resources for this discussion included the tabular risk-analysis data presented in Table 21 and Table 22, augmented with the extensive personal experiences of the combined Planning Committee membership.

For the purposes of the Planning Committee discussion while creating the data found within Table 18, the relative categories of Low, Medium, and High were considered as follows:

- Probability of Occurrence
  - Low – historically, the listed hazard has been observed with a frequency of one or fewer notable events within a ten-year period. This category also includes infrequent hazard events that may occur only once a century.
  - Medium – the occurrence of the listed hazard has been observed more frequently than once in a ten year period, but less frequently than twice every five year period, on average.
  - High – the listed hazard has occurred more than twice every five years, and includes annual event hazards, and even multiple times per-year hazards. To be considered for this ranking, the hazard does not necessarily occur every year, but when considered over a five-year period, the hazard is witnessed three or more times per five-year period.
- Potential to Impact People, Structures, Infrastructure, the Economy, and Traditional Way of Life
  - Low – the occurrence of the listed hazard has low potential to negatively impact the listed resources based on the exposure to developments and population centers, coupled with considerations for available resources to respond to these

threats. The risk exposure potentially impacts no lives and less than 25 structures when it is witnessed.

- Medium – the occurrence of the listed hazard has moderate potential to negatively impact the listed resources based on the exposure to developments and population centers, coupled with considerations for available resources to respond to these threats. The risk exposure potentially impacts fewer than 5 lives or less than 50 structures when it is witnessed.
- High – the occurrence of the listed hazard has high potential to negatively impact the listed resources based on the exposure to developments and population centers, coupled with considerations for available resources to respond to these threats. The risk exposure potentially impacts more than 5 lives or more than 50 structures with each occurrence.

The findings of the Planning Committee are summarized in Table 18.

Table 18. Phase I Hazard Assessment of Coeur d'Alene Reservation.

Probability of Occurrence	Low	Medium	High
High		Storm Water	Wildland Fire Wind Storms Severe Winter Weather
Medium	Landslides	Expansive Soils	Flood
Low		Earthquake / Seismic Shaking	
	Potential to Impact People, Structures, Infrastructure, the Economy, and Traditional Way of Life		

These data presented the basis for evaluation in the Coeur d'Alene Reservation Tribal Hazards Mitigation Plan with the determination that the hazards to be considered in this effort include:

1. Flood & Storm Water Drainage
2. Wildland Fire
3. Earthquakes & Seismic Shaking Hazards
4. Landslides
5. Expansive Soils
6. Severe Winter Weather & Wind Storms

The planning committee widely recognized the existence of additional potential risks, but felt that the inclusion of additional hazards could not be justified in terms of the magnitude of these listed natural hazards.

Additional discussions during these meetings and during subsequent considerations between Planning Committee members included attention given to:

1. Past mining contamination within the Silver Valley situated within the Coeur d'Alene River watershed extending east of the current borders of the Coeur d'Alene Reservation, but within the ancestral lands of the Coeur d'Alene Tribe, causing catastrophic contamination to Coeur d'Alene Lake,
2. Potential for Hazardous Materials spills along US95, and in commercial locations,
3. Civil Unrest and Terrorism incidents,

4. Mass Epidemics (human health),

These additional potential disasters (numbered 1-4, above) are not considered natural disasters and will not be directly addressed in this plan. However, there is a need for the Coeur d'Alene Tribe to address these other potential events, and it is recommended that once the infrastructure of this "natural disasters" Tribal Hazards Mitigation Plan is established, the Coeur d'Alene Tribe will initiate the needed planning and adoption of appropriate measures detailed in an appropriate planning document. The Coeur d'Alene Tribe has been intimately involved in the assessment and remediation effort of contamination in Coeur d'Alene Lake and along the Coeur d'Alene River where mining activities caused the contamination.

A summary of the hazards addressed by the State of Idaho Hazard Mitigation Plan (2007), past state or federal disaster declarations for the two counties where the Coeur d'Alene Reservation is located, and inclusion within this planning document are summarized in Table 19.

Table 19. Hazard Screening for the Coeur d'Alene Reservation.

Hazard Type	Hazard Identified in State HMP (2007)	Past State or Presidential Disaster Declaration	Hazard Profiled in this Plan
Avalanche	Yes	No	No
Coastal Erosion	No	No	No
Dam Failure	Yes	No	No
Drought	Yes	No	No
Expansive Soils & Clays	No	No	Yes
Flood	Yes	Yes	Yes
Hailstorm	Yes	No	Yes
Heat	Yes	No	Yes
Hurricane / Cyclone	No	No	No
Land Subsidence	No	No	No
Landslide	Yes	Yes	Yes
Seismic Shaking Hazards	Yes	No	Yes
Snow/Ice	Yes	Yes	Yes
Tornado	Yes	No	Yes
Volcano	Yes	Yes	No
Tsunami	No	No	No
Wildfire	Yes	Yes	Yes
Wind	Yes	No	Yes
Civil Unrest	No	No	No
Terrorism	No	No	No

Further correlation of the natural hazards profile addressed in this Tribal Hazards Mitigation Plan are listed in Table 20 and verify the assessments completed here in the determination of these potential events. The columns of 'N' and 'S' are used by State and FEMA reviewers of the Tribal Hazards Mitigation Plan to determine "Needs Improvement", or 'Satisfactory'. All components are required to achieve a rating of 'S' (satisfactory) for the plan to be approved.

Table 20. Hazard Profile Format Suggested by FEMA (March 2010), Optional.

Hazard Type	Hazards Identified Per Requirement 201.7(c)(2)(i)		A. Location		B. Extent		C. Previous Occurrences		D. Probability of Future Events	
	Not a Hazard	Yes	N	S	N	S	N	S	N	S
Avalanche	×									
Coastal Erosion	×									
Coastal Storm	×									

Table 20. Hazard Profile Format Suggested by FEMA (March 2010), Optional.										
Hazard Type	**Hazards Identified Per Requirement 201.7(c)(2)(i)**		**A. Location**		**B. Extent**		**C. Previous Occurrences**		**D. Probability of Future Events**	
	Not a Hazard	Yes	N	S	N	S	N	S	N	S
Dam Failure	×									
Drought	×									
Earthquake		×		×		×		×		×
Expansive Soils		×		×		×		×		×
Extreme Heat		×		×		×		×		×
Flood		×		×		×		×		×
Hailstorm		×		×		×		×		×
Hurricane	×									
Land Subsidence	×									
Landslide		×		×		×		×		×
Severe Winter Storm		×		×		×		×		×
Tornado		×		×		×		×		×
Tsunami	×									
Volcano	×									
Wildfire		×		×		×		×		×
Windstorm		×		×		×		×		×

Legend: 201.7(c)(2)(i) Profiling Hazards
A. Does the risk assessment identify the location (i.e., geographic area affected) of each hazard addressed in the new or updated plan?
B. Does the risk assessment identify the extent (i.e., magnitude or severity) of each hazard addressed in the new or updated plan?
C. Does the plan provide information on previous occurrences of each natural hazard addressed in the new or updated plan?
D. Does the plan include the probability of future events (i.e., chance of occurrence) for each hazard addressed in the new or updated plan?

4.1. History of Past Natural Disasters

4.1.1. Major Presidential Disaster Declarations within and Adjacent to the Coeur d'Alene Reservation

When an emergency incident exceeds the capability of the jurisdiction to adequately respond it requires assistance by the federal government. The State's Governor can request the US President to make a major disaster declaration. While only a state Governor, or his representative, can create a state declaration of emergency or disaster to the US President, the Tribal Chairman can make a disaster or emergency declaration for the Reservation and forward that to FEMA when a formal relationship between the Tribe and FEMA exists. The Coeur d'Alene Tribe Emergency Operations Plan (2010) provides the mechanism for the Tribe to make declarations of this nature.

The Code of Federal Regulations has defined a major disaster as:

> "Any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the U.S., which in the determination of the President, causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby" (GPO 2007).

Table 21. Major Disaster Declarations that Included the Extent of the Coeur d'Alene Reservation (FEMA 2010).

Year	Time Period	Event	Disaster Number	Extent
2009	January (Benewah County) March (IBHS & FEMA)	Ice jam flooding	M1825	St. Joe River in Shoshone and **Benewah County** (BCEMD 2009). Severe Winter Storm and Record and Near Record Snow (FEMA 2009).
2009	January – March	Heavy snow loads		During January to March 2009, heavy snow loads were observed across most of **North Idaho**, including Benewah County and Kootenai County. Several structures were destroyed by the "wet snow" pack that accumulated up to 2 feet of snow on roofs. No reports of life lost were made.
2008	May	Flooding	1781	North Idaho's flood emergency declaration included **Kootenai** and Shoshone Counties, and listed **Benewah**, Clearwater, Idaho, Bonner, and Boundary Counties, Idaho (FEMA 2009). State Disaster Declaration ID-02-2008.
2006	July	Hail		During the morning of June 13 a severe thunderstorm tracked out of southeast Washington into north Idaho. A hail storm causing local disruption and damage in **St. Maries**, 4 Miles southeast of Santa, and 6 Miles northwest of **Tensed**, in **Benewah County,** were reported (NOAA 2009).
2006	May	Hail, high winds		Scattered thunderstorms led to severe weather over portions of north central Idaho. These storms began to produce severe weather at **St. Maries** where penny sized hail was observed with wind gusts of 40-50 MPH. As the storms moved north, more severe weather occurred in the form of strong wind gusts (NOAA 2009).
1999	February	Flood		FEMA press release (HQ-99-053) announces that in **Benewah County** a dike is being compromised by rising water, posing a threat to houses in the area (FEMA 2009). Heavy rain caused **Hangman Creek** to flood in the **City of Tensed** and the Tribal community of DeSmet (NOAA 2009).
1998	August	Wildfire		Lightning sparked 25 small fires within the **St. Joe Watershed**, each ranging 1-5 acres in size (NOAA 2009).
1998	July	Thunderstorm, high winds		In the area of **St. Maries**, numerous trees were downed along the **St. Joe River**. A tree fell on a pickup truck. High winds forced cars off the road into a sewer pond (NOAA 2009).
1998	July	Hail		One inch diameter hail fell in the areas within, and west of and adjacent to the Coeur d'Alene Reservation causing local damages (NOAA 2009).
1998	July	Wildfire		A 2 acre wildfire threatened the **St. Maries High School** (NOAA 2009, BCEMD 2009).
1997	Spring	Flooding		Spring flooding in Southeastern and **Northern counties** (IBHS 2009).
1997	May 31	Thunderstorm, high winds		Along the **St. Joe River**, high winds and a thunderstorm blew down trees and ripped roofing materials loose in the area of **St. Maries** (BCEMD 2009, NOAA 2009).

Table 21. Major Disaster Declarations that Included the Extent of the Coeur d'Alene Reservation (FEMA 2010).

Year	Time Period	Event	Disaster Number	Extent
1997	March 6	Landslide		Landslides in various locations in Northern Idaho (**Benewah**, Bonner, Boundary, **Kootenai**, Shoshone), (BCEMD 2009, IBHS 2009)
1997	March 20	Flooding	1177	Rain showers led to flooding in **North Idaho counties** (FEMA 2009, IBHS 2009).
1996-97	November – January	Landslide		Landslides in various locations in Northern Idaho Counties - Adams, **Benewah**, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, **Kootenai**, Latah, Nez Perce, Owyhee, Payette, Shoshone, Valley, Washington (IBHS 2009)
1996-97	Winter	Winter storm	1154	Heavy snow, landslides, and floods from winter storms. **North Idaho** (FEMA 2009).
1996	February	Winter storm	1102	Counties – **Benewah**, Bonner, Boundary, Clearwater, Idaho, **Kootenai**, Latah, Lewis, Nez Perce, Shoshone (FEMA 2009).
1996	Spring	Flooding		Flooding throughout **Northern Idaho** (IBHS 2009)
1996	February	Severe storm		The worst flooding in 30 years forced thousands to flee. "*One week deep freeze, the next deep water*". The deluge was triggered from fast-melting snow and days of heavy rains. Approximately $5 million worth of damage occurred to highways from Bonners Ferry to Grangeville. **North Idaho was declared a state disaster area.** The town of **St. Maries** was flooded. Approximately $7 million damage to roads occurred because of this storm (IBHS 2009). Several roads were closed due to flooding from the **St. Joe River**. Some fields were closed as well. Highway 3 was closed in the **St Maries and Santa** areas due to water on the road. Approximately 400 people were evacuated when the **St. Maries and St. Joe Rivers** reached record levels. Nearly 200 buildings were damaged. A total damage estimate was $18 million (IBHS 2009).
1995	November - December	Flooding		Significant flooding occurred during the last week of November though the first week of December in 1995, impacting homes along all major river drainages in **Kootenai County and Benewah County**, especially along the **St. Joe River** (NOAA 2009).
1995	December 12	High winds		High winds cut across the western side of **Benewah County** to cause trees to blow down and roofing materials to be torn off with losses in the Sanders area estimated at $50,000 (NOAA 2009).
1995	December 3	High winds		High winds were reported in **St. Maries** causing trees to blow down causing approximately $5,000 in damages (NOAA 2009).
1992	June 11	Thunderstorm, high winds		Thunderstorms were reported in **Kootenai County and Benewah County** causing local damages (NOAA 2009).
1989	August 12	Thunderstorm, high winds		Thunderstorms were reported in **Kootenai County** and **Benewah County** causing local damages (NOAA 2009).
1984	February	Ice jams, flooding	697	Ice Jam flooding along the **St. Joe River** (FEMA 2009, BCEMD 2009).

Table 21. Major Disaster Declarations that Included the Extent of the Coeur d'Alene Reservation (FEMA 2010).

Year	Time Period	Event	Disaster Number	Extent
1983	November 18	Earthquake	694	Borah Peak earthquake (M7.3) centered in central Idaho with shocks felt in **Kootenai County and Benewah County** (FEMA 2009).
1982	February 15	Flooding		A warm, damp weekend weather system caused spotty erosion in farm fields and converted **north central Idaho**'s deep snow pack into a serious flood hazard. **St. Maries Creek**, a tributary of **St. Maries River**, flooded the logging communities between **Bovill and Fernwood**. Many buildings had up to 10 inches of water in them. A mudslide occurred near Orofino due to the large amounts of rain (NOAA 2009, IBHS 2009).
1981	Fall	Algae bloom		An explosion of blue-green algae in **Black Lake (within the Coeur d'Alene watershed)** occurred after unusually warm days. While it often is present in small amounts, this year it was in much larger quantities, later in the year than normal, and did not occur in other lakes in the area. Nine head of cattle and two dogs died from blue-green algae poising in Black Lake. Hunting, fishing, and swimming were advised against in the lake (IBHS 2009).
1980	May 18 Eruption May 19 Fallout	Volcanic eruption	624	Mount St. Helens erupted from Washington spewing volcanic ash over several states. Ash fallout covered cities and contaminated drinking water. The fallout prompted Governor Evans to declare a state of emergency. The **counties in the panhandle** received from 1 inch to 3-inches of an ash blanket. Costs for increased unemployment, destruction of vehicles and other equipment, damage to crops, livestock and timber, and lost tax revenues were about $13.7 million. This does not include loss to residents, local businesses and government (FEMA 2009).
1977	May 5	Drought	3040	Situation of widespread drought was declared by Idaho's Governor and the US President for **all of Idaho**. Although Southern Idaho was the hardest hit with this drought, all of the Idaho Panhandle was impacted by changing climate patterns and increased droughty conditions.
1975	July 6	Thunderstorm, high winds		Thunderstorms were reported in **Kootenai County and Benewah County** causing local damages (NOAA 2009).
1974	January	Floods		Flood waters isolated much of the **Coeur d'Alene mining district**. The waters burst dams, blocked major roadways and forced evacuation of at least 1,000 persons. About $65 million in damages. Shoshone and **Benewah Counties** were the hardest hit. $9.5 million in damage to road systems. $51.4 million in damage to private property. Governor Andrus declared the counties as disaster areas. More than 30 bridges were destroyed in 3 counties. Total damages for the region were estimated at $116 million. **St. Joe River** rampaged through **St. Maries**, Idaho. Parts of St. Maries were buried under 2½ feet of mud. Idaho National Guard was dispatched to St. Maries. At least 50 homes were destroyed from the St. Joe River (IBHS 2009).

Table 21. Major Disaster Declarations that Included the Extent of the Coeur d'Alene Reservation (FEMA 2010).

Year	Time Period	Event	Disaster Number	Extent
1964	December 21-23	Flooding	186	During the end of December 1964, warm weather combined with heavy rains and melting snow, causing flooding along the Payette, Big Wood, Little Wood, Portneuf, Clearwater and Boise River drainages. Hwy 21 and 15, US 95N and 30E were closed. Over 100 homes were damaged, numerous bridges were washed out, and thousands of acres of farmlands were flooded. Two deaths were attributed to the flood. A state of emergency was declared. The **Benewah-Shoshone-Kootenai County** area was the hardest hit in northern Idaho. Communities were isolated by small mountain streams that had become torrents (FEMA 2009).
1964	July 8	Thunderstorm, high winds		Thunderstorms were reported in **Benewah County** causing local damages (NOAA 2009).
1963	February 14	Flooding	143	Cold weather created ice jams and cloudbursts created flooding throughout several counties in the Panhandle including **Benewah County and Kootenai County**. President Kennedy authorized $250,000 in flood relief loans. Approximately $4.7 million in damage was caused throughout the state this year. Ice jam was about 2 miles in length from Lost Creek to Jupiter Creek. A giant ice jam occurred on the **St. Joe River** that threatened residents near **St. Maries** (FEMA 2009).
1948	May 23-June 5	Flood emergency declared		**Benewah County:** The 1948 flood was caused by abnormal snowmelt augmented by rainstorms in the latter part of May and in June. The floods caused contamination of the water system, which left residents without drinking water. Over $3.7 million damage to roads and highways and $30 million damage to crops (IBHS 2009, BCEMD 2009).
1938	April 18	Flooding		Heavy rains lead to flooding of **Benewah County**. The **St. Joe River** flooded **St. Maries**, and sustained approximately $100,000 in damage (IBHS 2009, BCEMD 2009).
1934	March 27-29	Flooding		Heavy rains lead to flooding in all of **North Idaho** (NOAA 2009).
1933	December 21-23	Flooding		A sudden thaw in December accompanied by heavy rains (over 20 inches in 23 days) caused landslides and flooding. **Coeur d'Alene Lake** reached an all time high level. The **South Fork of the Coeur d'Alene River and the St. Joe River** went over their banks. Thousands of people fled their homes and 11 were reported dead. Coeur d'Alene Lake reached 100-year flood levels. Nearly $1.5 million in property damage was reported in the St. Maries area alone. **Benewah County** reported over $4.2 million in damages (FEMA 2009).
1910**	August 21-22	Wildfire		In a brief 48-hour span, fires carried by hurricane-force winds burned more than 3 million acres, killed over 300 persons and destroyed between 7 and 8 billion board-feet of timber. The winds, which gave **The Big Blowup** its horror, came up from the southwest in the Nez Perce National Forest near Elk City. The government paid $5.4 million in claims of fire-related injuries alone. This $25.4 million in 1910 losses would equate to approximately $697 million in 2008 dollars.

4.1.2. SHELDUS Hazard Event Profile

SHELDUS (University of South Carolina 2009) is a county-level hazard data set for the U.S. for 18 different natural hazard event types such as thunderstorms, hurricanes, floods, wildfires, tsunami, and high winds maintained by the Hazards & Vulnerability Research Institute at the University of South Carolina. For each event the database includes the beginning date, location (county and state), property losses, crop losses, injuries, and fatalities that were attributed to each county. SHELDUS Hazard Profile for Benewah County and Kootenai County, Idaho, 1960-2008 have been combined into a summary of natural disasters that either resulted in damages on the Coeur d'Alene Reservation, or adjacent to the Coeur d'Alene Reservation. The damages summarized in Table 22 do not represent damages just on the Coeur d'Alene Reservation. This summary is inclusive of the listed disasters in their effect across the region. Some of these events were also reported in Table 21. At this time, there is not a comprehensive disaster summary database created for Indian Reservations in the USA. Summaries (Table 21 and Table 22) are intended to represent the natural disasters that have generally impacted the region of the Coeur d'Alene Reservation.

Table 22. SHELDUS Hazard Profile for Coeur d'Alene Reservation and Adjacent Counties in Idaho (University of South Carolina 2009).

Begin Date	End Date	Hazard Type	Remarks	Injuries	Fatalities	Property Damage	Crop Damage	Property Damage 2008
9/3/1960	9/4/1960	Lightning, Wind	WINDSTORM AND LIGHTNING	0.05	0	$1,136.36	$ -	$8,441.24
1/1/1961	1/3/1961	Winter Weather	Rime Ice	0	0	$1,000.00	$ -	$7,428.32
4/12/1961	4/13/1961	Wind	Wind	0.07	0	$ 113.64	$ -	$ 844.15
7/23/1961	7/23/1961	Lightning	Lightning	0	0	$5,000.00	$ -	$ 37,141.58
12/17/1961	12/19/1961	Winter Weather	HEAVY SNOW	1	0	$5,000.00	$ -	$ 37,141.58
4/6/1962	4/7/1962	Wind	Wind	0	0	$ 111.11	$ -	$ 770.37
4/19/1962	4/20/1962	Wind	WIND AND DUST	0.39	0	$ 113.64	$113.64	$ 787.91
11/19/1962	11/20/1962	Wind	Wind	0	0	$10,000.00	$ -	$ 69,333.70
12/16/1962	12/21/1962	Fog, Winter Weather	Fog, rime ice	0.16	0	$-	$ -	$-
1/1/1963	1/31/1963	Winter Weather	Snow and Ice	0.44	0	$-	$ -	$-
4/14/1963	4/14/1963	Wind	Wind	0.04	0	$ 111.11	$ -	$ 770.37
12/1/1963	12/31/1963	Fog, Winter Weather	Snow, ice and fog	0.27	0	$ 111.11	$ -	$ 770.37
1/1/1964	1/31/1964	Wind, Winter Weather	Snow, wind	0.22	0	$ 111.11	$ -	$ 770.37
2/15/1964	2/15/1964	Winter Weather	Snow and ice	2	0	$-	$ -	$-
3/11/1964	3/13/1964	Wind, Winter Weather	Snow and wind	0.16	0	$-	$ -	$-
8/30/1964	8/30/1964	Lightning	Lightning	0	0	$5,000.00	$ -	$ 34,666.85
12/20/1964	12/24/1964	Severe Storm, Thunder Storm, Wind, Winter Weather	Snow, rain, and wind	0	0	$ 111,111.11	$ -	$ 770,374.47
7/8/1965	7/8/1965	Hail, Severe Storm, Thunder Storm,	HAIL, RAIN	0	0	$-	$ 1,136.36	$-
7/26/1965	7/26/1965	Lightning, Wind	Wind, lightning	0	0	$ 111.11	$ -	$ 770.37
8/2/1965	8/2/1965	Hail, Severe Storm, Thunder Storm,	Hail, wind and rain	0	0	$ 111.11	$111.11	$ 770.37
8/19/1965	8/19/1965	Severe Storm, Thunder Storm, Wind,	Thunderstorm, wind, and rain	0	0.5	$ 250.00	$ -	$1,733.34
8/21/1965	8/21/1965	Hail, Wind	Hail and wind	1	0	$ 50.00	$ 5,000.00	$ 346.67
8/25/1966	8/26/1966	Wind	Wind	0	0	$ 111.11	$111.11	$ 722.20
8/26/1967	8/26/1967	Wildfire	Wildfire	0	0	$2,255,454.54	$ -	$14,660,088.01
7/19/1968	7/20/1968	Wind	Wind	0	0	$1,136.36	$113.64	$6,951.91
8/10/1968	8/23/1968	Severe Storm, Thunder Storm	Rain	0	0	$-	$11,363.64	$-
1/6/1969	1/7/1969	Winter Weather	SNOW STORM	0	0	$11,627.91	$ -	$ 67,182.29
1/26/1969	1/26/1969	Winter Weather	SNOW STORM	0	0	$11,627.91	$ -	$ 67,182.29
3/22/1969	3/23/1969	Wind	Wind	0	0	$ 111.11	$ -	$ 641.96

Table 22. SHELDUS Hazard Profile for Coeur d'Alene Reservation and Adjacent Counties in Idaho (University of South Carolina 2009).

Begin Date	End Date	Hazard Type	Remarks	Injuries	Fatalities	Property Damage	Crop Damage	Property Damage 2008
7/16/1970	7/16/1970	Hail, Lightning, Wind,	HAIL, LIGHTNING, WIND	0	0	$ 277.78	$27,777.78	$1,520.50
7/27/1970	7/27/1970	Wind	Wind	0	0	$5,000.00	$ -	$ 27,368.77
12/4/1970	12/5/1970	Winter Weather	Snowstorm	0	0	$ 50.00	$ -	$ 273.69
1/21/1971	1/21/1971	Wind	Windstorm	0	0	$1,000.00	$ -	$5,199.94
3/26/1971	3/26/1971	Wind	STRONG WIND	1	1	$50,000.00	$ -	$ 259,996.88
8/2/1971	8/2/1971	Severe Storm, Thunder Storm	Thunderstorm	0	0	$ 50.00	$5.00	$ 260.00
10/27/1971	10/27/1971	Winter Weather	Snow	0.07	0	$ 17.86	$ -	$ 92.87
12/8/1971	12/9/1971	Winter Weather	Snow	0	0	$ 50.00	$ -	$ 260.00
1/9/1972	1/12/1972	Wind, Winter Weather	WIND AND SNOW	0.07	0	$ 113,636.36	$ -	$ 590,901.98
1/23/1972	1/23/1972	Wind, Winter Weather	Wind, Snow	0	0.05	$ 227.27	$ -	$1,181.79
2/29/1972	2/29/1972	Wind	Wind	0	0	$ 555.56	$ -	$2,888.88
7/6/1972	7/6/1972	Lightning	Lightning	0	0	$ 500.00	$ -	$2,599.97
7/18/1972	7/18/1972	Lightning, Wind	Lightning, wind	0	0	$ 555.56	$ -	$2,888.88
8/9/1972	8/9/1972	Lightning, Wind	Wind, lightning	0	0	$ 166.67	$ -	$ 866.67
8/14/1972	8/15/1972	Severe Storm, Thunder Storm, Wind,	Thunderstorm, wind	0	0	$ 555.56	$ -	$2,888.88
12/6/1972	12/8/1972	Winter Weather	Freeze	0	0	$ 111.11	$ -	$ 577.77
6/22/1973	6/23/1973	Lightning, Wind	Wind, lightning	0	0	$ 161.29	$ -	$ 798.78
8/13/1973	8/25/1973	Lightning, Wind	Dry Lightning, Wind	0	0	$-	$111.11	$-
11/1/1973	11/30/1973	Severe Storm, Thunder Storm, Wind, Winter Weather	Snow, Rain, Wind	0.02	0	$ 111.11	$ -	$ 550.27
1/14/1974	1/18/1974	Severe Storm, Thunder Storm, Wind,	WIND/RAIN	0	0	$3,571,428.57	$ -	$15,476,138.88
9/29/1974	9/29/1974	Wind	Wind	0.13	0	$ 625.00	$ -	$2,708.32
1/7/1975	1/10/1975	Severe Storm, Thunder Storm, Winter Weather,	Heavy Rain, Snow	0	0.02	$1,136.36	$ -	$4,545.44
2/4/1975	2/6/1975	Wind, Winter Weather	wind, heavy snow	0	0	$ 111.11	$ -	$ 444.44
2/9/1975	2/13/1975	Winter Weather	heavy snow	0	0	$ 113.64	$ -	$ 454.56
6/2/1975	6/2/1975	Hail, Lightning, Severe Storm, Wind	Electrical storm, wind, rain, hail	0	0	$ 111.11	$11.11	$ 444.44
6/23/1975	6/23/1975	Hail, Lightning, Severe Storm, Wind	Electrical storm, wind, rain, hail	0	0	$ 111.11	$11.11	$ 444.44
7/6/1975	7/6/1975	Lightning, Wind	Lightning, wind	0.07	0	$ 357.14	$ -	$1,428.56

Table 22. SHELDUS Hazard Profile for Coeur d'Alene Reservation and Adjacent Counties in Idaho (University of South Carolina 2009).

Begin Date	End Date	Hazard Type	Remarks	Injuries	Fatalities	Property Damage	Crop Damage	Property Damage 2008
7/14/1975	7/14/1975	Hail, Lightning, Severe Storm, Wind	hail, wind, rain, lightning	0	0	$ 11.36	$113.64	$ 45.44
11/10/1975	11/10/1975	Wind, Winter Weather	Wind, SNOW	0	0	$1,136.36	$ -	$4,545.44
11/26/1975	11/27/1975	Winter Weather	Snowstorm	0	0	$ 11.36	$ -	$ 45.44
11/30/1975	11/30/1975	Winter Weather	Snowstorm	0	0	$ 113.64	$ -	$ 454.56
12/2/1975	12/2/1975	Wind	Wind	0	0	$ 500.00	$ -	$2,000.00
2/16/1976	2/17/1976	Wind, Winter Weather	Snow and Wind	0	0	$1,136.36	$ -	$4,377.01
5/10/1976	5/10/1976	Lightning, Severe Storm, Thunder Storm, Wind	Wind, Lightning and Rain	0	0	$7,142.86	$ -	$ 27,512.75
8/6/1976	8/6/1976	Lightning, Wind	Wind, Lightning	0.67	0	$ 166,666.67	$ -	$ 641,963.91
8/12/1978	8/31/1978	Severe Storm, Thunder Storm	Rain	0	0	$-	$62,500.00	$-
11/4/1978	11/4/1978	Wind	Wind	0	0	$12,500.00	$ -	$ 40,625.30
1/1/1979	1/31/1979	Winter Weather	Extreme Cold	0	0	$11,363.60	$ -	$ 33,765.97
2/1/1979	2/13/1979	Winter Weather	Extreme Cold	0	0	$1,136.36	$ -	$3,376.60
7/5/1979	7/5/1979	Lightning, Wind	wind, lightning	0	0	$16,666.67	$ -	$ 49,523.59
4/28/1980	4/28/1980	Wind	Wind	0	0	$50,000.00	$ -	$ 129,998.44
11/13/1981	11/14/1981	Wind	Wind	0	0	$55,555.56	$ -	$ 131,312.19
1/23/1982	1/23/1982	Wind, Winter Weather	Snow/wind	0	0	$25,000.00	$ -	$ 55,319.53
2/15/1982	2/15/1982	Flood	Flooding	0	0	$1,000,000.00	$ -	$2,212,781.02
2/16/1982	2/16/1982	Wind	Wind	0	0	$50,000.00	$ -	$ 110,639.05
3/18/1982	3/18/1982	Wind	Wind	0	0	$8,333.00	$ -	$ 18,439.10
4/23/1985	4/23/1985	Wind	Wind	0	0	$7,142.86	$ -	$ 14,285.72
12/9/1987	12/9/1987	Wind	High Winds	0	0	$7,142.86	$ -	$ 13,506.40
12/20/1987	12/21/1987	Winter Weather	Heavy Snow	0	0	$7,142.86	$ -	$ 13,506.40
12/22/1987	12/22/1987	Winter Weather	Heavy Snow	0.61	0	$1,136.36	$ -	$2,148.74
8/1/1988	8/31/1988	Drought	Drought	0	0	$-	$11,363.64	$-
10/1/1988	10/31/1988	Drought	Drought	0	0	$11,363.64	$11,363.64	$ 20,733.54
12/12/1988	12/13/1988	Wind	Wind	0	0	$10,000.00	$ -	$ 18,245.51
12/30/1988	12/30/1988	Winter Weather	Extreme Cold	0	0	$7,142.86	$ -	$ 13,032.51
1/31/1989	1/31/1989	Winter Weather	BLIZZARD, SNOW	0.29	0	$71,428.57	$ 7,142.86	$ 123,810.18
3/2/1989	3/2/1989	Flood	Flood	0	0	$7,142.86	$ -	$ 12,381.02
1/8/1990	1/8/1990	Wind	High Wind	0.03	0	$16,129.00	$ -	$ 26,625.62
11/20/1990	11/21/1990	Winter Weather	Heavy Snow	0	0	$4,166.67	$ -	$6,878.30
11/23/1990	11/23/1990	Wind	High Winds	0	0	$ 100,000.00	$ -	$ 165,079.16

Table 22. SHELDUS Hazard Profile for Coeur d'Alene Reservation and Adjacent Counties in Idaho (University of South Carolina 2009).

Begin Date	End Date	Hazard Type	Remarks	Injuries	Fatalities	Property Damage	Crop Damage	Property Damage 2008
11/24/1990	11/26/1990	Flood	Flooding	0	0	$10,000.00	$ -	$ 16,507.92
12/4/1990	12/4/1990	Wind	High Winds	0.13	0	$6,250.00	$ -	$ 10,317.45
12/18/1990	12/31/1990	Winter Weather	Extreme Cold	0.68	0.02	$11,363.64	$113,636.36	$ 18,759.00
12/30/1990	12/31/1990	Winter Weather	Blizzard	0	0	$2,500.00	$ -	$4,126.98
2/28/1991	2/28/1991	Winter Weather	Snow	0.29	0	$7,142.86	$ -	$ 11,255.33
3/3/1991	3/3/1991	Wind	High Wind	0	0	$1,136.36	$ -	$1,790.61
10/16/1991	10/16/1991	Wind	Wind	1.14	0.14	$71,428.57	$ 7,142.86	$ 112,553.29
4/9/1992	4/9/1992	Wind	Dust Storm	0	0	$1,724.14	$ -	$2,636.90
4/17/1992	4/17/1992	Wind	Wind	0	0	$11,363.64	$11,363.64	$ 17,379.58
6/1/1992	6/30/1992	Drought	Drought	0	0	$-	$ 1,136,363.64	$-
7/1/1992	7/31/1992	Drought	Drought	0	0	$-	$ 1,136,363.64	$-
8/1/1992	8/31/1992	Drought	Drought	0	0	$-	$ 1,136,363.64	$-
8/11/1992	8/15/1992	Lightning	Dry Lightning	0	0	$1,136.36	$113.64	$1,737.95
8/20/1992	8/20/1992	Heat, Wind	Wind, Dry Heat	0	0	$26,315.79	$26,315.79	$ 40,247.44
8/21/1992	8/21/1992	Winter Weather	Cold Front	0	0	$5,555.56	$55,555.56	$8,496.69
8/24/1992	8/26/1992	Winter Weather	Freeze	0	0	$ 138.89	$13,888.89	$ 212.42
9/1/1992	9/30/1992	Drought	Drought	0	0	$-	$ 1,136,363.64	$-
10/1/1992	10/31/1992	Drought	Drought	0	0	$ 113,636.36	$ 1,136,363.64	$ 173,795.76
11/19/1992	11/20/1992	Winter Weather	Heavy Snow	0	0.15	$2,500.00	$ -	$3,823.51
11/21/1992	11/21/1992	Winter Weather	Heavy Snow	0	0	$12,500.00	$125,000.00	$ 19,117.53
1/1/1993	3/15/1993	Winter Weather	Weather Stress	0	0	$-	$ 7,142.85	$-
1/7/1993	1/7/1993	Winter Weather	Snow	0	0	$10,000.00	$ -	$ 14,857.07
1/20/1993	1/20/1993	Wind	Wind	0.25	3	$ 125.00	$ -	$ 185.71
9/1/1993	9/30/1993	Winter Weather	Cool and Wet Growing Season	0	0	$-	$11,363.64	$-
11/12/1993	11/12/1993	Wind	High Winds	0	0	$12,500.00	$ -	$ 18,571.34
5/15/1994	5/15/1994	Wind	HIGH WINDS	0	0	$16,666.67	$ -	$ 24,074.00
10/20/1994	10/20/1994	Severe Storm, Thunder Storm, Wind,	THUNDERSTORM WINDS	0	0	$50,000.00	$ -	$ 72,221.98
11/1/1994	11/1/1994	Wind	HIGH WINDS	0.1	0	$5,000.00	$ -	$7,222.20
12/1/1994	12/1/1994	Severe Storm, Thunder Storm, Winter Weather,	HEAVY RAIN/SNOW	0	0	$1,136.36	$ -	$1,641.40
12/5/1994	12/5/1994	Winter Weather	HEAVY SNOW	0	0	$7,142.86	$ -	$ 10,317.43
2/19/1995	2/20/1995	Flood	FLOODS	0	0	$25,000.00	$ -	$ 35,135.06
4/15/1995	4/15/1995	Winter Weather	FROST	0	0	$-	$100,000.00	$-

Table 22. SHELDUS Hazard Profile for Coeur d'Alene Reservation and Adjacent Counties in Idaho (University of South Carolina 2009).

Begin Date	End Date	Hazard Type	Remarks	Injuries	Fatalities	Property Damage	Crop Damage	Property Damage 2008
1/16/1996	1/16/1996	Wind	HIGH WIND	0	0	$10,000.00	$ -	$ 13,684.20
1/23/1996	1/23/1996	Winter Weather	WINTER STORM	0	0	$3,600.00	$ -	$4,926.31
2/8/1996	2/8/1996	Flood	FLOODS	0.17	0	$20,000,000.00	$ -	$27,368,392.24
4/24/1996	4/26/1996	Flood	FLOODS	0	0	$16,666.67	$ -	$ 22,807.00
11/16/1996	11/16/1996	Winter Weather	HEAVY SNOW	0	0	$ 857,142.86	$ -	$1,172,931.10
5/1/1997	5/31/1997	Flood	FLOODS	0	0	$ 571,428.57	$ -	$ 761,904.76
5/31/1997	5/31/1997	Tornado		0	0	$50,000.00	$ -	$ 66,666.67
6/1/1997	6/15/1997	Flood	FLOODS	0	0	$ 666,666.67	$ -	$ 888,888.89
7/21/1997	7/21/1997	Hail, Severe Storm, Thunder Storm,	THUNDERSTORM WIND/HAIL	0	0	$10,000.00	$ -	$ 13,333.33
12/20/1997	12/20/1997	Winter Weather	HEAVY SNOW	0	1	$-	$ -	$-
1/11/1998	1/11/1998	Winter Weather	EXTREME COLD	0	0	$16,666.67	$ -	$ 21,940.80
3/4/1998	3/5/1998	Winter Weather	HEAVY SNOW	0	0	$3,571.43	$ -	$4,701.60
7/2/1998	7/2/1998	Wildfire	WILD/FOREST FIRE	0	0	$20,000.00	$ -	$ 26,328.95
7/9/1998	7/9/1998	Severe Storm, Thunder Storm, Wind,	THUNDERSTORM WIND	0	0	$50,000.00	$ -	$ 65,822.38
7/31/1998	7/31/1998	Flood	FLOOD	0	0	$5,000.00	$ -	$6,582.24
8/12/1998	8/12/1998	Wildfire	WILD/FOREST FIRE	0	0	$10,000.00	$15,000.00	$ 13,164.48
8/19/1998	8/21/1998	Wildfire	WILD/FOREST FIRE	0	0	$25,000.00	$ -	$ 32,911.19
9/14/1998	9/14/1998	Wildfire	WILD/FOREST FIRE	0	0	$20,000.00	$ -	$ 26,328.95
12/25/1998	12/25/1998	Wind	HIGH WIND	0	0	$ 140,000.00	$ -	$ 184,302.68
2/2/1999	2/2/1999	Wind	HIGH WIND	0	0	$ 600,000.00	$ -	$ 780,000.78
2/6/1999	2/7/1999	Winter Weather	WINTER STORM	5	0	$-	$ -	$-
2/24/1999	2/25/1999	Flood	FLOODS	0	0	$ 250,000.00	$ -	$ 325,000.33
2/25/1999	2/25/1999	Avalanche	AVALANCHE	0	0	$5,000.00	$ -	$6,500.01
7/7/1999	7/7/1999	Hail, Severe Storm, Thunder Storm,	TSTM WIND/HAIL	0	0	$30,000.00	$ -	$ 39,000.04
9/25/1999	9/25/1999	Wind	HIGH WIND	0	0	$10,000.00	$ -	$ 13,000.01
12/18/1999	12/18/1999	Winter Weather	WINTER STORM	2	0	$66,666.67	$ -	$ 86,666.76
1/9/2000	1/9/2000	Wind	HIGH WIND	0	0	$8,000.00	$ -	$ 10,024.06
1/31/2000	1/31/2000	Flood	URBAN/SMALL STREAM FLOOD	0	0	$15,000.00	$ -	$ 18,795.11
4/4/2000	4/4/2000	Severe Storm, Thunder Storm, Wind,	THUNDERSTORM WIND	0	0	$15,000.00	$ -	$ 18,795.11
4/13/2000	4/15/2000	Flood	FLOOD	0	0	$15,000.00	$ -	$ 18,795.11

Table 22. SHELDUS Hazard Profile for Coeur d'Alene Reservation and Adjacent Counties in Idaho (University of South Carolina 2009).

Begin Date	End Date	Hazard Type	Remarks	Injuries	Fatalities	Property Damage	Crop Damage	Property Damage 2008
4/14/2000	4/16/2000	Flood	FLOOD	0	0	$13,333.33	$ -	$ 16,706.76
12/15/2000	12/15/2000	Wind	HIGH WIND	0	0	$7,500.00	$ -	$9,397.55
3/13/2001	3/13/2001	Severe Storm, Thunder Storm, Wind,		0	0	$25,000.00	$ -	$ 30,232.67
12/1/2001	12/1/2001	Winter Weather		0	0	$16,666.67	$ -	$ 20,155.12
5/19/2002	5/19/2002	Severe Storm, Thunder Storm, Wind,		2	0	$15,000.00	$ -	$ 17,931.00
2/1/2003	2/1/2003	Flood		0	0	$30,000.00	$ -	$ 35,056.15
11/19/2003	11/19/2003	Wind		0	0	$50,000.00	$ -	$ 58,426.91
8/2/2004	8/2/2004	Severe Storm, Thunder Storm, Wind,	Thunderstorm Wind	2	0	$5,000.00	$ -	$5,714.29
1/10/2006	1/10/2006	Wind	Strong Wind	0	0	$30,000.00	$ -	$ 32,165.03
1/15/2006	1/20/2006	Landslide	Landslide	0	0	$7,500.00	$ -	$8,041.26
3/8/2006	3/8/2006	Wind	Strong Wind	0	0	$1,000.00	$ -	$1,072.17
5/19/2006	5/19/2006	Lightning	Lightning	0	0	$10,000.00	$ -	$ 10,721.68
7/5/2006	7/5/2006	Lightning	Lightning	0	0	$15,000.00	$ -	$ 16,082.51
12/14/2006	12/15/2006	Wind	High Wind (G76)	0.43	0	$68,000.00	$ -	$ 72,907.40
1/6/2007	1/6/2007	Wind	High Wind (G58)	0	0	$3,000.00	$ -	$3,120.00
1/9/2007	1/10/2007	Wind	Strong Wind	0	0	$ 666.67	$ -	$ 693.34
6/4/2007	6/4/2007	Lightning	Lightning	0	0	$30,000.00	$ -	$ 31,199.95
6/29/2007	6/29/2007	Severe Storm, Thunder Storm, Wind,	Thunderstorm Wind (55EG)	0	0	$33,000.00	$ -	$ 34,319.95
8/31/2007	8/31/2007	Severe Storm, Thunder Storm, Wind,	Thunderstorm Wind	0	0	$2,000.00	$ -	$2,080.00
1/11/2008	1/11/2008	Winter Weather	Winter Weather	0.5	0	$-	$ -	$-
5/18/2008	5/31/2008	Flood	Flood	0	0	$50,000.00	$ -	$ 50,000.00
7/10/2008	7/10/2008	Wind	High Wind	0	0	$ 196,666.67	$ -	$ 196,666.67

Using the summaries, presented in Table 22, several observations concerning the frequency and financial magnitude of natural hazards within and surrounding the Coeur d'Alene Reservation can be made. In terms of frequency of large-scale disaster events, **severe weather** leading to disaster events occurs with the highest frequency in the region. A frequency of 16 **winter weather** events during November and December (each), have been witnessed between 1960 and 2009 (Figure XXVI, Table 22). The frequency of winter weather is highest during the winter months; however, one event that occurred in August, 21,1992, was categorized as winter weather because the storm dropped ice rain and snow, breaking trees over the roadway and dropping power lines. Although August is categorized as the "hottest month" of the year on the Coeur d'Alene Reservation, these seemingly odd weather systems can be witnessed (Figure XXVI, Table 22). Winter weather-related storm events have accounted for approximately $66,000 in losses each year, with a total, 2008 adjusted loss figure, of $3.2 million during this period, and included within the SHELDUS hazard profile (Table 22).

Lightning has represented a loss of approximately $18,000 per year, or $871,000 in losses during this 49 year period (Table 22). Lightning events of significance have been recorded a total of 21 times during the 49 year period of record, and less than once every two years. This should not be considered as the frequency of lightning storms in the region. Lightning is a common evening experience on the Coeur d'Alene Reservation with hundreds of strikes seen on a single night during June through September as the hot summer days cool to chilly summer nights in the Upper Columbia Plateau.

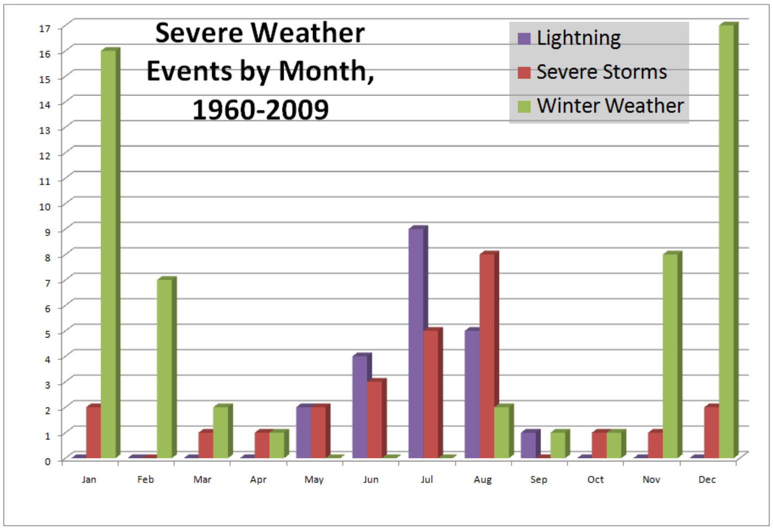
Thunder storms are cataloged separately from lightning storms in the SHELDUS database of natural disasters (Table 22). There have been a total of 23 thunderstorm events within the region between 1960 and 2009, representing slightly less than one damage causing event every two years. Thunderstorm losses have totaled approximately $16.6 million during this 49 year period, or about $339,000 per year.

Other severe weather-related events include **hail storms**, with an average occurrence one event within each 6 year period, for a total of 9 occurrences within the 49 year period of record (Table 22). These events have led to a financial loss of approximately $1,141 per year, or a total period loss of $56,000, as reported in the SHELDUS database, and adjusted for inflation to 2008 dollars.

Drought impacts have been recorded in the region approximately 7 times during the period of record, or about once every 7 years (Table 22). Each of the losses were recorded in October and reflected crop losses. These drought losses have totaled approximately $195,000 during the 49 year period, or on average, $27,800 per event (less than $4,000 per year).

Further discussions of severe weather and "normal weather patterns" are addressed in Section 4.3 (Weather Features of the Upper Columbia Plateau).

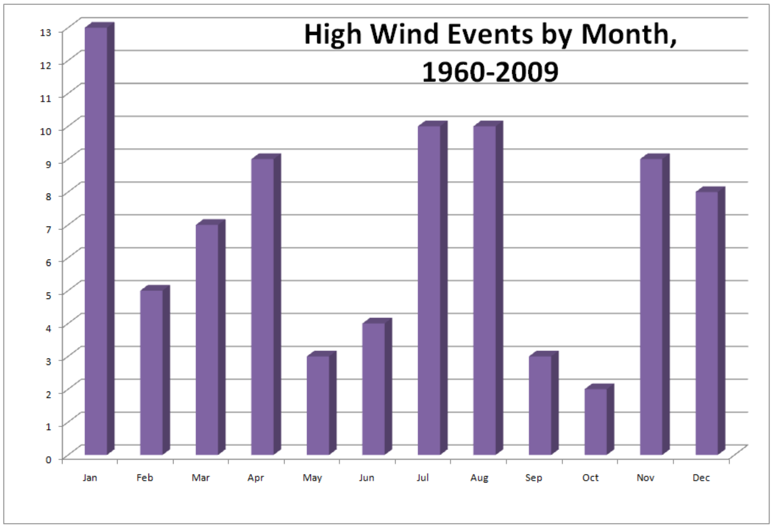
Figure XXVI. Severe Weather Frequency between 1960 and 2009, where the Coeur d'Alene Reservation is Located.



High-wind events are another frequent visitor to the Coeur d'Alene Reservation. The timing and patterns of severe winds are less predictable than some of the other hazards. In general, the classification of "severe winds" are limited to those winds that both exceed 40 miles per hour in gusts, and cause damages to people, structures, infrastructure, crops, or forestlands. Within the SHELDUS database (Table 22), there have been approximately 83 damaging high-wind events within the Coeur d'Alene Reservation between 1960 and 2009, with approximately 5 events witnessed every 3 years, during that period (Figure XXVII). Often, these storm systems are not solely a high-wind event, but are frequently accompanied by lightning, rain, or other weather system components. The financial losses from these wind storms are highly variable, with $20.5 million (2008 dollars) witnessed during this period, or $419,500 per year (Table 22).

Further discussions of high winds and "normal weather patterns" are dealt with in Section 4.3 (Weather Features of the Upper Columbia Plateau)..

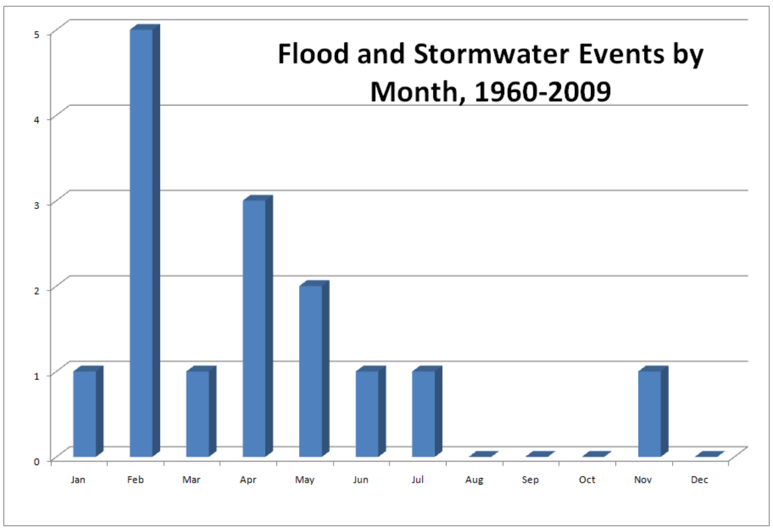
Figure XXVII. High Wind Frequency between 1960 and 2009, Where the Coeur d'Alene Reservation is Located.



The frequency of past flooding events within the Coeur d'Alene Reservation has been confined to winter and spring months, normally between January and July (Figure XXVIII). One event has been noted as occurring on November 24, 1990, when warm rains fell on a light snowpack causing a rapid rain-on-snow event and flooding within the Hangman Creek, St. Joe and St. Maries Rivers. The frequency of rain-on-snow events is witnessed, more often than not, in January, February, and sometimes March, as the heavy winter snows (beginning in November) drop a substantial snowpack on the region (between 2 and 3 feet in depth). Extratropical storms from the Pacific Ocean can move up the Columbia River and into the Upper Columbia Plateau dropping heavy rains on the frozen surface and on the snowpack, leading to rain-on-snow events that quickly translate into flooding events throughout the region. There have been approximately 15 disastrous flood events of note within the region over the 49 year period, with on average, one major event every 3 years.

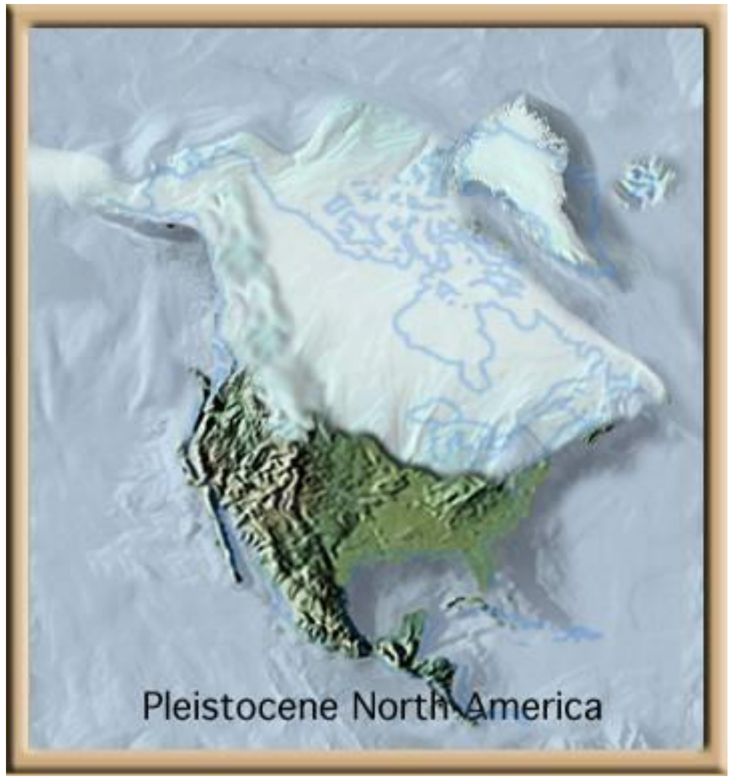
During the 49 year period, the average annual losses from flooding within the Kootenai County and Benewah County, has equaled approximately $649,000 per year, for a total loss of $31.8 million during the 49 year period (all expressed in adjusted 2008 dollars, Table 22).

Figure XXVIII. Flooding Frequency between 1960 and 2009, where the Coeur d'Alene Reservation is Located.



4.2. Global Climate Change

Figure XXIX. Paleogeography based on The Evolution of North America (Scotese 2003) showing the glacial ice cap over North America during the last ice age.



During the initial scoping of the Coeur d'Alene Reservation Phase I Hazard Profile by the Planning Committee, discussions included the topic of global climate change and the resulting effects of weather patterns, flood, drought, and other weather changes to the cycle of life on the Coeur d'Alene Reservation. In response to these discussions, this planning effort has been cast in the light of potential changes to natural disasters resulting from global climate change. This section begins with a cursory review of historical changes to the climate, and recent impacts from those changes, then transitions into a look of the future potential impacts.

Many of the sub-sections to this chapter begin by sharing native folklore tales to explain the natural disasters observed over the centuries of oral tradition. These legends are not intended to explain what we today understand to be weather pattern changes or seismic stability. These legends demonstrate that the native cultures of the Pacific Northwest have dealt with the negative effects of natural disasters for the extent of human history within this continent. Historical responses to natural disasters are as important to dealing with them today as they were in the past.

Earthquake and flood references are common in Native oral traditions all along the Upper Columbia Plateau. Some of these stories are literal, and clearly refer to recent historical happenings. Other stories, such as those that refer to earthquake effects, are expressed metaphorically.

About 10,000 to 12,000 years ago, vast continental glaciers were in retreat (Figure XXIX), leaving behind rounded valleys and marshy meadows. There were no dense forests or expansive meadows during the glaciation – all surface vegetation was scraped off by the advancing glaciers moving southward. At the southern edges of the glaciers, and throughout the glacial retreat, elk, bison, wolves and mammoths roamed the newly exposed land, and humans roamed with them (NPS 2009). Most speculations about the glacial retreat beginning about 12,000 years ago designate this period as the time when humans began to permanently populate this region.

Coeur d'Alene Lake was once a segment of a pre-glacial river flowing through this region. The ice sheet (Figure XXIX), covered the valleys to the east, and the glaciers overtopped these passageways. During the glacial retreat, melt waters flooded across the outlet of the valley's path located at the northwestern terminus of the current-day Coeur d'Alene Lake. Rock, sand,

and gravel transported by the glacial ice were deposited at the constriction of the river valley and caused floodwaters to form. Some estimates of the depth of the floodwaters within the glacial lake, put the depth of the flood waters to the edges of the current day Plummer, Worley, and DeSmet, now located over 550 feet above the level of the lake. Large geologic debris such as massive boulders, in combination with the finer glacial outwash and glacial ice debris, led to the formation of a glacial lake outburst flood (called Jökulhlaup) when the lake contained by the glacier burst through the ice-sheet dam at the terminus.

The result of that glacial lake formation and its collapse, or Jökulhlaup, created the conditions necessary for Coeur d'Alene Lake to be formed (Figure XXX).

Figure XXX. Present day Coeur d'Alene Lake where glaciers once held back a massive lake that failed in a Jökulhlaup, and then reformed to the lake seen today.

The Columbian mammoth (*Mammuthus columbi*) lived in this region of North America. Mammoths are thought to have first appeared almost four million years ago and became extinct about 10,000 years ago, at the same time as most other Pleistocene megafauna. Though their habitat spanned a large territory, mammoths were most common in ice-age forests within and around the Coeur d'Alene Reservation (Schriber 2007). During the Pleistocene Epoch, 1.6 million to 10,000 years ago, much of North America was covered by great sheets of ice (Scotese 2003) (Figure XXIX).

Partial and complete skeletons of Woolly Mammoths have been recovered from meadowlands around this region to the north from the shores of Lake Pend Oreille through Coeur d'Alene Lake region, and south in the region of Grangeville near Tolo Lake.

The Marmes Rockshelter is an archaeological site first excavated in 1962, near the confluence of the Snake and Palouse Rivers, in present-day Franklin County, southeastern Washington. Findings at this site are remarkable because of the high level of preservation of organic materials, the depth of stratified deposits, and the apparent age of the associated Indian human remains (Hicks 2004). At that time, the site held the oldest found human remains in North America.

Findings at the Marmes Rockshelter revealed evidence of human occupation from a period dating back to approximately 8,000 years ago. Evidence has supported the understanding that

that the area was home to humans as long ago as 11,250 years ago (Hicks 2004). The people living at the site hunted game such as elk and deer using atlatls, and also hunted smaller mammals such as beavers, while they gathered mussels from the river (Fiedel 1992). The excavation turned up graves, which included beads carved from shells, sewing needles, and spear points (Peltier 1975). The excavation also turned up chalcedony and chert arrowheads. Those in the upper layers were made of agate, which is not found in the area (Kirk 1970). Stone tools were found as well, such as scrapers for use in tanning hides, and mortars and pestles (Hicks 2004).

In layers dated to 7,000 years ago, large amounts of shells belonging to a snail of the genus *Olivella* were found, which would have been imported from the Pacific Ocean Coast, 250 miles to the west. The majority of the shells had holes drilled through them, indicating that they had adorned necklaces (Kirk 1970).

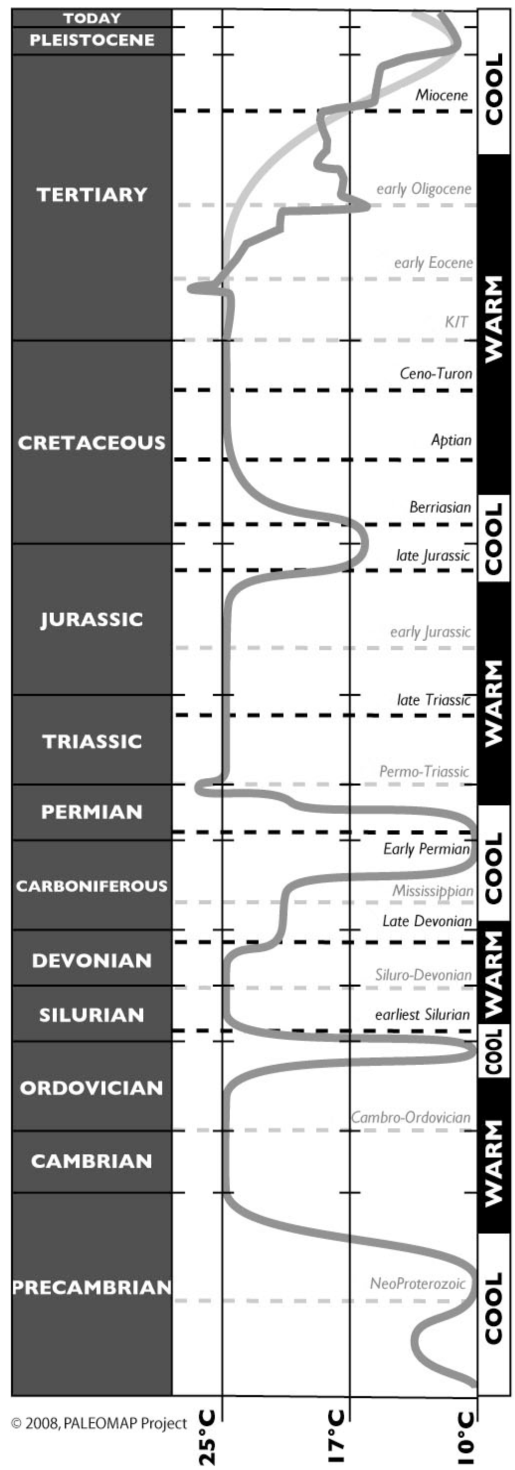
By about 3,000 years ago, as the aboriginal human population increased within the North American Continent, early inhabitants shifted their habitation focus to lowland rivers and lakes. Fishing, gathering, and hunting land mammals formed the foundation of a rich and complex culture (NPS 2009).

Human occupation of this area seems to follow environmental changes of the last 15,000 years. Glaciers covered most of what is now Northern Idaho, Eastern Washington, and Western Montana. They receded and left behind rivers and valleys that people likely followed in pursuit of ice-age mammals such as the mammoth and the giant bison.

The first people arrived in this region sometime before 11,000 years ago. Archeologists have found physical evidence of their presence such as distinctive stone tools, projectile points, and others similar to those located at the Marmes Rockshelter.

As the climate became warmer and drier, the animals, vegetation and human lifestyles also changed. Large ice-age (megafauna) animals that were adapted to cold and wet conditions became extinct. People, who could no longer

Figure XXXI. During the last 2 billion years the Earth's climate has alternated between a frigid "Ice House", like today's world, and a steaming "Hot House", like the world of the dinosaurs (Scotese 2002).



rely on large mammals for food, depended on smaller animals, such as deer, moose, and elk. Plants such as camas, bitterroot, huckleberries, and serviceberries also became important food staples.

Global climate is highly variable, and currently it is in a cycle of warming because we are still leaving the last ice age (Figure XXXI) and because globally, humans are adding greenhouse gases to the atmosphere (Scotese 2002). This cycle of global climate change holds the potential to disproportionately impact agrarian and coastal populations.

Understanding synoptic-scale weather patterns across large landscapes, or mesoscale responses within watersheds, to climate change and sea-level rise is quite underdeveloped (FMI 2008). This is partly because the time scales of concern are short (annual to centennial) and fall between the small scales addressed by most numerical models and the large sales described in the conceptual models of geomorphologists (Figure XXXI). An additional problem is that the type of models often used to bridge this gap are based on the extrapolation of historic behavior and is not precise as the climates change.

<u>Climate Change is not here considered a natural disaster, but instead it is considered a natural part of the global climate cycle of change</u> that took a turn nearly 12,000 years ago when the glaciers began their retreat. This glacial retreat to the north opened up lands held in the lock of glacial ice to make available fertile soils for meadows, forestlands, lakes and valleys. This cycle of change from the last “hot peak” of the Tertiary period to the “cold gorge” of the Pleistoncene period took nearly 50.7 million years to complete (22.0 million years during the Eocene Epoch, 11.0 million years during the Oligocene Epoch, and 17.7 million years of the Miocena Epoch) (Figure XXXI).

Global cooling happened during a 50.7 million-year period of time preceding the current Epoch. The current synoptic-scale (long-term) global climate change development observed is a trend of global warming, started about 12,000 years ago and was signaled by the retreat of the glaciers. *Are anthropogenic carbon emissions increasing the rate of global climate change?* The answers to that question are debated by many scientists around the globe. The speed of changes introduced by climate change and the extremes of that change (hotter and colder, wetter and drier) must be viewed in the long-term synoptic scale looking forward to the coming centuries and millennia, while practitioners are by necessity, focused on the mesoscale profile of the coming months, years, and possibly decades.

In general, the largest impact expected in this short-term (mesoscale) outlook for the Upper Columbia Plateau, is to a trend of global warming that can bring with it warmer temperatures during all months of the year, accompanied by wetter seasons.

Climate change and vegetative responses to those changes are interrelated processes, both of which take place on a global scale (IPCC 2007). Global warming is projected to have significant impacts on conditions affecting vegetative processes (including agriculture), through changes in temperature, atmospheric carbon dioxide content, increased glacial run-off, amplified precipitation, and the interaction of these elements. These conditions determine the vegetative carrying capacity of the biosphere. The overall effect of climate change on vegetative productivity generally, and agriculture specifically, will depend on the balance of these effects.

At the same time, forest growth and agricultural production have been shown to produce significant effects on climate change, primarily through the sequestration of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the Earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radiative forcing. Land-use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide; agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in earth's atmosphere (Lobell *et al.* 2008).

Climate change could alter patterns of disease and insect populations within forested environments within the Upper Columbia Plateau, and worldwide, by 1) direct effects on the development, survival, reproduction, dispersal, and distribution and hosts and pathogens, 2) physiological changes in tree defenses, and 3) indirect effects from changes in the abundance of mutualists and competitors (Klopfenstein *et al.* 2009).

The Schitsu'umsh peoples recognized the force of the natural environment on their lives from the times immemorial. One of the tales related to this recognition of natural forces has been conveyed in written form by Teit *et al.* (1917):

> "A LONG time ago conditions on the earth were different from what they are now, and people had a hard time to live. There was much wind and heat, and little rain or snow. It was very dry. Some say thunder was frequent, and lightning killed many people. Many monsters lived on earth and killed people. Gradually these conditions were changed by coyote and others, who made many transformations beneficial to the people. Coyote also introduced the salmon, made fishing places and taught many arts. Giants and dwarfs of several kinds inhabited some parts of the country, particularly mountains and forests. Coyote did not transform all of them, and some are said to exist at the present day. In the same way some "mysteries" - both land and water beings - continue to exist. Even many beings that Coyote transformed had not all their evil powers taken from them, and they sometimes harm people at the present day."

Figure XXXII. Youth Art Contest, 13 and Older, Third Place Winner: Dylan Vincent.

4.3. Weather Features of the Upper Columbia Plateau

The Coeur d'Alene Reservation lies on the eastern edge of the broad Columbia Basin area of Idaho and Washington, bounded by the Cascade Range on the west and the Rocky Mountains on the east. The elevations in this region vary from less than 400 feet above sea level near Pasco, Washington, to over 7,000 feet in the mountain areas to the east. The Coeur d'Alene Reservation is located in the transition area where the long gradual slope of the plateau of the

Columbia Basin meets the sharp rise leading to the Rocky Mountain Ranges (Livingston 2010). Much of the current-day Coeur d'Alene Reservation rests along the southern shores of Coeur d'Alene Lake at elevations between 2,111 feet and 5,458 feet above sea level.

In general, Coeur d'Alene Reservation's weather has the characteristics of a mild, arid climate during the summer months and a cold, coastal type in the winter (Livingston 2010). The weather east of the Cascades is generally characterized by cold winters and hot summers combined with lower precipitation amounts compared to areas west of the mountains. The prevailing winds over the region are from the west and southwest. The spring and autumn have more consistent and stronger winds while summer and winter have generally lighter and more intermittent winds.

The Cascade Mountains provide a permeable barrier to the moderating influence of the Pacific Ocean and explain more extreme temperatures of Eastern Washington and Northern Idaho in comparison with the west side of the Cascades. With winds generally from the west, the Columbia Basin is downwind of the Cascade volcanoes and in the very rare circumstances of an eruption which can cause a significant ash fall (Mass 2008). The region experienced this event during the May 18, 1980 eruption of Mount St. Helens.

The climate of the Coeur d'Alene Reservation combines some of the characteristics of damp coastal type weather and arid interior conditions. Most of the air masses that reach the area are brought in by the prevailing westerly and southwesterly circulations. Frequently, much of the moisture in the storms that move eastward and southeastward from the Gulf of Alaska and the eastern Pacific Ocean is precipitated out as the storms are lifted across the Coast and Cascade Ranges. The precipitation and total cloudiness in North Idaho are greater than that of the desert areas of south-central Washington. The lifting action of the air masses as they move up the east slope of the Columbia Basin frequently produces the cooling and condensation necessary for formation of clouds and precipitation. Infrequently during the winter months, the area comes under the influence of dry continental air masses from the north or east. On occasions when these air masses penetrate into the region the result is high temperatures and very low humidity in the summer and sub-zero temperatures in the winter. In the winter most of the severe arctic outbursts of cold air move southward on the east side of the Continental Divide and do not affect this area (Livingston 2010).

A major factor contributing to the weather patterns of the Columbia Basin is its terrain. Winter weather includes many cloudy or foggy days and below freezing temperatures with occasional snowfall of several inches, to a couple of feet, in depth. Sub-zero temperatures and traffic-stopping snowfalls occur on average about once or twice a year (Livingston 2010). In the winter, the Rocky Mountains oftentimes block the cold air from the Canadian Arctic. If the cold air is deep enough, some of it pushes over the Rockies. Since only a small portion of the arctic outbreaks push south and west over the mountains and into the region, eastern Montana is generally colder than northern Idaho and eastern Washington during the same time of the year (Livingston 2010).

The general lack of precipitation, especially in summer, is explained by presence of the Cascades that form a barrier to the west to eastward moving warm, moist air of the Pacific Ocean. After crossing the Cascade crest, air descends over the eastern slopes of the Cascades into the Columbia Basin producing a sharp decline in clouds. Annual precipitation in the deep basin is generally less than 10 inches a year.

Thunderstorms in this region are intermittent and rarely produce severe localized flooding and debris flows (slope failures). Thunderstorms occur from time to time in the landforms surrounding and within the Coeur d'Alene Reservation. Rarely, slow-moving thunderstorms, forced by terrain features, allow large amounts of water to accumulate in one area. Narrow valleys or watersheds where rain can be concentrated, are also contributors to flash-flooding events (Mass 2008).

4.3.1. Tribal Legends

Within the previous section of this Tribal Hazards Mitigation Plan (Section 4.2, Global Climate Change) discussion was given to the importance of Legends of the *Schitsu'umsh* people. Many of the legends of the *Schitsu'umsh* were focused on the events of the weather and strived to explain the origins and the source of current patterns.

4.3.1.1. The Blowing Wind

One such legend was briefly recounted in a Council Fires article in May 2010 by Raymond Brinkman, of the Coeur d'Alene Language Center.

~ ne' ułchiit'i'ch ~

By Raymond Brinkman

Weather or Not?

If you've lived here any length of time at all would you be surprised to learn that there are a number of terms in the Coeur d'Alene language about the weather? Some make their appearance in the calendar, where we use them to designate the winter months of December, January, and February. The term for the last, in fact, describes a time of rapidly changing, volatile weather. sk'wesus refers to that time of the year when it may be snowing one minute, hailing the next, and sunny and warm later on. In Idaho, that's February, as we transition into syihih, 'early Spring.'

There's nothing unusual about how descriptions of the weather occur in Coeur d'Alene sentences. They conform to the regular rules of the grammar and behave just like our students expect: We can say 'itsq'up't ('it's raining'), q'up't khwa aspa ('it rained yesterday'), and pintch 'atsq'up't 'entsi' ('it always rains there').

However, in the story language of Coyote and his misadventures, the sense of time doesn't necessarily conform to what's predictable. Often a story is set in the present, even as we think of these events as occurring long, long ago. (No doubt it's because the lessons are timeless.) For example, we learned from Lawrence Nicodemus's qine' a version of the Coeur d'Alene story in which Coyote stops Wind's destructive ways. He does so by snaring Wind and striking a bargain. Wind will henceforth blow only on occasion, at more predictable times of year, and often for the benefit of humans (e.g., to dry meat, to blow the snow cover off the ground). In return, Coyote releases Wind and teaches humans to build sturdier houses, to dress for the weather, and to honor Wind's nature to be chilly at times, and sometimes forceful.

Maybe Lawrence's grandmother had this time of year in mind when she began the story, pintch 'iini'wt ła 'atsqhelsq'it 'iini'wt... ('The Wind was always blowing, all day long...').

4.3.1.2. The Hot and the Cold Winds

A Schitsu'umsh legend of the winds is retold by Teit *et al.* (1917):

> "Formerly the Earth was vexed with hot and cold winds, caused by the Wind People, who were striving with each other. The Cold-Wind people lived in the far north, and the Hot-Wind people in the south. The Cold-Wind people would press the bag in which they kept the wind in their house, and immediately a cold wind would rush out, and blow over the country. When it reached the Hot-Wind people, they became cold, and at once pressed their wind-bag, and hot wind rushed north. When it reached the Cold-Wind people, they became sick, and they pressed their bag. Thus the conflict continued constantly between the two. Someone made peace between these people, or curtailed their powers. Therefore, cold and warm winds blow as they do now."

4.3.1.3. The Hot-Wind People and the Cold-Wind People

A Schitsu'umsh legend of the seasons is retold by Teit *et al.* (1917):

> "The Chinook-Wind people lived in the south, in the timbered mountains. The Cold-Wind people lived in the north, in the bare, snowy mountains. Between them lived the Indians, who had no power over the winds. The Chinook-Wind people were friendly with the Indians, and travelled among them. The Cold-Wind people never visited them. Therefore, there was very little cold in the Indian country. The Chinook-Wind's son went north, and married a daughter of the Cold-Wind people, and introduced cold by bringing her back to his home. The annual visits of her people to see her brought on the winter seasons. Before that, the Cold-Wind chief never came out of his house. He always remained in their own country. Their houses were made of ice. Only when they walked about outside did it become cold. When they opened the doors of their houses, cold winds blew out, and it became somewhat cold. They never kept their doors open very long. Thus it was long ago, before the Chinook-Wind's son married."

4.3.1.4. Heat and Cold

A Schitsu'umsh legend of the temperature changes of spring is retold by Teit *et al.* (1917):

> "Heat and Cold were two brothers, the former good-looking, and the latter ugly. One day Heat travelled south, and the Cold made up his mind to kill the people. He made the weather so cold that most of the people died. Heat hurried back to save them, and made the weather so hot that he killed his brother, and the frost and ice and snow which he had made disappeared. It was then ordained that cold should not prevail long at a time, and should always be driven away by heat. We see the killing of Cold by his brother every spring."

4.3.1.5. Thunderer

A Schitsu'umsh legend of the thunder and lightning is retold by Teit *et al.* (1917):

> "Thunder used to kill many people by shooting down large arrow-stones. When he wanted rain, he sang. A man went to his house in the high mountains, and tore up his dress, which was made of feathers. After this the thunder was only able to thunder when it was about to rain, and could not kill any more."

Figure XXXIII. Youth Art Contest, 12 and Younger, Third Place Winner: Justine Laumatia.

4.3.2. Characterizing Normal Weather

There is a high degree of weather variability within the landforms of the Coeur d'Alene Reservation. Topographic variations that begin at the low point of Coeur d'Alene Lake are influenced by the rising hillsides that climb to the ridgelines surrounding the Reservation to the south and east. Stream networks that traverse the Coeur d'Alene Reservation are fed by a combination of foothill and mountain ridgeline sources. Precipitation is highly variable and show tendencies of increasing precipitation with increasing elevation. Annual precipitation ranges from a low of only 20" per year near DeSmet and Mowry to a high of 44" at Moses Mountain and 54" at Eagle Peak (PRISM 2010).

Numerical data for this report concerning monthly weather trends within the Coeur d'Alene Reservation were created using the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping system, developed by Dr. Christopher Daly, PRISM Climate Group director at Oregon State University. PRISM is a unique knowledge-based system that uses point measurements of precipitation, temperature, and other climatic factors to produce continuous, digital-grid estimates of monthly, yearly, and event-based climatic parameters. Continuously updated, this unique analytical tool incorporates point data, digital elevation models, and expert knowledge of complex climatic extremes, including rain shadows, coastal effects, and temperature inversions. PRISM data sets are recognized world-wide as high-quality spatial climate data sets. PRISM is the USDA's official climatological data source (PRISM 2010).

PRISM is an analytical model that uses point data and an underlying grid such as a digital elevation model (DEM) and a 30-year climatological average (e.g. 1971- 2010 average) to generate gridded estimates of monthly and annual precipitation and temperature (as well as other climatic parameters). PRISM is well suited to regions with mountainous terrain, because it incorporates a conceptual framework that addresses the spatial scale and pattern of orographic processes. Grids evaluated for this report have been modeled on a monthly basis (PRISM 2010).

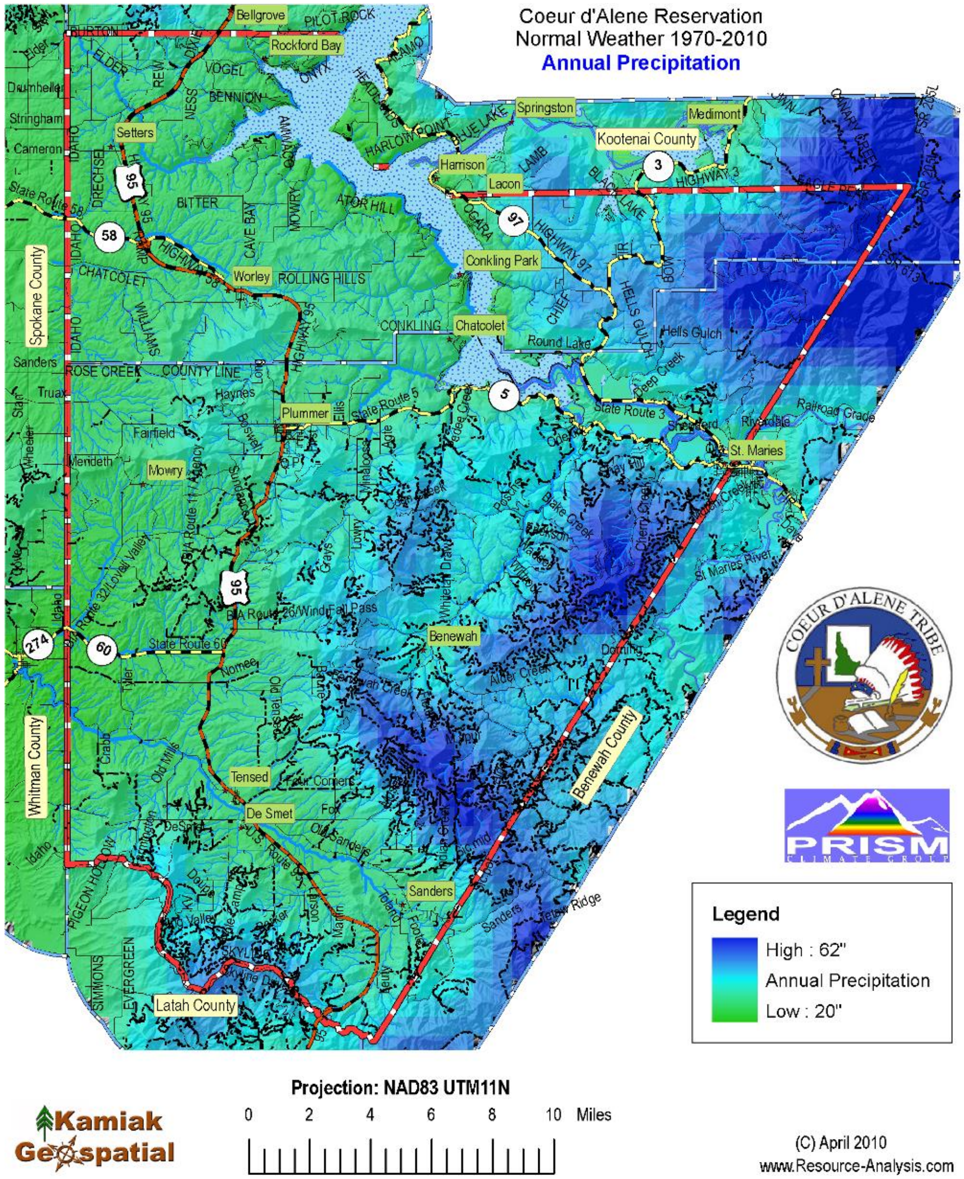
4.3.2.1. Precipitation

Within the Rocky Mountain influence area of the Coeur d'Alene Reservation, winter storms bring moisture from the Pacific Ocean, generally traveling from the southwest to the northeast, and are uplifted by the terrain, creating a precipitation maximum on the windward side (western Cascade Mountain range) and a minimum on the leeward side (eastern Cascade Mountain range) (Mass 2008). Extratropical cyclone storms approach the coastline often drawing their moisture from the equatorial latitudes and the cold air from the Gulf of Alaska. Variations in the approach trajectory from the south to the northwest account for varying amounts of precipitation, wind, and rain versus snow at a given location. Another common vector for storm systems entering the region of the Coeur d'Alene Reservation is from arctic cold fronts anchored in Canada that create moving weather systems from the north to the south and carrying cold temperatures in the winter.

Storms that approach from the north often contain relatively colder air and limited moisture. The rare cases where storms approach from the northeast, east, or southeast are characterized by light precipitation and little temperature change.

The effects of this system of regional weather patterns bring highly variable climate conditions to the Coeur d'Alene Reservation. Precipitation shows monthly variations that are responsive to the topographic variation of the Coeur d'Alene Reservation with the lowest annual precipitation amount (20 inches per year) seen along the eastern extent of the Reservation at Hangman Creek near the communities of DeSmet and Tensed. This pattern yields to the uplift provided by the terrain to witness the highest precipitation amounts along the northeastern corner of the Coeur d'Alene Reservation where totals reach nearly 62 inches per year (Figure XXXIV) (PRISM 2010).

Figure XXXIV. Annual Precipitation Derived from PRISM Datasets from 1971-2009 on the Coeur d'Alene Reservation (PRISM 2010).



The timing of precipitation events within the Coeur d'Alene Reservation is responsive to the seasons of the year. The months receiving the highest amount of precipitation include November through February when approximately 48% of annual precipitation arrives (Table 23). These reported values represent an average precipitation amount across the entire Coeur d'Alene Reservation, not just selected extreme precipitation locations (where higher and lower amounts can fall with every storm). For this reason, the total precipitation reported here (Table 23) is different than that referenced in Figure XXXIV. The former reference is to minimum and maximum precipitation amounts across the entire Coeur d'Alene Reservation while the latter references average precipitation in specific areas of the Coeur d'Alene Reservation.

Table 23. Average Monthly Precipitation for All of the Coeur d'Alene Reservation (PRISM 2010).

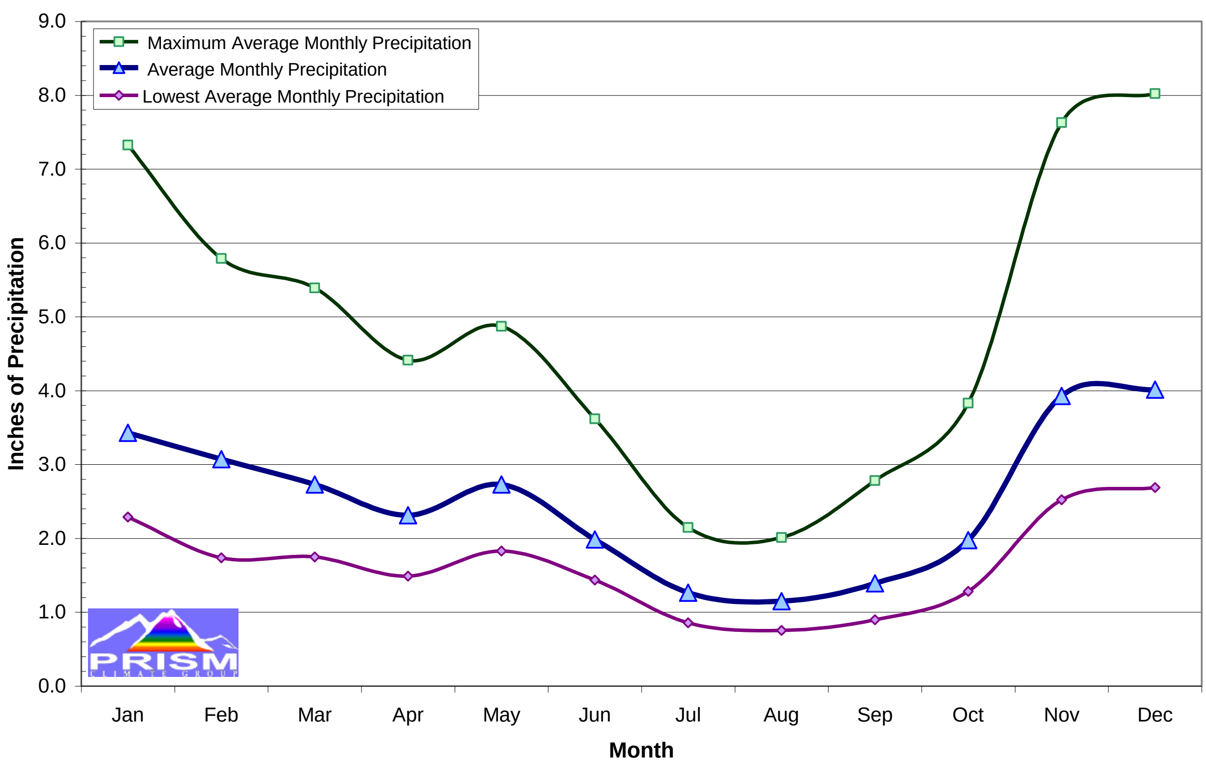
Month	Average Monthly Precipitation (inches)	Percent of Total	Areas of Lowest Precipitation	Areas of Highest Precipitation

Table 23. Average Monthly Precipitation for All of the Coeur d'Alene Reservation (PRISM 2010).

Month	Average Monthly Precipitation (inches)	Percent of Total	Areas of Lowest Precipitation	Areas of Highest Precipitation
Jan	3.4	11%	2.3	7.3
Feb	3.1	10%	1.7	5.8
Mar	2.7	9%	1.7	5.4
Apr	2.3	8%	1.5	4.4
May	2.7	9%	1.8	4.9
Jun	2.0	7%	1.4	3.6
Jul	1.3	4%	0.9	2.1
Aug	1.1	4%	0.8	2.0
Sep	1.4	5%	0.9	2.8
Oct	2.0	7%	1.3	3.8
Nov	3.9	13%	2.5	7.6
Dec	4.0	13%	2.7	8.0
Total	**30.0**		**19.5**	**57.8**

The deviation of precipitation within the Coeur d'Alene Reservation between the areas receiving the highest precipitation and the lowest precipitation is striking. The heavy December showers can deposit almost 8.0 inches of rainfall along the ridgelines of the eastern side of the Reservation while at the same time the western zones from DeSmet to Setters may only receive 2.7 inches from the same storms in December (Figure XXXV).

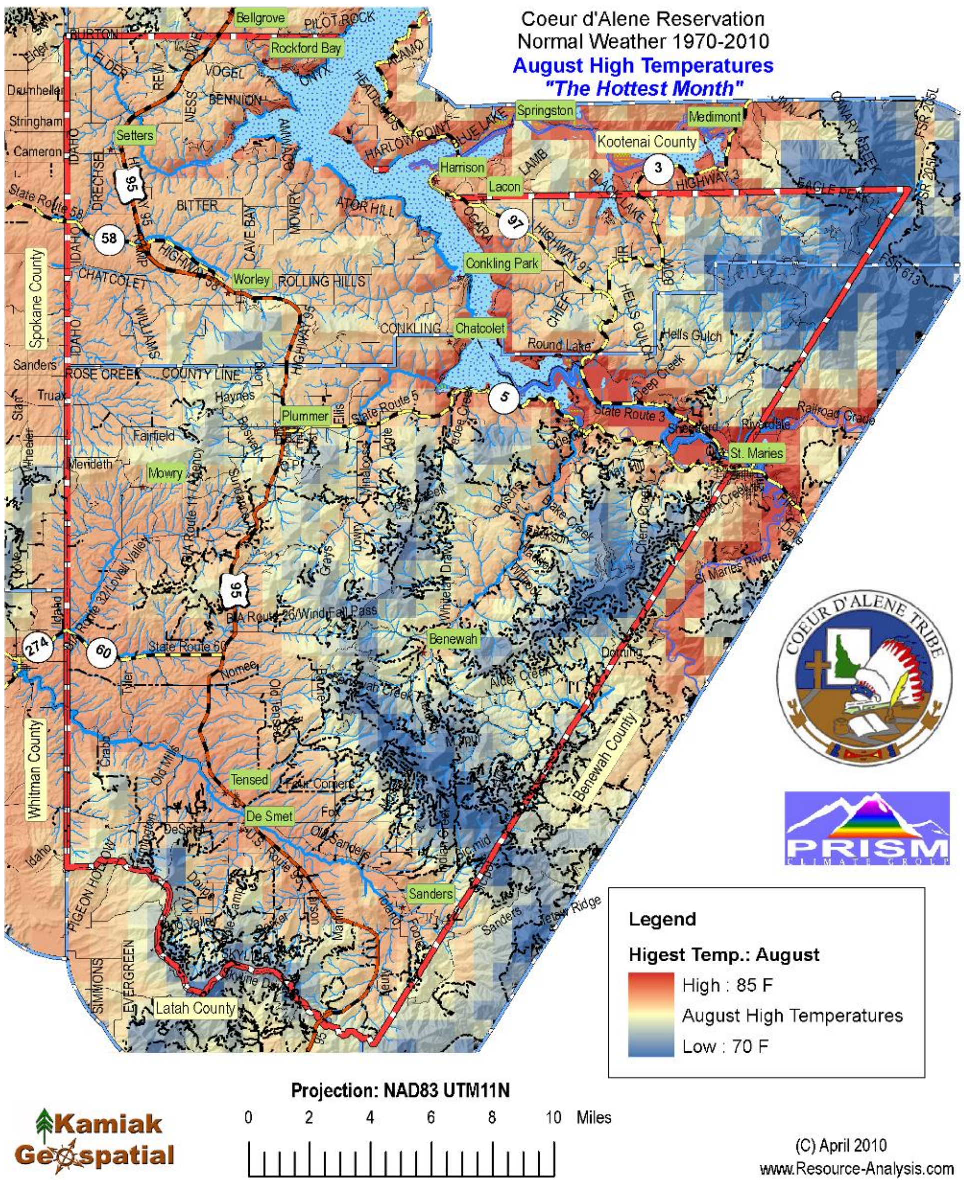
Figure XXXV. Monthly precipitation showing the average normal precipitation on the Coeur d'Alene Reservation, as well as the maximum are minimum precipitation (PRISM 2010).



4.3.2.2. Temperature

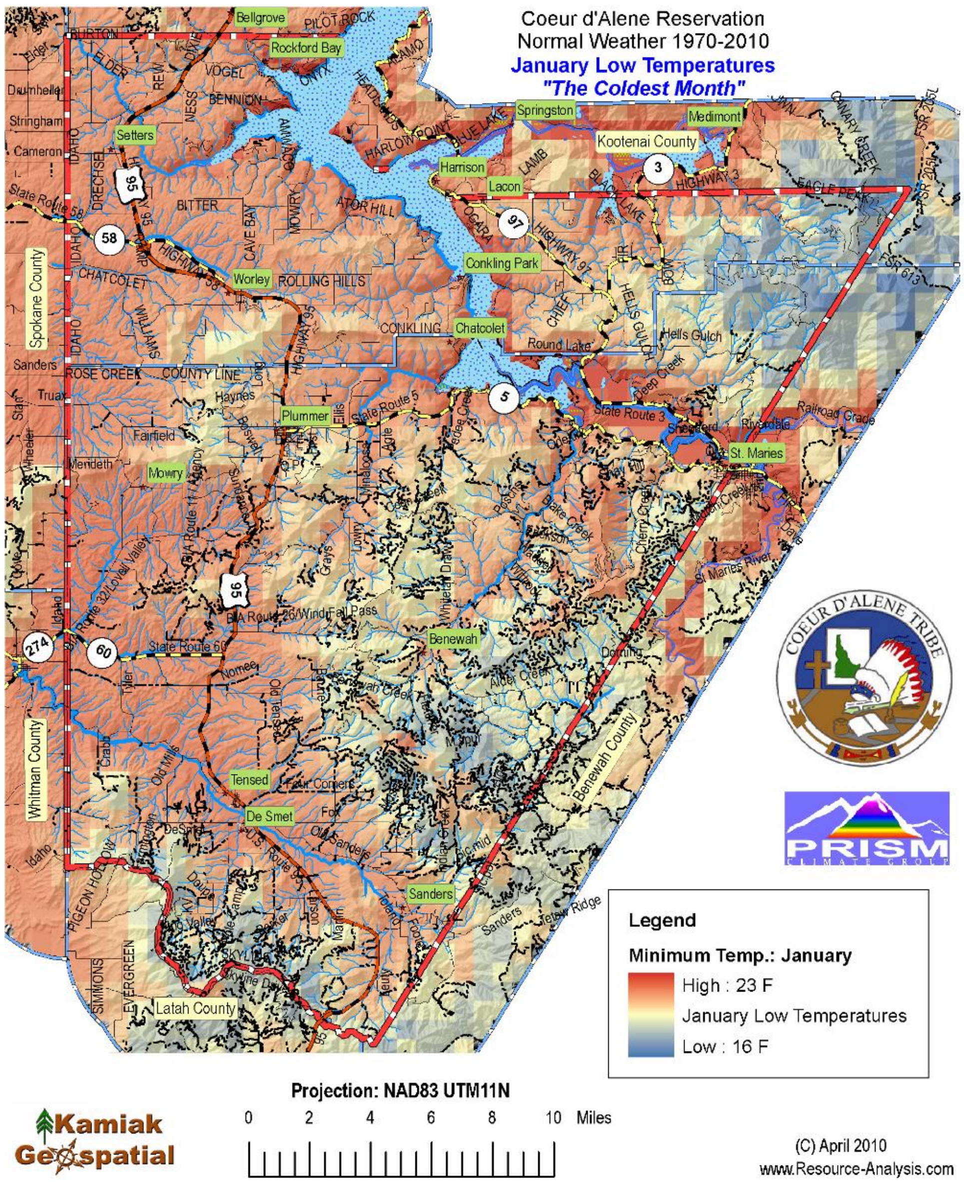
Temperature deviation within the Coeur d'Alene Reservation is equally variable in response to topographic lift and seasonal weather patterns. The average monthly hottest temperatures on the Coeur d'Alene Reservation are observed in July and August when the thermometer can climb to an average temperature of 81º F in St. Maries, Harrison, and other points along Coeur d'Alene Lake. Conversely the average monthly high in July and August is only 72º F along the ridgelines of the Reservation (0). That is not to say that the temperature on the Coeur d'Alene Reservation does not exceed these values – they do, these numbers are averages. The determination of the highest average temperature is completed by recording the high temperature recorded each day of the month for a 30 year period and creating an average monthly temperature based on those values.

Figure XXXVI. August Average High Temperatures on the Coeur d'Alene Reservation (PRISM 2010).



In contrast, the coolest month of the year on the Coeur d'Alene Reservation is generally seen in January when the average monthly low temperature reaches only 16º F along the upper ridgeline elevations of the northeastern corner and along the ridgelines of the eastern side of the Reservation. At the same time, average monthly low temperatures in St. Maries, Harrison, Rockford Bay and other points along Coeur d'Alene Lake will moderate to only 23º F (Figure XXXVII). The western side of the Reservation, on average, witnesses low temperatures in the neighborhood of 20º F during this coldest month of January. The outcome of these monthly low averages is determined much like the average high temperatures. In this case, the lowest daily temperatures are recorded each day of the month and then averaged for the entire month to determine the average low temperature across the Coeur d'Alene Reservation (PRISM 2010).

Figure XXXVII. January Average Low Temperatures on the Coeur d'Alene Reservation (PRISM 2010).



Monthly extremes of temperature show how the variation from the highest average monthly temperature in a selected month (e.g., August) may differ from the lowest average monthly temperature from the same month on the Coeur d'Alene Reservation by as much as 41º F (Table 24). At the other extreme, lowest average temperatures in January, the difference between the highest of the low daily temperatures and the lowest is nearly 19 º F (Table 24).

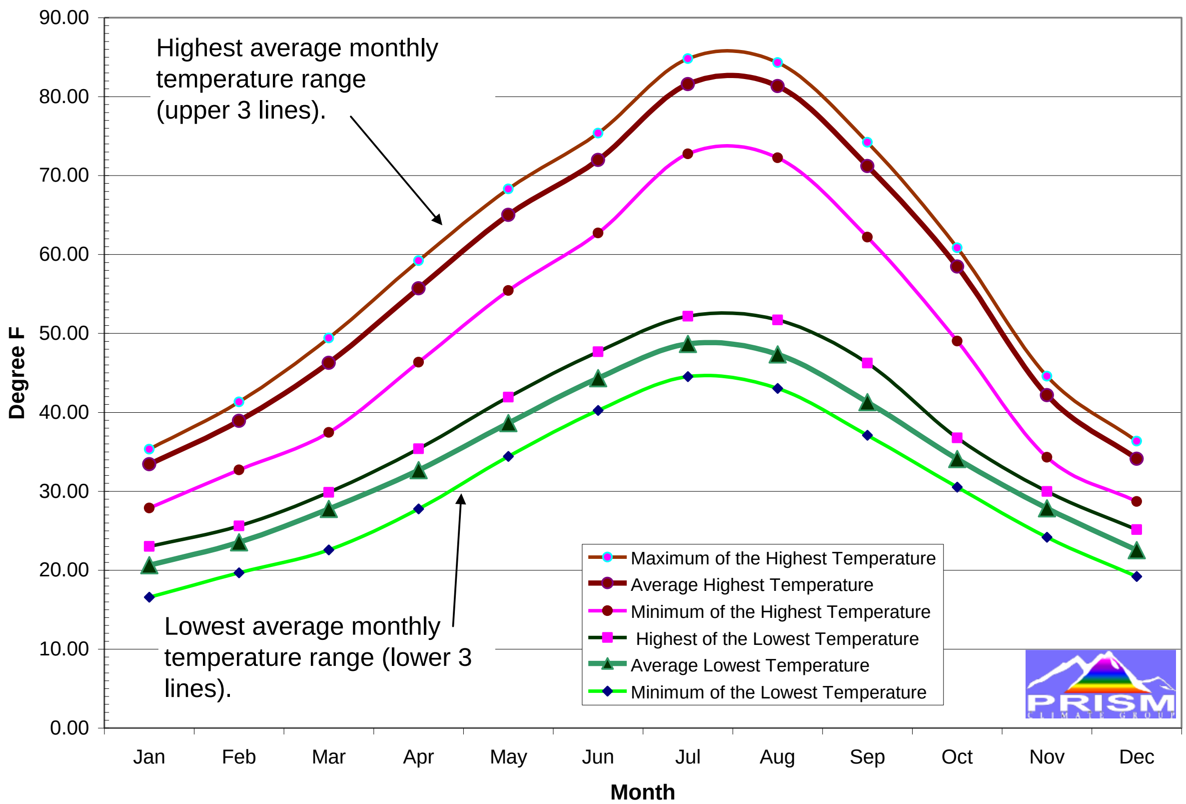
Table 24. Variations in Monthly Temperature Extremes within the Coeur d'Alene Reservation (PRISM 2010).

Lowest Monthly Temperature Extremes (º F)				Highest Monthly Temperature Extremes (º F)		
Month	Minimum Lowest Monthly Temperature	Average Lowest Monthly Temperature	Maximum Lowest Monthly Temperature	Minimum Highest Monthly Temperature	Average Highest Monthly Temperature	Highest Maximum Monthly Temperature
Jan	16.6	20.6	23.0	27.9	33.4	35.3
Feb	19.7	23.5	25.6	32.7	38.9	41.3
Mar	22.6	27.8	29.9	37.4	46.3	49.4
Apr	27.8	32.7	35.4	46.3	55.7	59.2
May	34.4	38.6	41.9	55.4	65.0	68.3
Jun	40.2	44.3	47.7	62.7	72.0	75.4
Jul	44.5	48.7	52.2	72.8	81.6	84.8
Aug	43.0	47.3	51.7	72.2	81.3	84.3
Sep	37.1	41.3	46.2	62.2	71.2	74.2
Oct	30.5	34.1	36.8	49.0	58.5	60.8
Nov	24.2	27.8	30.0	34.3	42.2	44.6
Dec	19.2	22.5	25.1	28.7	34.1	36.3

While precipitation variations across the Coeur d'Alene Reservation were presented to show the differences in monthly rainfall amounts, the same can be presented for temperature variations (Figure XXXVIII). The high temperatures seen on the Coeur d'Alene Reservation (0) exhibit the greatest variation between coolest and warmest locations during the period March through September (Figure XXXVIII), when the difference between the highest "high temperature" and the lowest "high temperature" is over 12º F. Cool temperature extremes throughout the year generally show a variation between 6º F and 7º F, although September historically has shown variations as much as 9º F between the highest of the "low temperatures" and the lowest of the "low temperatures" (Table 24).

These characteristics define the local temperate and precipitation ecotype known to this region that combines moderated temperatures (few extreme lows and few extreme highs) with infrequent and moderate amounts of rainfall delivered most months of the year.

Figure XXXVIII. Monthly temperatures showing the average temperature variations between the warmest and the coolest temperatures on the Coeur d'Alene Reservation (PRISM 2010).



Clouds and precipitation are greatly enhanced when air is forced to ascend the windward slopes of mountain barriers. Most major Northwest flooding events start with an extensive region of light-to-moderate precipitation linked to a strong Pacific low-pressure system and its associated fronts. This precipitation is then greatly increased, sometimes by factors of two-to-five times, as air ascends the mountains (Mass 2008). When moisture-laden storms move up the Columbia River and are not forced over the Cascade Mountains, where precipitation often is dropped in the process, it results in a storm system composed of rain clouds that will rotate northward to the region of the Coeur d'Alene Reservation. As the front moves eastward, the topographic uplift causes the dropping of often significant amounts of precipitation from the foothills of the eastern side of the Coeur d'Alene Reservation to the ridgeline of the Rocky Mountains. Frequently, these storms in the spring and fall are delivered in combination with high winds, thunder, and lightning.

4.3.3. Characterizing Extreme Weather

The Upper Columbia Plateau is essentially a large topographic bowl surrounded to the west by the Cascade Mountains, to the north by the Okanogan highlands, and to the east by the Rocky Mountains. The Blue Mountains of southeast Washington provide yet another rim to the buffer of the region. Even the exposure to the south in Oregon is met with higher elevations of the Oregon plateau and differential pressure systems. The low topographic relief provided by the Columbia River gorge only yields 750 feet at Lewiston, Idaho, on the Nez Perce Reservation. The exit to the Pacific Ocean by the Columbia River provides only a narrow drainage of atmospheric pressure.

4.3.3.1. Heavy Snowfall

During the winter, cold air is often trapped within this large basin for prolonged periods of time. Conditions leading to an inversion are common in this region during the winter with warmer air trapped above a layer of cold air at the surface.

Weather hazards in this area include the snowfall and subzero temperatures mentioned above. Winter storm winds in excess of 40 mph sustained with gusts over 50 mph occur about once or twice per year with more powerful storms less frequent. Normal rain and snow amounts are considered beneficial for the most part, although excessive heavy rain resulting in localized and more widespread flooding is possible (Livingston 2010).

Prolonged heavy snow can cause interruptions to commerce and over a season can result in a heavy snow pack and the possibility of spring snow melt flooding. Heavy rain-on-snow, coupled with antecedent sub freezing temperatures and a rapid warm up can result in serious stream, river and lake flooding. February 1996 and January 1997 precipitation and warming temperature events hit this area hard and the records show the re-occurrence of this phenomenon has been about once every 15 to 20 years and is expected to continue this frequency into the near future (Livingston 2010).

4.3.3.2. Cold Air Damming

When a Pacific weather system moves across the region in winter, the type of precipitation delivered to the Coeur d'Alene Reservation is determined by the temperature and depth of cold, low-level air in the basin and warmer temperatures above (Garratt 1992). Snow is observed when temperatures below and above are relatively homogeneous and cold. However, in case a layer of above-freezing air is located aloft, rain will fall into a subfreezing layer near the surface resulting in freezing rain or ice pellets (sleet). The temperature and type of precipitation differential occurring in the western and eastern sides of the Columbia Basin can be explained by the phenomenon called cold air damming (Miller 2007). It usually occurs when there is cold Arctic air and high pressure to the north with the cold air moving southward into the Columbia Basin through valleys in the Okanogan Highlands. This results in accumulation of the coldest, densest air on the western side of the basin producing high pressure on the eastern side of the mountain barrier (Mass 2008).

The topography of the Columbia Basin is ideally suited to cold air-damming events in the winter. The dome of cold air that is banked up against the eastern slopes of the Cascades is a critical factor in the weather for this area. Snow levels west of the Cascade crest will often rise to 5,000 feet or more, while on the east side of the Cascade crest, snowfall continues at the surface due to the process of cold air damming. Freezing rain events can be explained through this process as well, as the warmer air aloft from western Washington rides over the cold air dome trapped along the surface (Miller 2007).

4.3.3.3. Severe Thunderstorms

The region of the Coeur d'Alene Reservation has a long history of periodic, but infrequent, severe weather events impacting the economy and lives of the region. These events often come as storms that bring high winds, heavy rains, and are even combined with hail, snow, or freezing rain. Sometimes, the hardest hitting and largest impact storms are short bursts of a leading front moving from the Gulf of Alaska through the Cascade Mountains, into the Columbia Basin, and then into the region of the Coeur d'Alene Reservation where the Rocky Mountain foothills begin to lift the front causing precipitation to fall and the winds to swirl (Mass 2008).

Severe thunderstorms are infrequent with the greatest hazard considered to be wildfire during the dry summer months. Heavy rain from thunderstorms can cause localized flooding and difficult driving conditions, while true "gully washing" flash flooding from thunderstorm rain alone is very rare. Small soft hail is a frequent occurrence in the spring and early summer, but is not usually considered a hazard. Larger, more damaging hail can affect the area, but on an infrequent basis (**Error! Reference source not found.**). Damaging tornadoes are also very rare (**Error! Reference source not found.**, **Error! Reference source not found.**). Red-flag fire conditions occur annually when low humidity and high wind combine leading to dry conditions in the forests of the region. If preceded by a significant number of starts from lightning, the situation can be very hazardous and very difficult to contain (Livingston 2010).

4.3.3.4. Rain-on-Snow Events

Many years have witnessed rain-on-snow events that occur when warm air fronts bring the storms causing flash snow melt, accompanied by rains that can cause landslides and flooding. Although hurricanes are not seen in this region, “funnel clouds” have been reported and tornadoes have been witnessed, with measurable impacts to structures and the economy (2005). Sheered-off trees, broken power poles, torn-off roofs, flying debris (some the size of a car), and other severe weather-associated hazards can occur during these rare events (1995 and 2005 were example years). These are not comprehensive, of course, but they do serve to document the impacts individual storms can have on the residents of the Coeur d’Alene Reservation.

One example of a significant snow and freezing rain event is illustrative of impacts on this region during a November 18-19, 1996 event. Cold arctic air from Alberta and British Columbia was drawn to the south and west at low levels while a potent Pacific storm system brought warm moist air in from the west. Freezing rain collected on trees and power lines eventually becoming heavy enough to break tree limbs with the ice up to 1.5 inches thick. Tree limbs fell on power lines, causing approximately a hundred thousand Spokane County residents (in Washington) to be without electricity; some stayed without power up to nine weeks. Ten deaths and twenty-two million dollars of damage were attributed to the ice storm. A state of emergency was declared in Spokane County with President Clinton naming the region a federal disaster area (Mass 2008). Similar impacts were seen across the region.

In early February, 2009, a storm front moved into the Upper Columbia Plateau, bringing cold temperatures and approximately 24 inches of snowfall within a 72 hour period to the Coeur d’Alene Reservation. Following the deposit of the snowpack, temperatures changed as a warm front moved into the region and dropped rain on the snowpack. The result was a very high snow load on the roofs of many structures, in addition to region-wide flooding. While homeowners and emergency crews were able to shovel snow from the roofs of many buildings, some structures were damaged, while others completely collapsed under the weight of the wet snow on the roof (Figure XXXIX).

Figure XXXIX. Structural collapse under snow load along US 95, south of DeSmet and north of Sanders in February 2009.

4.3.3.5. Ice Storms

A storm producing significant thickness of freezing rain is often referred as an "ice storm". Freezing rain is notorious for causing travel problems on roadways, breaking tree limbs, and downing power lines in its wake. It is also known for being extremely dangerous to aircraft since the ice can effectively 're-mould' the shape of the airfoil (FAA 2010). Usually, freezing rain is associated with the approach of a warm front when cold air, at- or below-freezing temperature, is trapped in the lower levels of the atmosphere as warmth streams in aloft.

Freezing rain often causes major power outages. When the ice layer exceeds 0.2 inches, tree limbs with branches heavily coated in ice can break off under the enormous weight and fall onto power lines (or onto home roofs). Windy conditions, when present, will exacerbate the damage. Power lines coated with ice become extremely heavy as well, causing support poles, insulators, and lines, to break.

The ice that forms on roadways makes vehicle travel dangerous. Unlike snow, wet ice provides almost no traction, and vehicles will slide even on gentle slopes. Because freezing rain does not hit the ground as an ice pellet and is still a rain droplet when it makes contact with the ground, the freezing rain conforms to the shape of the ground surface, or objects such as a tree branches or cars before it freezes. This makes a continuous and thick layer of ice, often called glaze. Since sleet is in pellet form, it can be easily moved around, unlike freezing rain that is a continuous layer of ice and cannot be pushed by a snow plow.

4.3.3.6. Tornadoes

Tornadoes in the Inland Northwest are rare compared to some other North American locations. East of the Cascades, tornadoes are seen generally only in April and May, when the atmosphere is most unstable. It takes considerable time for the atmosphere to heat up after being chilled all winter, although the land surface is warmed rapidly by the powerful springtime sun. With cool temperatures aloft and warm temperatures near the surface, temperatures decrease rapidly with height: the necessary condition for tornado events. Tornado activity may continue into the summer because the lower atmosphere gets very warm due to a lack of ocean influence. Summertime tornado activity could be enhanced over eastern side of the Cascades due to the subtropical moisture that streams northward out of the Gulf of California into the northwestern interior region from late June into early September (Mass 2008).

On April 5, 1972, the deadliest and most intense Pacific Northwest tornado on record struck the Portland metropolitan area (Oregon). One of only three high intensity tornadoes ever observed over Oregon, Washington, and Idaho with winds estimated between 158 and 206 miles per hour, this storm touched down along Portland's waterfront and then crossed the Columbia into Vancouver, Washington, leaving a wake of destruction nine miles long and a quarter-mile wide. The 1972 tornado was embedded in an unusually strong line of thunderstorms that crossed the Cascade Mountains and produced another high-intensity tornado later that same day outside of Davenport, near Spokane, Washington (Mass 2008).

4.3.4. Probability of Future Events

Severe weather includes a variety of events, generally grouped together into the moniker of "severe weather". These individual events can combine into larger incidents. Taken individually, they include heavy rain, high winds, heavy snowfall, hail, thunder, lightning, extreme and prolonged cold, extreme and prolonged heat, and drought. When considered as individual events, the frequency of severe weather is expected once every five years and more frequently. The future frequency of events is expected to be at least this common.

When considering the influence of global climate changes on the occurrence and behavior of natural disaster events, severe weather appears to be most vulnerable to changes in periodicity and destructive force. Anecdotal reports in the national media, scientific journals, and observations of events, have described increasing rainfall, warming temperatures even at higher elevations, and increased energy delivered by storms. At the same time, human habitation has expanded its reach into areas previously not suited for permanent homes, businesses, or infrastructure. The combined effect of the spread of human developments with increased storm force can lead to frequent (multiple times each year) destructive force events.

Severe weather is a driving force of energy for other hazards such as wildfire and flooding. These disaster events will be discussed in further detail in subsequent sections of this document.

Predicting future severe weather events presents the same nature of predicting the weather next week, or next month. In general terms, the observer would expect that the future nature of severe weather events within the Coeur d'Alene Reservation would be similar to the histories documented in this planning document that illustrate extreme weather fluctuations, from occasional extreme warmth in the winter, to cold in the summer.

Generalizations about this extreme weather probability cannot be articulated as predictably as some of the other natural hazards, but conceptually it can be articulated as being responsive to the impacts of global climate change (Section 4.2, Global Climate Change). The changes to weather patterns have been observed during the past century. Unfortunately, that period of time limits our ability to make meaningful predictions about the ebb and flow of weather pattern changes. It is expected that severe weather impacts to the Coeur d'Alene Reservation will impact the region with the same pattern of damages, although the location and severity will be variable. It is also expected that new extremes will be witnessed during the next 50 to 100 years for all measurements of severity (e.g., wind speed and duration, rainfall daily extremes, drought intensity, river flow minimums and maximums, new high temperatures and new low temperatures).

4.3.5. Potential Mitigation Measures

Hazard exposure to the mix of high winds, high winds in combination with freezing rain or ice rain on the Coeur d'Alene Reservation, can be managed through the identification and trimming of hazard trees near homes and power lines. Ice on lines can cause power-line and telephone-line breakage leading to a disruption of communications and power for prolonged periods of time. Repairs to the system are often complicated because utility company repairmen must navigate stormy conditions while attempting to restore normal operations. Ice on area roadways can cause accidents and pose a hazard to both motorists and pedestrians.

Heavy snows can immobilize the Coeur d'Alene Reservation, isolate rural farms and homes, and cause the death of exposed animals. Heavy snowfall can clog roadways, immobilize transportation assets, and disrupt emergency and medical services. Roof-top snow accumulation can cause the collapse of buildings and death or injury to its inhabitants

The impact of prolonged winter storms on the local economy can be pronounced. The cost of snow plowing, de-icing, and overtime pay, can severely impact the budgets of the Tribe, Counties, Cities, and State jurisdictions. Disruption of transportation resources can impede the flow of food and supplies, and slow the economy.

Winter storms cause multiple fatalities each year resulting from vehicular accidents on icy or snow-clogged roads. Some people may die of heart attacks due to overexertion while shoveling heavy, wet snow. Each year, fatalities result from fires or carbon monoxide poisoning due to the use of alternative heating methods during storm-caused power outages. In more rare cases, individuals die of hypothermia from prolonged exposure to cold.

High winds take two distinctive forms on the Coeur d'Alene Reservation; as straight-line winds approaching from the southwest, west, or northwest and reaching wind gusts exceeding 50 mph or more, and downburst winds. Straight-line winds have caused trees to snap and fall across homes and utility lines, roofs to be ripped from the structures they cover, and even lead to the total displacement of structures. Downburst winds are no less frequent, but their destructive force is often isolated to localized impact areas, resulting in patches of downed trees, damaged buildings, and spoiled crops.

The forests of the Coeur d'Alene Reservation are extensive; the ponderosa pine, Douglas-fir, grand fir, western white pine, and western redcedar grow in sparse to dense forests. The forests have been replanted following timber harvesting activities and they have re-seeded naturally, to dominate open spaces especially along the shores of Coeur d'Alene Lake and the eastern side of the Reservation. Agricultural lands and less densely populated ponderosa pine forests are commonly found within the western side of the Reservation. The location of trees near homes, businesses, and infrastructure (within the WUI), often need to be treated on a frequent cycle (once every 5 years) to keep buildings and infrastructure safe from wind damage. Roads can be blocked and power lines can break during high-wind events. Emergency crews are dispatched to clear the roads and infrastructure when damages are found.

In light of high-wind warnings that have hit the Coeur d'Alene Reservation, it is recommended to initiate the service of incorporating high-wind warnings to the operation of the Emergency Evacuation Center (EOC). These services would include those presented in the following sub-sections.

Additional action items related specifically to severe weather include:

- Enter into the StormReady Program and facilitate the placement of a NOAA weather radio tower on the Reservation,
- Inspect both public and private buildings for snow-loading capacity (every 10 years),
- Inspect roofing material stability on public and private buildings to sustain high straight-line winds without displacement,

- Integrate severe weather pre-construction mitigation capabilities (roofing fasteners, snow-load capability, and related items) into Tribal building-code requirements,
- Acquire Radio Station equipment, license its use, and begin using as a public service station for residents and visitors to the Coeur d'Alene Reservation that can be activated during emergency situations,
- Purchase and install back-up generators for evacuation site use during emergencies.

4.3.5.1. High Wind Safety Actions – ahead of the storm

- Verify that homes meet current building code requirements for high-winds. Experts agree that structures built to meet or exceed current building code high-wind provisions have a much better chance of surviving violent windstorms.
- Protect windows by installing commercial shutters or preparing 5/8 inch plywood panels that can be installed or disassembled as needed in the face of severe storms.
- Garage doors are frequently the first feature in a home to fail. Reinforce all garage doors so that they are able to withstand high winds.
- Once a year, assess properties to ensure that landscaping and trees do not become a wind hazard from breakage.
    i. Trim dead wood and weak / overhanging branches from all trees.
    ii. Certain trees and bushes are vulnerable to high winds and any dead tree near a home is a hazard.

4.3.5.2. High Wind Safety Actions – as a severe storm approaches

- Most mobile / manufactured homes are not built to withstand severe straight-line or downburst winds. Residents of homes not meeting that level of safety should relocate to a nearby safer structure once Coeur d'Alene Tribe EOC officials issue a severe-wind evacuation order.
- Once a severe-wind evacuation warning is issued by the National Weather Service, time should be sufficient to install window shutters or plywood panels.
- When a severe-wind evacuation warning is issued, residents should secure or bring inside all lawn furniture and other outside objects that could become a projectile in high winds.
- Residents should listen carefully for safety instructions from Coeur d'Alene Tribe EOC officials, and go to designated "Safe Rooms" or "Evacuation Centers" when directed to do so.
- Residents should monitor NOAA Weather Radio channels for updates.
- Residents are encouraged not to leave the "Safe Room" until directed to do so by local officials, even if it appears that the winds calmed.

4.4. Floods

Flooding and storm water accumulation is more widespread along the edges of rivers and lakes. Flooding can impact any area where water accumulates on the surface and reaches a structure, road surface, or sensitive vegetative area.

4.4.1. Tribal Legends

Deluge legends are generally mythical stories of a great flood sent by a deity or deities to destroy civilization as an act of divine retribution, and are featured in the mythology of many cultures.

4.4.1.1. The Nka'memen Water-Mystery

A legend of the water-mystery is retold by Teit *et al.* (1917):

> "Near the head of the St. Joe River is a lake called Nka'memem (Swallowing). When people looked at it, sticks jump out of the water. Once two brothers came out on the ridge above the lake. They had been hunting, and were very thirsty. The elder brother asked the other to bring him some water. The younger brother refused, saying, "No one goes near this lake!" The elder said, "I shall die if water is not brought to me." The younger then descended, drew some water quickly, and ran uphill as fast as he could. The water of the lake followed him. He put down his bucket alongside his brother, and ran down the other side. He looked back, and saw a wave rise over the top of the ridge where his brother was, and stand up there for a while. When it disappeared, he went back and found his elder brother drowned."

4.4.2. Understanding Water Related Damages

Flooding is a natural process that occurs when water leaves river channels, lakes, ponds, and other water bodies where water is normally confined and expected to stay. It is also a serious and costly natural hazard affecting all of the Upper Columbia Plateau when it occurs around buildings and infrastructure. Floods damage roads, farmlands, and structures, often disrupting lives and businesses. Flood-related disasters occur when property and lives are impacted by the flooding water. An understanding of the role of weather, runoff, landscape, and human developments in the floodplain is therefore the key to understanding and controlling flood-related disasters.

Natural flood events on the Coeur d'Alene Reservation are grouped into five general categories:

1. **Riverine Flooding:** a rise in the volume of a stream until that stream exceeds its normal channel and spills onto adjacent lands.
    a. **Slow kinds:** Runoff from sustained rainfall or rapid snowmelt exceeding the capacity of a river's bank-full width. Causes include heavy rains from monsoons, hurricanes and tropical depressions, warm winds and, more commonly on the Coeur d'Alene Reservation, warm rainfall landing on a deep and frozen snow pack (rain-on-snow events).
    b. **Fast kinds:** Runoff causes a flash flood as a result of an intense and often prolonged thunderstorm or a rain-on-snow event coupled with high rainfall in lower altitudes.
2. **Flash Flooding:** Flash flooding results from high water velocity in a small area but may recede relatively quickly. These floods are generally fed by low-order streams and occur in headwater areas. Streams prone to flash flooding do not possess the expansive floodwater storage area that higher-order streams typically possess. Flood storage areas are identified by wide and flat valley bottoms where flood waters decrease flow velocity, drop sediment load, and then re-enter the main stream channel. Low-order streams, especially in north Idaho, are typically confined to steep "V" shape valley bottom lands where channel widening does not occur. The only path for water to follow is the main stream channel where volume increases with heavy rain and snowmelt, causing water velocity to increase accordingly. Flash flooding is the combination of high water volume

with high water velocity. When a topographic widening of the valley is found, a flash flood is the result. The joining of two or more low-order streams into a floodplain, or a floodplain with high-order streams can accelerate into a riverine flood type, often of the "fast kind".

3. **Ice/Debris Jam Flooding:** Floating debris or ice accumulates at a natural or man-made obstruction in rivers and restricts the flow of water, causing it to leave the bank-full width of the river and spill onto the floodplain and beyond. This flood type is common along the St. Joe River in response to the steep canyon walls geographically arranged to receive little or no water-melting sunlight as the valley drops elevation on its approach to Coeur d'Alene Lake. In the case of the St. Joe River specifically, the constriction is a natural narrowing of the river channel near Calder (in Shoshone County) and the debris is ice accumulation from the river and its tributaries. This natural ice dam can occur anywhere from the general area of Calder all the way into St. Maries. When this is witnessed, flooding around the ice-dam impacted areas can flood homes, roads, and significant infrastructure.
4. **Mud Floods or Muddy Floods:** These flood types result from super-saturated soils on moderate to steep slopes that are generally destabilized by types of development (road building, structure construction) or other disturbance (landslides, or drastic changes in vegetation cover). The flow of these super-saturated soils can follow the same path as water down ravines, and in the process displace flood zones with heavy concentrations of mud and debris. While these are most common on croplands (such as the Hangman Creek watershed), they can also occur on harvested forestlands (such as the Benewah Valley), and in high-impact housing developments (such as those found along the bluffs surrounding Coeur d'Alene Lake and within the Reservation). Muddy floods are a hillside process and not the same as mudflows, which are a mass-wasting process discussed in the Landslides Section (Section 4.6) of this document. Muddy floods primarily lead to damage of road infrastructure (leaving a mud blanket or clogging sewage networks) and private property.
5. **Catastrophic Flooding:** These floods are caused by a significant and unexpected event such as a dam breakage or levee failure. Sometimes these floods are triggered by other natural or man-caused hazards such as an earthquake, landslide, volcanic eruption, or dam failure.

Flood damages are assessed in three related categories:

1. **Primary Effects:**
    a. Physical damage: These damages include harm to buildings, bridges, cars, sewer systems, roadways, canals, and any other type of structures,
    b. Casualties: Described as the number of people and livestock that die due to drowning, leading to epidemics and diseases.
2. **Secondary Effects:**
    a. Water supplies: Can lead to the contamination of water. Clean drinking water becomes scarce.
    b. Diseases: Unhygienic conditions are present. Spread of water-borne diseases occurs.
    c. Crops and food supplies: Shortage of food crops can be caused due to loss of an entire harvest.

d. Trees: Tree species not tolerant to prolonged subsurface water saturation can die from suffocation.

3. **Tertiary and Other Long-Term Effects:**

    a. Economic: Economic hardship due to a temporary decline in tourism, rebuilding costs, and food shortage leading to price increase.

The most commonly observed flood type on the Coeur d'Alene Reservation is a Riverine Flood. A "base flood" is the magnitude of a flood having a one-percent chance of being equaled or exceeded in any given year. Although unlikely, "base floods" can occur in any year, even successive ones. This magnitude is also referred to as the "100-year Flood" or "Regulatory Flood" by state government (IBHS 2008).

The low-relief areas adjacent to the channel that normally carries water, are collectively referred to as the floodplain. In practical terms, the floodplain is the area that is inundated by floodwaters. In regulatory terms, the floodplain is the area that is under the control of floodplain regulations and programs (such as FEMA's National Flood Insurance Program, which publishes the Federal Insurance Rate Maps, or FIRM maps). Idaho State Code (IBHS 2008) defines the floodplain as:

> *"That land that has been or may be covered by floodwaters, or is surrounded by floodwater and inaccessible, during the occurrence of the regulatory flood."*

4.4.2.1. Beavers

The beaver is considered a keystone species by many wildlife biologists, endowed with the ability to enhance biodiversity through the creation of beaver ponds and wetlands (Wright *et al.* 2002). These riparian habitats enlarge the perimeter of the un-dammed two-bank profile of a stream allowing aquatic plants to colonize newly available habitat. Insect, invertebrate, fish, mammal, and bird diversity are also expanded by the creation of these beaver dams (Rosell *et al.* 2005). Beavers perform a key role in ecosystem processes, because their foraging has a considerable impact on the course of forest succession, species composition and the structure of plant communities.

The presence of beaver dams in streams creates flood conditions behind the dam structure (Pollock *et al.* 2004). The North American Beaver builds lodges along rivers, streams, lakes, and ponds in order to ensure water around their lodges that is deep enough to prevent the freezing of the site during the cold winter months. Beavers dam streams to create a pond where their lodge can be located. During this process of damming the stream, the beaver dams flood areas of surrounding forest and fields, giving the beaver safe water access to leaves, buds, and inner bark of growing trees for food (Rosell *et al.* 2005). Beaver typically prefer hardwoods but will feed on softwood cambium as well and will also eat cattails, water lilies and other aquatic vegetation, especially in the early spring. Contrary to widespread belief, beaver do not eat fish (Young 2007). In areas where their pond freezes in winter, beavers will collect food supplies (tree branches) in late fall, to store them underwater (usually by sticking the sharp chewed base of the branches into the mud on the pond's bottom), where they can be accessed throughout the winter. Often the stockpile of branches will project above the pond and collect snow. This insulates the water below it and keeps the pond open at that location (Rosell *et al.* 2005).

A British fur trader, David Thompson, during the mid 19th century, described the "sagacity" of the beaver. In his written words, "Beaver dams were so cleverly constructed that no amount of water could damage them, whereas those erected 'by the art of man' – apparently a lesser art – were frequently washed away." Another fur trader from the era, Ross Cox, commented on the "dexterity in cutting down trees, their skill in constructing their houses, and their foresight in collecting and storing provisions". Cox was moved to comment on their social organization of labor: nothing could be more wonderful, he suggested, than the skill and patience shown by parties of twenty or thirty beaver coming together to build their winter lodges. A few of the older animals superintended the felling of trees and processing of logs. According to Cox, “it is no unusual sight to see them beating those who exhibit any symptoms of laziness. Should, however, any fellow be incorrigible… he is driven unanimously by the whole beaver tribe to seek shelter and provisions elsewhere.” Such outcasts, the Indians called “lazy beaver”, according to Cox. Those beaver were condemned to a winter of hunger, and as a result their fur was not half as valuable as that of those beaver whose “persevering industry” assured them of protection from the elements (Verbert 1997).

On the Coeur d’Alene Reservation, beaver activity has been in a documented decline for many decades. The primary issue of Beaver dams on the Coeur d’Alene Reservation is seen when dams block the normal flow of water moving through road/stream crossing structures causing water to backup to form a pond. This occurrence does not usually lead to a disaster event, but, when beaver dams plug culverts or restrict stream flow under bridges, water cannot flow normally past the road crossing. During high flow events the water will release pressure by cresting over the road and eroding it into the stream.

Further complications of these beaver dams happen when beaver dam waters are found in relatively flat terrain (such as within the Hangman Creek watershed), causing water to overtop roads. Vehicle traffic often “splashes” through these wet crossings causing sediment to be pumped off the road bed and into the streams (Green 2010). This causes potentially detrimental effects to fisheries while degrading the road quality.

Although a single beaver dam may have little influence on stream flow quantity, a series of dams can have a significant results (Grasse 1951) by moderating the peaks and troughs of the annual discharge patterns, including flood water events. During low flow periods of the year, Duncan (1984), working in an Oregon watershed, determined that up to 30% of the stream network’s water was retained in beaver ponds. The general hydrologic pattern of the Coeur d’Alene Reservation, and the Upper Columbia Plateau generally, is peak rainfall and stream flows during the winter and spring months with decreasing flows in the late summer and early fall pending the arrival of rains. By increasing storage capacity in the form of beaver ponds, it has been suggested that large numbers of beaver dams can lead to greater stream flows during late summer, this low-flow period (Parker 1986), which may result in continual flows in previously intermittent streams (Yeager and Hill 1954, Rutherford 1955).

Beaver dams, depending on their number and location, may decrease peak river discharge and stream velocity during a flood event, thereby reducing erosion potential associated with the flood event (Parker 1986) and possibly reducing flood impacts downstream (Bergstrom 1985).

Although beaver dams can reduce the severity of flooding events, they may contribute to them if dam failure occurs (Butler 1991). The failure of a beaver dam on a small stream in Alberta produced an estimated flood wave which was 3.5 times the maximum discharge recorded over a 23-year period on that stream (Hillman 1998).

4.4.3. Determining the Floodplain on the Coeur d’Alene Reservation

This Tribal Hazard Mitigation Plan effort has defined the floodplain for the Coeur d’Alene Reservation through the FIRM Map designations listed as finalized in September 2009 and shown on several maps referenced in this document. These FIRM maps were approved by FEMA while cooperating with both Kootenai County and Benewah County. While these efforts have mapped some significant floodplains within the Coeur d’Alene Reservation, the efforts failed to capture many of the populated places important to Tribal members on the Reservation. In general, the FIRM mapping completed by FEMA has captured the floodplains of the incorporated cities on the Reservation, the St. Joe River, Coeur d’Alene Lake, and lands held in

Trust by the Federal Government for the Coeur d'Alene Tribe. Several populated places, such as the Hangman Creek watershed, Benewah Valley, and others, have not been analyzed for FIRM by FEMA.

FEMA has not mapped the FIRM on much of the Coeur d'Alene Reservation. In an effort to provide the Coeur d'Alene Tribe with an initial regulatory basis to design floodplain protection strategies within the Coeur d'Alene Reservation, Kamiak Ridge developed an assessment of the floodplains within the exterior boundaries of the Coeur d'Alene Reservation (Figure XL).

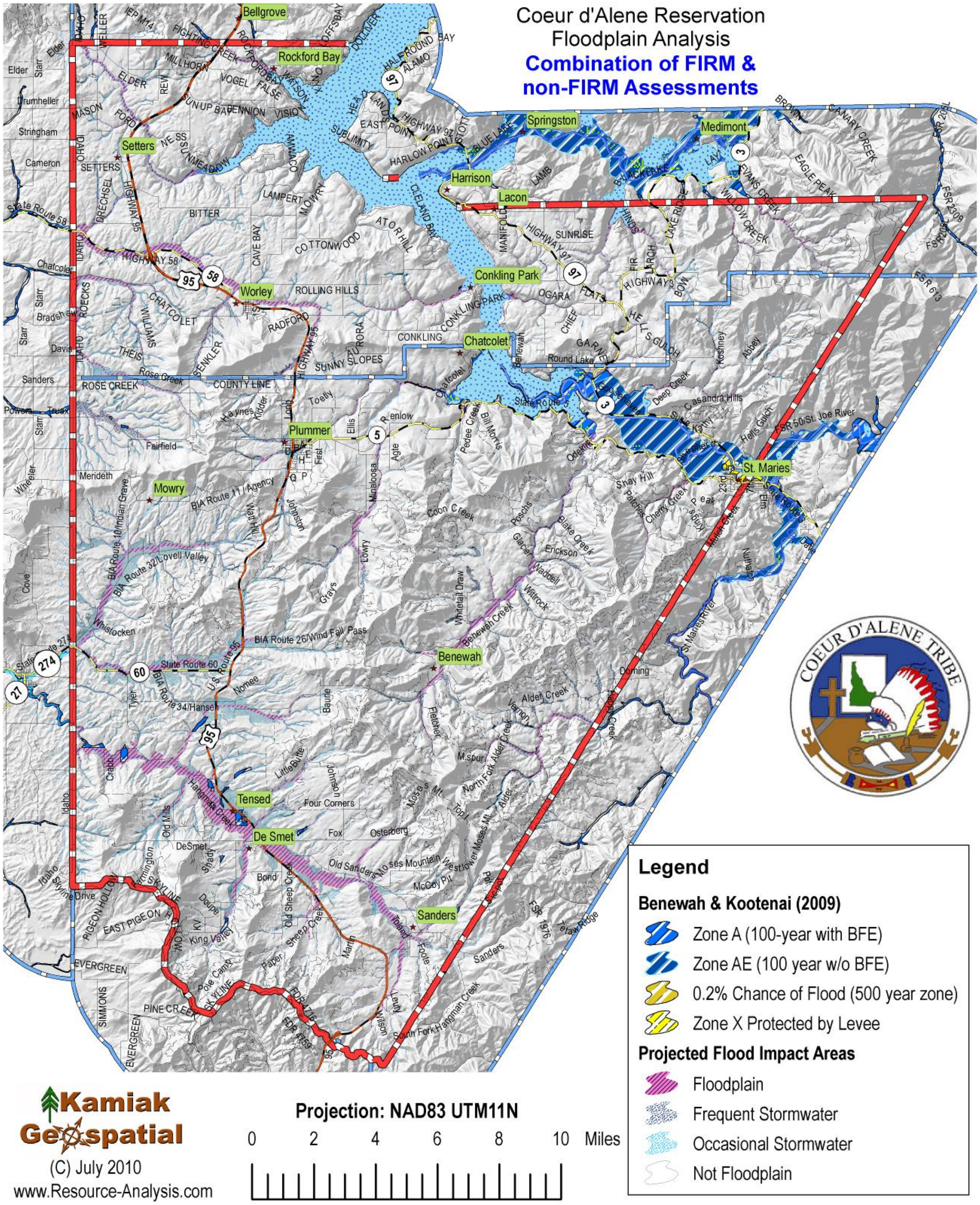
This floodplain assessment utilized soil survey data generated by the Coeur d'Alene Tribal GIS Department, topographic data (1 meter resolution digital elevation models (DEM)), and field sampling of recent historical flood events. These field sampling events involved visits to Hangman Creek watershed, the Benewah Valley, Fighting Creek, Rock Creek, and other locations to record the locations of past floods identified by local residents, and physical evidence, with a portable Global Positioning System (GPS) unit. The year of the flood event and the location were used to create a database to reconcile the flood magnitude with the precipitation and river flow levels when available. These data combined to create an initial assessment of Projected Flood Impact Areas within the Coeur d'Alene Reservation.

These data do not replace FEMA-derived and approved FIRM designations of flood zones. These floodplain estimates do not qualify as floodplain designations for entry into the NFIP. Those decisions must be made by the Coeur d'Alene Tribe leadership in cooperation with FEMA. When, and if, that happens, and if the Coeur d'Alene Tribe enters the NFIP, then FEMA and the Coeur d'Alene Tribe may enter into an agreement to create FEMA-derived FIRM assessments. That process may take years to complete.

The assessment completed for this planning effort is intended to allow the Coeur d'Alene Tribe the tools to begin regulating the development of the critical floodplains on the Coeur d'Alene Reservation in the effort of protecting people, structures, infrastructure, the environment, the economy (especially fisheries), and the traditional way of life.

Maps of predicted flood risks are presented on large-scale and small-scale wall maps and have been used for planning purposes and public display at meetings (Figure XL).

Figure XL. Potential Flood-Impact Areas of the Coeur d'Alene Reservation.



4.4.4. Weather

Winter weather conditions are the main driving force in determining where and when base floods will occur. The type of precipitation that a winter storm produces is dependent on the vertical temperature profile of the atmosphere over a given area. The Upper Columbia Plateau experiences riverine flooding from two distinct types of meteorological events:

- spring runoff and
- winter rain/snowmelt events.

The major source of flood waters in the Upper Columbia Plateau is normal spring snow melt. As spring melt is a "natural" condition, the stream channel is defined by the features established during the average spring high flow (bank-full width). Small flow peaks exceeding this level and the stream's occupation of the floodplain are common events.

Unusually heavy snow packs or unusual spring temperature regimes (e.g., prolonged warmth) may result in the generation of runoff volumes significantly greater than can be conveyed by the confines of the stream and river channels. Such floods are often the ones that lead to widespread damage and disasters. Floods caused by spring snow melt tend to last for a period of several days to several weeks, longer than the floods caused by other meteorological events.

Floods that result from rainfall on frozen ground in the winter, or rainfall associated with a warm, regional frontal system that rapidly melts snow at low and intermediate altitudes (rain-on-snow), can be the most severe. Both of these situations quickly introduce large quantities of water into the stream channel system, easily overloading its capacity.

These situations are also amplified by ice-jam flooding events common to the St. Joe River. This river drainage is especially problematic because it is directionally aligned east to west with steep banks rising over a thousand feet on both sides. The topography eliminates solar radiation to the river bottom during the winter, leading to accumulations of river ice. However, the south facing slopes of the St. Joe River commonly receive enough solar radiation to melt snow accumulations, leading to snowmelt overland flow that eventually mixes with the river ice to cause ice jams.

On small drainages, the most severe floods are usually a result of rainfall on frozen ground but moderate quantities of warm rainfall on a snow pack, especially for one or more days, can also result in rapid runoff and flooding in streams and small rivers. Although meteorological conditions favorable for short-duration warm rainfall are common, conditions for long-duration warm rainfall are relatively rare. Occasionally, however, the polar front becomes situated along a line from Hawaii through Oregon and warm, moist, unstable air moves into the region. Most winter floods develop under these conditions, as was the case with the northern Idaho floods of 1996 (IBHS 2007).

In general, the meteorological factors leading to flooding are well understood. They are also out of human control, so flood mitigation must address the other contributing factors leading to losses.

4.4.5. Topography and Geographic Influences

The nature and extent of a flood event is the result of the hydrologic response of the landscape. Factors that affect this hydrologic response include soil texture and permeability, land cover and vegetation, land use, and land management practices. Precipitation and snowmelt, known collectively as runoff, follow one of three paths, or a combination of these paths, from the point of origin to a stream or depression: overland flow, shallow subsurface flow, or deep subsurface ("ground water") flow. Each of these paths delivers water in differing quantities and rates. The character of the landscape will influence the relative allocation of the runoff and will, accordingly, affect the hydrologic response.

Unlike precipitation and ice formation, steps can be taken to mitigate flooding through manipulation or maintenance of the floodplain. Insufficient natural water-storage capacity and changes to the floodplain landscape can be offset through water storage and conveyance systems that run the gamut from highly engineered structures to constructed wetlands.

Careful planning of land use can build on the natural strengths of the hydrologic response. Re-vegetation of burned slopes diverts overland flow (fast and flood producing) to subsurface flow (slower and flood moderating). Details on rehabilitating burned areas to reduce flash floods, debris flows, and landslides can be found in the Landslide section of this document (Section 4.6).

The amount, location, and timing of water reaching a drainage channel – from natural precipitation and controlled or uncontrolled reservoir releases – determines the flow at downstream locations. Some precipitation evaporates, some slowly percolates through soil, some may be temporarily sequestered as snow or ice, and some may produce rapid runoff from surfaces including rock, pavement, roofs, and saturated, or frozen ground. The fraction of incident precipitation promptly reaching a drainage channel has been observed from nil, for light rain on dry, level ground, to as high as 170 percent for warm rain on accumulated snow (Babbitt & Doland 1949).

One major and three minor stream systems within the Coeur d'Alene Reservation are the St. Joe River (major), and Hangman Creek, Benewah Valley, Plummer Creek, and the Rock Creek systems (minor). The St. Joe River system drains lands to the east all the way to the crest of the Rocky Mountains. Hangman Creek drains the uplands of the southern extent of the Coeur d'Alene Reservation, while Plummer Creek drains much of the central portions of the Reservation. The Benewah Valley drains a relatively narrow high elevation cleft between two parallel ridgelines where precipitation is higher than the lands to the west, and solar radiation is limited in the winter, leading to higher-than-average snow packs. Hangman Creek exits the Coeur d'Alene Reservation where it enters the State of Washington on its journey to Spokane, Washington. Both Plummer Creek and the Benewah Valley cut their way through the upper plateau on its way to Coeur d'Alene Lake. Rock Creek flows past the City of Worley, parallel to US 95, where it crosses near the Coeur d'Alene Casino, and the premiere Circling Raven Golf Club. Rock Creek flows north, then crosses under US95 on its journey westward and off the current Coeur d'Alene Reservation and into the State of Washington, near Rockford in Spokane County.

Although several land-use plans have been developed for floodplains around the world, few are as compatible with the floodplain as this pristine 620 acre golf course.

4.4.5.1. Understanding Stream Order as an Analysis Tool

Stream-order classification is an analysis tool for understanding the mechanisms of stream channels and water conveyance through the network of river systems. Stream-order numbers convey information about the number of streams converging as the network grows. The Shreve Stream Order is a specific variant of this tool. This method of stream ordering by magnitude was proposed by Shreve (1967) and is widely used today. All streams with no contributing tributaries are assigned a magnitude (order) of one. Magnitudes are additive down slope. When two streams intersect, their magnitudes are added and assigned to the downslope link.

Using this set of criteria, low-order streams are typical of headwater streams. High-order streams represent areas where potentially hundreds of "first-order streams" have converged to create a large river system, such as the St. Joe River or the Coeur d'Alene River. Shreve Stream Order values will be discussed in the flood analyses for each community in this document and will be used to express flood characteristics defined above.

Conceptually, the higher the Shreve stream-order value, the higher the potential for that segment of the stream to exhibit characteristics consistent with riverine floods. Shreve stream-order segments with low magnitude are generally more consistent with a flash-flood profile, because in most instances these segments of the system do not possess the flat-valley-bottom profile consistent with a broad flood zone.

4.4.6. History

The Coeur d'Alene Reservation has experienced a long history of high-magnitude floods since first recorded in 1894, typically recorded as "50-year" or "100-year" flood events. The diverse landscape and weather patterns within the Upper Columbia Plateau are the triggers for those high-magnitude floods. Rain-on-snow events and above-normal spring high temperatures are typical antecedents to spring floods. The combination of these two factors can be devastating and can cause extraordinary flooding events. When coupled with ice-jam flooding along the St. Joe River, the combination of flood-event impacts can be unpredictable and disastrous.

Damaging flood events were first recorded in the St. Joe River watershed, in the St. Maries region as early as 1894, with subsequent floods recorded in 1896, 1917, 1933, 1938, 1948, 1956, 1964, 1974, 1996, 1997, and 2008 (Clement & Young 2010, Schlosser 2010).

Major flooding typically occurs during winter and spring seasons and is often triggered by rain-on-snow events. The conditions of an annual winter snow pack with an inversion weather system that brings above-freezing temperature rains to the headwaters of the area lead to the highest stream water flows. These conditions can turn a normal-level water flow in rivers to extreme-flow surges within five days that remain above flood stage for as long as two weeks.

Normal-flow exacerbation of the water transport system in the region's rivers is caused by infrastructure development in the form of bridges and the construction of roads beside rivers during the past 100 years. Additional aggravation of the normal water transport system can be witnessed by structural developments placed within the regulatory flood zone that restrict the functioning of water transport systems. The case of infrastructure developments on the Coeur d'Alene Reservation in the form of bridges and roads beside rivers has caused a definable complication to the normal flow of water in the region's streams and rivers. Examples of this have been seen along the St. Joe River and Hangman Creek systems as bridges have been overtopped or became part of debris dams during high-water events. The St. Joe River Road was placed alongside the major river drainage of the same name and has modified the unrestricted water profile.

Table 21 and Table 22 detail many past hazard events on the Coeur d'Alene Reservation. A cursory look through these events reveals that many were related to flooding. The following discussion looks at some of the recent and more historical flood events impacting the Coeur d'Alene Reservation.

4.4.6.1. 2008 Flood Events

According to the National Weather Service the Idaho Northern Panhandle had been receiving unprecedented snow falls unlike any seen in the previous ten years.

On February 14, 2008 Benewah County started breaking the ice out of Coeur d'Alene Lake to the start of slack water on the St. Joe River. This was to keep ice jams from developing when the spring runoff started.

On February 20, 2008 the National Weather Service projected that the St. Joe River at St. Maries would hit flood stage in late March. They projected a 90% chance the water level at St. Maries would be between 32.2 feet to 33.2 feet with a 10% chance it might be higher than 33.2 feet.

On March 13th, a meeting was held in Pinehurst with emergency responders from Kootenai, Shoshone and Benewah Counties. This was a planning meeting on how counties and agencies would respond to the anticipated 2008 spring flood.

Benewah County started to collect additional sandbags from the Idaho Bureau of Homeland Security in Boise and from the Army Corp of Engineers in Albeni Falls, Idaho.

March 14-15: A “flood-fight” course was held in St. Maries. This class was offered by the Institute of Emergency Management.

April 9: The National Weather Service predicted that the St. Joe River at St. Maries would crest during the 2nd or 3rd week of May between 32 to 34 feet.

April 14: The temperatures turned 10 to 15 degrees below normal with snow levels dropping down to 2,500 feet.

April 16: The National Weather Service predicted that the flood stage at St. Maries would reach 120% to 150% above the normal seasonal flow.

May 9: The National Weather Service predicted that the peak flow of the St. Joe River at St. Maries would be about 35 feet during the first week of June.

May 15: The National Weather Service predicted that the St. Joe River at St. Maries would hit flood stage on Sunday, May 18th, and be at 35.08 feet by mid day on May 21st and then level off to 33.3 feet. They projected that the river elevation could hit 36 feet. The Army Corp of Engineers was notified and they started to be mobilized toward St. Maries. Near-record temperatures were recorded May 16 and 17th. Levee monitoring was started looking for boils and problems along the toe of the levees. Sand was positioned for the filling of sand bags.

May 17: Warm temperatures along with rain started in the region. The National Weather Service forecast the St. Joe River at St. Maries would exceed 36 feet late May 19 or May 20. The elevation of the St. Joe River at St. Maries was affected by the high water conditions in Coeur d’Alene Lake that held back the water flow from the St. Joe River.

May 22: The Benewah County Commissioners declared a State of Emergency due to the anticipated flooding caused by the excessive snow pack and warm temperatures above 80 degrees during the day and temperatures above freezing during the night.

May 22: The St. Joe River Crested at 36.94 feet.

June 9: The St. Joe River at St. Maries dropped below flood stage.

Kootenai County declared a disaster on May 16, 2008, due to the imminent threat of floods. As the Coeur d’Alene River reached flood stage in Cataldo, ground water and seepage from the dike created flooding in that area. A tractor and pump, manned by personnel from the Shoshone County Fire District, was setup in Cataldo and pumping operations began on May 18, 2008. People continued to drive on flooded roads putting themselves as well as emergency responders in danger.

On May 22, 2008, the Benewah County Commissioners declared a State of Emergency due to repetitive winter storms causing a great buildup of snow in Benewah County and the potential for flooding in anticipation of the snowmelt accompanied with the imminent ice-jam flooding along the St. Joe River (Schlosser 2010).

A Presidential Disaster Declaration (1781) for Kootenai and Shoshone Counties was issued for May 15 to June 9, 2008. Latour Creek Road was flooded as well as other roads near the Coeur d’Alene River (Clement & Young 2010).

Figure XLI. Bike trail parking lot at Hwy 3, near South Black Rock Road, on May 20, 2008, along the lower Coeur d'Alene River.

The Kootenai County Sheriff's Marine Division staged in Cataldo with a boat provided transportation to the more than 200 residents cut off from access and services. A pregnant female was evacuated, as birth was imminent, and she resided in a no-access area. An elderly female was evacuated from her home as she did not have basic services. The Kootenai County Mobile Command Center was staged in Cataldo to monitor and coordinate flood operations. It was later positioned in Rose Lake as flood waters moved down the Coeur d'Alene River Basin (Clement & Young 2010).

On May 22, 2008, sandbagging operations began along the Spokane River including Harbor Island. On May 23, 2008, pumps were brought in to pump water out of Harbor Island. Sand and sandbags were delivered out to various sites in the county for sandbagging operations throughout the incident period (Clement & Young 2010).

Many of the damages cited by the Idaho Governor in the State Disaster Declaration recognized severe damages to roads and bridges, with an initial estimate of $1.9 million. On July 31, 2008, President Bush declared a major disaster for Idaho, focused on helping local government and tribal entities and certain nonprofit organizations in the two counties recover from damages caused by flooding between May 15 and June 9, 2008. The counties named in the declaration to receive help were Kootenai and Shoshone (FEMA 2008).

Approximately 19 roads were closed at one time in Kootenai County due to flooding. Various boat launches and ramps were also closed due to high water. A no-wake zone went into effect on the Coeur d'Alene and Spokane Rivers and Coeur d'Alene Lake during high waters to prevent more damage to homes and erosion of the shores, as well as public safety issues due to the excessive debris. Large pieces of debris including docks and whole trees were observed floating in the water systems. The County requested assistance from the state of Idaho to assist with assessment and debris removal (Clement & Young 2010).

The Latour Creek Bridge approach was washed out stranding residents. Many roads throughout the region were damaged due to the high waters, winds, and debris. Portions of "Rails to Trails" system were washed out and flooded (Clement & Young 2010).

Figure XLII. Bridge approaches were compromised along the Coeur d'Alene River during the May 2008 floods.

4.4.6.2. 1996-1997 Flood Events in Benewah, Kootenai, and Surrounding Counties

January through February 1996 - The third week of January 1996 brought large amounts of low-elevation snow, especially in the Idaho Panhandle where weather stations measured an additional 10 inches of snow to the existing snowpack. By the end of January, sites in the north had as much as 2½ feet of snow on the ground. During the last week of January temperatures dropped into the single digits (°F) for highs and below zero for lows. This caused ice to form on many of the rivers where low temperatures were in the range of 20 to 30 degrees below zero. On February 6, a warning was issued indicating that temperatures were warming up, that snow was becoming wet and dense, and although the mainstream rivers were not showing a response, there was a high potential for flooding. By February 7, the Boise National Weather Service began receiving reports of small-stream flooding in the area east of Lewiston including small tributaries to the Clearwater River. Preliminary assessments indicated the most severe impacts were to infrastructure and housing, with approximately 708 family dwelling units affected. Damage to public property, not counting federal highways, was estimated at approximately $12.9 million. A Major Disaster Declaration for Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, Lewis, Nez Perce, and Shoshone Counties was signed by Governor Batt on February 10, 1996, and by President Clinton the following day.

December 1996 through February 1997 - During middle–to-late December 1996, and January and February of 1997, above-normal snowfall occurred in northern and western Idaho. A warm, moist current of air from the subtropics (known locally as the "Pineapple Express") arrived within the Upper Columbia Plateau, dumping warm rain on melting snow. The result was widespread flooding, power outages, landslides, road closures, and structure damage from crushing snow loads. Riverbank erosion and landslides filled the rivers with thick silt and debris. Large sections of the highway system were damaged or destroyed, isolating several communities for days. Mountain snowpacks in the late winter were holding more than one and a half times the amount of water normally held in the mountain snow at that time of year.

Snowfall was well above average in northern Idaho regions, sometimes exceeding twice the design snowloads of buildings. There was substantial damage to several schools and other public and private structures. The aftermath resulted in over $7 million in damages and over $6 million in clean-up, recovery, and restoration costs (in the Idaho Panhandle).

December 25th – Unseasonably heavy snowfall began throughout north, central, and southwestern Idaho causing localized power failures and road closures, particularly in sparsely populated rural and mountain areas. Warming conditions and continued heavy rainfall created a rapid melting of the snow pack and heavy runoff. The weight of heavy snow caused damage to many structures.

December 26th – The National Weather Service issued a Winter Storm Watch for Central and Northern Idaho.

December 27th – The National Weather Service upgraded the Storm Watch to a Winter Storm Warning for all of Northern Idaho, for 6-12 inches of new snow.

December 29th – The National Weather Service issued a Winter Storm Warning for Northern Idaho for up to 10 more inches of new snow.

December 30th – Boise and Shoshone Counties were issued Disaster Declarations as a result of snow.

December 31st – Idaho State Police reported a high possibility of flooding in Lewiston, Nez Perce County, with 20 inches of snow on the ground. Latah County was issued a Disaster Declaration. A Small-Stream Flood Warning was issued by Emergency Management Systems for northern counties of **Benewah**, Bonner, Boundary, **Kootenai**, Shoshone, Latah, Lewis, and Nez Perce. The National Weather Service issued a Flood Warning for the South Fork of the Palouse River with impact in **Benewah**, Latah, and Lewis Counties.

January 1st – The Emergency Operations Center (EOC) was activated in Moscow.

January 2nd – Thirteen Idaho counties and four cities issued Disaster Declarations and 80 families were displaced. The National Weather Service forecast indicated decreasing rain and lowering of freeze levels to 3000 feet by 1/3/1997.

January 4th – The US President signed a Declaration for disaster assistance, DR-1154-ID, for Individual Assistance, and Categories A and B under the Public Assistance Program. Thirteen counties were designated: Adams, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, Latah, Payette, Shoshone, Valley, and Washington. All rivers were receding and recovery efforts were underway in flooded areas.

January 10th – Locations of five disaster Recovery Centers were decided on, one fixed (Payette) and five mobile (Sandpoint/Kellogg, Moscow, Council, Cascade, and Lowman/Garden Valley).

January 22nd – The Presidential Declaration was amended to add **Benewah and Kootenai** Counties for Individual Assistance and Categories A and B under the Public Assistance Program. In addition, Adams, Bonner, Boundary, Clearwater, Elmore, Latah, Nez Perce, Payette, Shoshone, Valley, and Washington Counties were granted Categories C through G and Hazard Mitigation and Public Assistance (no Individual Assistance).

January 24th – A Levee Task Force was formed to coordinate the response of federal agencies to repair levees, dikes, and other water control devices damaged during the disaster.

4.4.7. St. Maries Levee System

Almost 17 miles of levees are managed by dike districts and provide flood protection and the drainage of 3,120 acres. An intricate system of levees totaling 37 segments is present in the area of St. Maries along the St. Joe River banks. These levees were established to minimize the negative impacts on homes, businesses, and commerce linked to the location of this community on the St. Joe River system near Coeur d'Alene Lake, in combination with the water-based transportation system leading to Coeur d'Alene. These levees have served the region although examples of levee failure have resulted in events categorized as disasters.

4.4.7.1. History of the Levees

All of the levee systems along the St. Joe River and the Coeur d'Alene River, have been put in place by Dike Districts formed by the State of Idaho, with local management of the Dikes carried out by Dike District Chairmen. Current management of these levee systems and their designs, have been conducted by the Dike Districts in cooperation with the USACE.

There are many miles of levees along the lower Coeur d'Alene River designed to limit flood damages from the South Fork Coeur d'Alene River and the lower Coeur d'Alene River before it enters Coeur d'Alene Lake near Harrison. The Coeur d'Alene River Basin is of particular concern because its flood-prone profile and the environmental contamination evidenced by the nation's largest Superfund clean-up project (Schlosser 2009). The Coeur d'Alene Tribe has been cooperating with mitigation activities taking place in Shoshone County, located upstream of the current-day exterior boundary of the Coeur d'Alene Reservation, and where significant Superfund clean-up activities are taking place. Several small lakes, referred to as the Chain Lakes are located along the river system and continue to experience development along their shorelines (Clement & Young 2009).

The St. Joe River drains 1,886 square miles and is 130 miles long. It flattens to approximately 1 foot-per-mile gradient in the lower 42 miles before it enters Coeur d'Alene Lake. The annual runoff is 2.33 million acre feet. The St. Maries River drains 480 square miles and drains into the St. Joe River near St. Maries.

The river gauge 0.01 miles upstream from the mouth of the St. Maries River has been in use since 1911. There are 16.7 miles of levees constructed by six levee districts protecting 3,900 acres in the St. Maries area. These levees have failed in 1948, 1956, 1964, and 1996.

The St. Maries levee was constructed by the USACE in 1942. It was designed for a flood stage 5 feet higher than the 1933 flood calculations with an additional two feet of freeboard (height above flood stage). The St. Maries levee is about 6 to 10 feet higher than the dike district levees. It is an earth and earth-filled timber-crib levee. It is 2.5 miles in length consisting of 12,000 feet of earth-levee-style construction and 700 feet of earth-filled timber-crib wall style construction. It was accepted into the 44 CFR 65.10 levee system in 2008.

The Riverdale, Meadowhurst, Cottonwood, and Shepherd Road levees are in the PL 84-99 program.

- The Meadowhurst Dike District 1 was established on March 13, 1916.
- The Shepherds Road Dike District 2 was established on March 13, 1916.
- Dike District 3 was established on January 20, 1917.
- The Cottonwood Dike District 5 was established on August 21, 1925.
- The Riverdale Dike District 7 was established January 24, 1938. It protects 486.89 acres. The average elevation of the levee was 2,140 feet when constructed. Following the breach during the 1996 flood, the elevation was raised.

During the February flood of 1996, the Meadowhurst and Riverdale levees broke at river bottom level, approximately 25 feet deep. The Riverdale levee sustained approximately 250 feet of damage, the Meadowhurst levee sustained approximately 150 feet of damage.

When these dikes failed, 963 acres of land were inundated by floodwaters. It was estimated that the Riverdale Dike area released over 2 billion gallons of water, while Meadowhurst released approximately 426 million gallons within a five-week period.

The flood waters severely impacted Idaho State Highway 3 and the St. Joe River Road (Forest Service Road 50). Highway 3 was under water for two weeks, and the St. Joe River Road was closed for 30 days. The losses to homes and property were estimated at over $3.7 million. There were hazards from water and sewer contamination, sewage backup, electrical problems, fire, and threat to human life. This flooding directly affected 37 businesses (67 unemployment claims were filed), 120 homes were damaged, the schools were closed, and the St. Maries Airport was closed. Local business owners and Benewah County spent over $600,000 in in-kind labor, materials, and equipment during and after the disaster.

Meadowhurst Dike improvements included reconstruction of 8,000 linear feet of State Highway 3, repairing approximately 10,000 linear feet of the Meadowhurst levee, which included dike elevation and installation of a clay-core trench, and elevating approximately 1,500 linear feet of the St. Joe River Road.

Riverdale Dike improvements included elevation of 1,500 linear feet of the Mill Town Road and the elevation and installation of a clay-core trench along the cross-county segment of the levee.

4.4.7.2. US Army Corps of Engineers Inspections

The USACE conducts periodic inspections of the individual levees along the St. Joe River. These inspections involve visual examination of the levee condition to evaluate vegetation, encroachments, and general structural integrity. A current status rating is assigned by the inspector. Table 25 provides a summary of inspections conducted by the USACE on May 23, 2007.

Table 25. Summary of Levee Inspection Reports.

Levee Name	Sponsor	Inspection Date	Status
Shepherd's Road Levee (Dike District 2)	City of St. Maries	23 May 2007	Minimally Acceptable (encroachments)
Comments:	The overall condition of the levee is unknown. There are so many encroachments on the levee, the structural integrity is indiscernible. The number of structures that have been constructed into the levee, close together, is alarming. The compaction and backfill levee material is unknown. Many driveways are paved leaving little pervious surface near the levee and making it hard to determine if seepage is a problem. It is hard to determine where a weak spot will develop. The levee crown is no longer drivable due to the encroachments.		
St. Maries Floodwall and 205 Levee	City of St. Maries	23 May 2007	Acceptable
Comments:	The levee behind the Potlatch Plant has been brushed and trees removed to the toe. The riverward slopes are free of dense vegetation. The landward slope is sod. Areas of potential improvement: Some riprap settlement, but nothing that would impair function of the project. There are a few trees over 4" diameter breast high (DBH) within the levee prism. There is brush along the levee in places.		

Table 25. Summary of Levee Inspection Reports.

Levee Name	Sponsor	Inspection Date	Status
Riverdale Levee (Dike District 7)	Benewah County	23 May 2007	Minimally Acceptable
Comments:	There are many mature cottonwood trees growing within the levee prism that require removal. The levee has been excavated and is not acceptable and could lead to levee failure. There are a number of encroachments within the levee prism. Overall the levee is in minimally acceptable condition. The County, Riverdale Dike District and the Corps should meet to determine if the Riverdale District is interested in continuing in the PL 84-99 program[3]. In order to offer reliable flood protection from this levee system the following improvements must be made prior to the next inspection: A. Remove trees over 4" DBH from the levee prism that pose a threat to the integrity of the levee. There must be a significant improvement in removing the brush along the levee face and toe prior to the next inspection. B. Brush and mow the levee in areas where homeowners don't do the maintenance. C. Inspect encroachments and excavation into the levee to determine if they are a threat to the structural integrity of the levee. D. Remove ecology blocks and return levee to prior level of protection.		
Meadowhurst Levee (Dike District 1)	City of St. Maries	23 May 2007	Acceptable
Comments:	Overall the levee system is in good condition. In order to improve the effectiveness of this levee system and to ensure that it retains Acceptable Rating in the PL84-99 program, the following improvements should be made: A. Remove trees over 4" DBH from the levee prism that pose a threat to the integrity of the levee. B. Continue to perform routine annual maintenance on the levee. The PL 84-99 program requires mowing to minimum of 6 inches along the crown and 12 inches along the landward slope. C. Work with homeowners to remove personal items from the levee driving surface during flood season.		

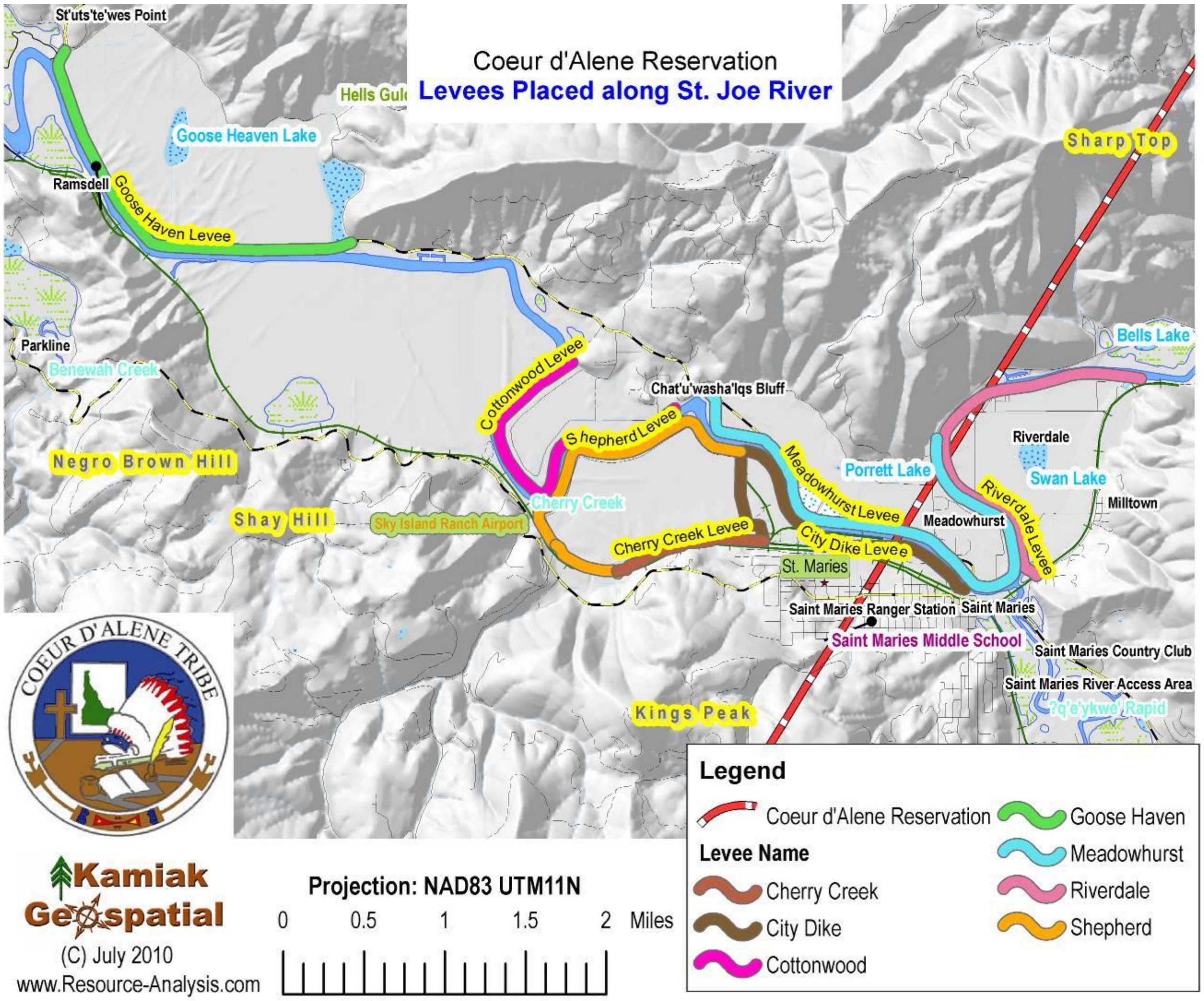
[3] **United States Army Corps of Engineers (USACE) PL84-99 Rehabilitation Program.** The PL 84-99 Rehabilitation Assistance Program is a federal levee rehabilitation program that repairs levees damaged only during declared emergencies for high-water events. "PL 84-99" refers to Public Law 84-99, the federal government's Flood and Coastal Storm Emergencies act. The goal of the program is to provide safety and risk reduction through the evaluation and repair of levees damaged during declared flood emergencies.

Table 25. Summary of Levee Inspection Reports.

Levee Name	Sponsor	Inspection Date	Status
Cherry Creek Levee	City of St. Maries	23 May 2007	Acceptable
Comments:	In order to continue the effectiveness of this levee system and to ensure that it remains eligible in the PL84-99 program, the inspection team recommends continuing with the current maintenance program including: A. Continue with regular mowing and brushing along levee system especially at upstream end. The program requires mowing to a minimum of 6 inches along the crown and 12 inches along the landward slope. B. Monitor levee and remove all trees and shrubs with 4" DBH or greater, especially in the spray field ditch. C. Monitor for burrowing animal activity. D. Routinely open/close the screw gate to ensure operability during high water events.		
Cottonwood Point Levee (District 5)	Benewah County	23 May 2007	Unacceptable
Comments:	The overall levee is in unacceptable condition as a full inspection cannot be completed due to vegetation. It has been rated probationary over the last few inspections and no attempt has been made to perform maintenance. In order for the levee to return to Acceptable Status in the PL84-99 System, the following maintenance must be performed prior to the next levee inspection: A. Remove the fruit and ornamental trees in the levee prism at 275 Cottonwood Drive. These were required to be removed in the past. B. Monitor growth of trees along the levee. Remove all trees over 4" diameter within the levee prism. It is necessary to remove all trees that can cause levee instability. C. Continue with brushing and mowing along the levee system. D. Cooperate with the landowners to ensure the levee is free of encroachments during flood season.		
Goose Haven (Dike District 3)			
Comments:	This levee is not in the PL 84-99 Program.		

All of the recommendations in the comments section of these reports have been integrated into the recommendations of the Benewah County Multi-Jurisdictional Hazards Mitigation Plan, adopted by the Benewah County Commissioners, and the St. Maries City Mayor, and approved by FEMA on June 25, 2010 (Schlosser 2010). The location of the levees along the St. Joe River are shown in Figure XLIII.

Figure XLIII. System of Levees along the St. Joe River.



4.4.8. Dams on the Coeur d'Alene Reservation

There are neither hydroelectric dam sites nor flood control dams on the Coeur d'Alene Reservation. There are several small water reservoirs used for municipal water supplies, but the volume of water retained by these structures is minimal (Table 26). A small number of diversion structures and underground conveyance systems on small tributaries could do a fair amount of property damage if they were to fail.

The Hazard rating used by the Idaho Department of Water Resources to classify dams and reservoirs is based on a three-tier system consisting of Low, Significant, and High-hazard categories. It is important to note that the hazard classification assigned to any particular structure is based solely on the potential consequences to downstream life and property that would result from a failure of the dam and sudden release of water. Hazard is not to be used synonymously with the term "Risk" as they are not the same. Risk incorporates a probability of failure; thus risk is equal to the probability of occurrence multiplied by the consequences that would result from a dam failure (IDWR 2009).

- High Hazard - A high-hazard rating does not imply or otherwise suggest that a dam suffers from an increased risk for failure. It simply means that if failure were to occur, the resulting consequences likely would be a direct loss of human life and extensive property damage. For this reason all high-hazard dams must be properly designed, and at all times responsibly maintained and safely operated because the consequences of failure are much too great. IDWR considers the inundation of residential structures with flood water from a dam break to a depth greater than or equal to two (2) feet to be a sufficient reason for assigning a high-hazard rating.

- Significant Hazard - Significant hazard dams are those structures whose failure would result in significant damage to developed downstream property and infrastructure or that may result in an indirect loss of human life. An example of the latter would be a scenario where a roadway is washed out and people are killed or injured in the automobile crash.
- Low Hazard - Low hazard dams typically are located in sparsely populated areas that would be largely unaffected by a breach of the dam. Although the dam and appurtenant works may be totally destroyed, damages to downstream property would be restricted to undeveloped land with minimal impacts to existing infrastructure.

Table 26. Dams registered with the Idaho Department of Water Resources.

Dam Name	State Well ID	Tributary	Hazard Category	Dam Height (feet)
ABELL	91-7138	ST JOE RIVER	Undetermined	-
CHAPMAN	94-2225	SPOKANE RIVER	Undetermined	-
MCCLELLAND NO 1	93-7001	ROCK CREEK	Undetermined	-
MCCLELLAND NO 2	93-7000	ROCK CREEK	Undetermined	-
PUGH	94-XX24	LAMB CREEK	Low hazard	19
SCHNEIDER	95-8650	FIGHTING CREEK	Low hazard	17
SEWELL	93-XX01	HANGMAN CREEK	Low hazard	16
TREFZ	95-9080	LAKE CREEK	Undetermined	-
ZOOK	91-7114	ST. JOE RIVER	Low hazard	17

All of these dams (Table 26) meet the criteria of “low hazard”. The approach for mitigating dam risks includes monitoring these sites for changes in the status of protection.

4.4.9. Coeur d’Alene Reservation Flood Profile

All five types of flood events occur within the Coeur d’Alene Reservation. Riverine flooding occurs along all tributaries and in the main channel to the St. Joe River. The mountainous terrain of the region creates a flood-prone environment. Rain-on-snow events can and do occur at almost all elevations across the Reservation. These events often contain enough moisture to cause flooding on most river systems, not only the St. Joe River and its tributaries.

On the western side of the Coeur d’Alene Reservation, Hangman Creek exhibits the broadest flood profile consistent with a Riverine Flooding of the Slow kind. Although the contributing area of this drainage is significantly less than the area flowing into the St. Joe River System at St. Maries, the impact seen in the region of DeSmet and Tensed is significant. Because of the higher elevation of this region in Benewah County, flood events are frequently rain-on-snow events that cannot drain through the system of culverts and drainage structures along the surface roads. Water-conveyance exacerbated flooding is common when these circumstances occur. The Rock Creek watershed (from Worley to the Washington State line) and the upper Plummer Creek watershed (near Plummer) is much smaller than the Hangman Creek watershed, but the combination of high elevation, the wide floodplain, and the soils of the area can lead to flooding and damages to structures and infrastructure within the zone.

In general, flood events can be predicted 24 to 72 hours in advance of the rising waters. Emergency plans that are in place can be executed before floodwaters overtop the river banks, to minimize loss of life and business disruption. Plans for reducing structural damage need to be put in place and executed long before the rain begins to fall and the snow begins to melt.

Summer thunderstorms can result in flash flooding of specific smaller drainages. Often there is little time to react to the quickly rising waters. Due to the nature of the terrain, localized flooding from thunderstorms tends to be more of a stormwater drainage problem for many smaller communities. Short-term blockage of roads is usually the biggest impact as drainage structures are overwhelmed by the amount of water.

Ice and debris flows can occur as part of riverine and flash-flooding events, usually exacerbating the effects of those types of floods. In the case of a fire or heavy logging activity, flash flooding can result due to the loss of vegetation that would otherwise intercept some of the surface-water flow velocity. Details on reducing the effects of these types of debris flows can be found in the Landslide section of this report (Section 4.6).

4.4.10. Resources at Risk

Floods generally come with warnings and flood waters rarely go where they are totally unexpected based on expert predictions. Those warnings are not always heeded, though, and despite the predictability, flood damage continues.

The failure to recognize or acknowledge the extent of the natural hydrologic forces in an area has led to development and occupation of areas that can clearly be expected to flood on a regular basis or even an infrequent basis. Despite this, communities are often surprised when the stream leaves its channel to occupy its floodplain. A past reliance on structural means to control floodwaters and “reclaim” portions of the floodplain has also contributed to inappropriate development and continued flood-related damages.

Unlike the weather and the landscape, this flood-contributing factor can be controlled. Development and occupation of the floodplain places individuals and property at risk. Such use can also increase the probability and severity of flood events (and consequent damage) downstream by reducing the water-storage capacity of the floodplain, or by pushing the water further from the channel or in larger quantities downstream.

A large array of geospatial data has been collected to better understand and quantify the exposure to flood risks on the Coeur d’Alene Reservation, including flooding. The FIRM maps supplied to Benewah County and Kootenai County by FEMA in September 2009 were used to define the flood-prone areas for 100-year and 500-year flood events. Additional consideration was given to non-FEMA mapped floodplains within the Coeur d’Alene Reservation, as has been summarized in Section 4.4.2.1 and Figure XL. The location of individual structures was mapped for the entire Reservation, combined with values on those structures as determined by the counties, the Tribe, the State, and other public entities. The location of an asset within any of the floodplain zones has justified those structures as being at risk to flooding.

Section 2.6 (Structure Assessment & Values), Table 3, and Figure VIII, have provided details on a database of structure locations and values within the Coeur d’Alene Reservation. This database, with spatial reference, provided the assessment of determining the risk exposure on the Coeur d’Alene Reservation. The analysis procedure began by selecting all structures (embedded with value) within each flood zone.

For the purposes of this assessment, the determination of the floodplain, where consideration was given by FEMA for inclusion or exclusion of FIRM has not been further analyzed for floodplains. In those areas that were not considered by FEMA efforts for assessment of floodplain mapping, the additional assessments were made. In many locations, the FIRM mapping included specific municipalities (such as the City of Tensed, City of Plummer), but not the lands surrounding the municipalities. In other examples, lands held in trust by the Federal

Government were mapped for FIRM, but adjacent properties were not. The additional floodplain mapping conducted for this effort, assumed that any location of formally mapped FIRM would not be challenged. All additional mapping was conducted for those areas where FIRM was not previously considered or published by FEMA.

The determination of the extent of the additional floodplain areas was not articulated as an ‘A’ zone, ‘AE’ zone, ‘0.2% probability of occurrence’, or other FIRM classifications of severity. All of the additional assessments of floodplain mapping provided the sole classification of ‘floodplain’. Additional flood-related assessments included an assessment of stormwater accumulation; surface-water accumulations determined to be ‘frequent’ or ‘occasional’. These determinations were derived from a combination of data from the NRCS Soil Survey for surface-water accumulations, accompanied with the slope of the sites. For these purposes, the determination of ‘frequent’ is expected by be seen at least once a year, and possibly multiple times each year. The ‘occasional’ classification identifies sites where the occurrence may be witnessed as infrequently as once every five years.

For the purposes of this assessment, it is assumed that the improvement value of a parcel with a structure is completely attributed to the structure or structures on that parcel.

4.4.10.1. Private Property Improvement Values at Risk to Flood Loss

The results of this analysis of structures located within the Coeur d’Alene Reservation are summarized for privately owned structures (Table 27). Based on this determination of the structure location in respect to the components of the floodplain, there are approximately 34 privately owned structures, valued at $1.0 million located within the FIRM flood zone ‘A’ (100-year flood zone). Approximately 157 structures valued at $22.4 million are located within the FIRM flood zone ‘AE’ (500 year flood zone). Another 69 structures valued at $6.1 million are in a location protected by a ACOE certified levee (along the St. Joe River and within or adjacent to the City of St. Maries).

Additional assessments of potential floodplains for those areas not previously determined in published FEMA released FIRM assessments, reveals that approximately 61 privately owned structures valued at $5.3 million are located within the areas determined to be within the floodplain. An additional 61 structures, valued at $4.4 million, are in locations where surface-water accumulations leading to stormwater damages could occur at a ‘frequent’ recurrence, and 94 structures, valued at $3.9 million, are located in the ‘occasional’ zone of stormwater accumulations.

4.4.10.2. Non-Private Property Improvement Values at Risk to Flood Loss

The results of this analysis of structures located within the Coeur d’Alene Reservation are summarized for non-privately owned structures (Table 28). Based on this determination of the structure location in respect to the components of the floodplain, there are approximately 9 structures, valued at $3.3 million located within the FIRM flood zone ‘A’ (100-year flood zone). Approximately 15 structures valued at $4.2 million are located within the FIRM flood zone ‘AE’ (500 year flood zone). Another 8 structures valued at $2.1 million are in a location protected by a levee (along the St. Joe River adjacent to the City of St. Maries).

Additional assessments of potential floodplains for those areas not previously determined in published FEMA-released FIRM assessments, reveals approximately 6 structures valued at $14.6 million, are located within the areas determined to be within the floodplain. An additional 8 structures, valued at $26.9 million, are in locations where surface-water accumulations leading to stormwater damages could occur at a ‘frequent’ recurrence, and 16 structures, valued at $10.5 million, are located in the ‘occasional’ zone of stormwater accumulations (Table 28).

Table 27. Value and Number of Private Structures Located within Differing Categories of the Floodplain on the Coeur d'Alene Reservation.

Community Name	Tribally Determined			FEMA FIRM Determined (Sept 2009)			Not In Floodplain	
		Storm water Accumulation						
	Floodplain	Occasional	Frequent	A	AE	X PROTECTED BY LEVEE	Value	Number
BELLGROVE	$-	$470,416	$-	$-	$-	$-	$1,319,141	28
BENEWAH	$948,900	$44,110	$935,329	$-	$-	$-	$8,585,570	179
CHATCOLET	$177,010	$-	$-	$69,810	$-	$-	$13,449,962	183
CONKLING PARK	$274,063	$-	$-	$-	$-	$-	$14,190,716	233
DE SMET	$-	$182,170	$-	$-	$-	$-	$2,120,076	47
HARRISON	$-	$-	$1,692,800	$-	$-	$-	$16,713,779	171
LACON	$72,862	$-	$-	$-	$-	$-	$4,706,206	108
MEDIMONT	$110,040	$-	$10,480	$-	$-	$-	$4,090,501	145
MOWRY	$-	$389,270	$-	$-	$-	$-	$3,707,685	65
PLUMMER	$32,460	$697,197	$106,780	$45,840	$-	$-	$38,868,157	494
ROCKFORD BAY	$-	$68,508	$330,000	$1,270	$-	$-	$84,679,778	703
SANDERS	$26,490	$28,710	$263,020	$-	$-	$-	$6,262,519	97
SETTERS	$533,928	$12,930	$268,670	$-	$-	$-	$5,957,457	89
ST. MARIES	$1,908,543	$165,070	$-	$-	$22,326,830	$6,084,971	$43,431,319	719
TENSED	$268,012	$1,777,844	$-	$895,458	$-	$-	$2,111,896	127
WORLEY	$995,440	$40,890	$772,013	$-	$-	$-	$5,258,871	190
Count	**61**	**94**	**61**	**34**	**157**	**69**		**3,578**
Total Value	**$5,347,748**	**$3,877,115**	**$4,379,092**	**$1,012,378**	**$22,326,830**	**$6,084,971**	**$255,453,633**	

Table 28. Value and Number of Public Structures Located within Differing Categories of the Floodplain on the Coeur d'Alene Reservation.

	Tribally Determined			FEMA FIRM Determined (Sept 2009)			Not In Floodplain	
		Storm water Accumulation						
Community Name	Floodplain	Occasional	Frequent	A	AE	X PROTECTED BY LEVEE	Number	Value
AGENCY	$-	$-	$-	$-	$-	$-	7	$1,303,983
CHATCOLET	$-	$-	$-	$2,600,000	$-	$-	4	$2,750,000
CONKLING PARK	$-	$-	$-	$-	$-	$-	5	$1,372,688
DE SMET	$25,000	$2,500,000	$-	$-	$-	$-	42	$15,247,304
HARRISON	$-	$-	$500,000	$-	$-	$-	5	$674,000
HEYBURN STATE PARK	$-	$-	$-	$500,000	$-	$-	13	$8,600,000
LACON	$-	$-	$-	$-	$-	$-	2	$112,680
MOWRY	$-	$152,000	$-	$-	$-	$-	2	$304,000
PLUMMER	$1,665,000	$5,881,617	$-	$-	$-	$-	96	$40,144,417
ROCKFORD BAY	$-	$10,000	$-	$-	$-	$-	9	$1,060,424
SANDERS	$-	$-	$-	$-	$-	$-	2	$304,000
SETTERS	$12,000,000	$-	$-	$-	$-	$-	1	$12,000,000
ST. MARIES	$-	$-	$-	$-	$4,187,130	$2,108,182	30	$12,171,841
TENSED	$103,262	$1,996,100	$-	$170,025	$-	$-	13	$2,269,387
WORLEY	$757,377	$-	$26,437,506	$-	$-	$-	82	$127,968,593
Count	**6**	**16**	**8**	**9**	**15**	**8**	**313**	
Total Value	**$14,550,639**	**$10,539,717**	**$26,937,506**	**$3,270,025**	**$4,187,130**	**$2,108,182**		**$226,283,317**

4.4.11. Probability of Future Events

The probability of flood events within the Coeur d'Alene Reservation is consistent with the assessment determined by the State of Idaho Hazard Mitigation Plan (November 2007) as follows:

> **High:** Steep, mountainous terrain, history of flooding events, number of new developments and number of rivers, lakes, creeks in vicinity of flood zones, flood-control systems often overwhelmed.
>
> **Medium:** Geography is moderate; fewer susceptible streams and creeks; historically less flood-prone, flood control is normally adequate.
>
> **Low:** Few historical events, Little or no new development in flood zones, geography is less flood-prone, sufficient flood control operations.

Coeur d'Alene Reservation has a high probability of future flooding events with events expected to be seen as frequently as multiple times each year, and no less frequent than once every five years.

Flood frequency on the Coeur d'Alene Reservation has been recorded in conceptual models of personal accounts, news reports of the region, and physical evidence of past flooding. Although illustrative, these accounts fail to apply uniform measures of flood intensity (depth), duration (days), or location (watersheds affected).

These accounts serve to quantify the high frequency of flood related events (1 every 3-5 years). It is likely that this frequency will continue into the future even with significant changes to the global climate weather patterns discussed here. Although frequency may remain relatively consistent, the intensity of flooding events may change. The only sure way of limiting the exposure of residents to these extreme flood events is to locate homes, businesses, and infrastructure outside of the maximum floodplain extent to avoid these catastrophic events.

4.4.12. FEMA Programs Concerning Floods

As of the preparation of this Tribal Hazards Mitigation Plan, the Coeur d'Alene Tribe is not a participant in any of the flood-mitigation programs of FEMA.

The National Flood Insurance Program (NFIP) was created by the Congress of the United States in 1968 through the National Flood Insurance Act of 1968 (P.L. 90-448). The NFIP enables property owners in participating communities to purchase insurance protection from the government against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods (FEMA 2009). Participation in the NFIP is based on an agreement between local communities and the federal government and states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHA), the federal government will make flood insurance available within the community as a financial protection against flood losses. The SFHAs and other risk premium zones applicable to each participating community are depicted on FIRM. The Mitigation Division within the Federal Emergency Management Agency manages the NFIP and oversees the floodplain management and mapping components of the Program (FEMA 2009).

The intent of the act was to reduce future flood damage through community floodplain management ordinances and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection. The NFIP is meant to be self-supporting, though in 2004 Congress found that repetitive-loss properties cost the taxpayer about $200 million annually. Congress originally intended that operating expenses and flood-insurance claims be paid for through the premiums collected for flood-insurance policies. NFIP borrows from the U.S. Treasury for times when losses are heavy, and these loans are paid back with interest.

The program was first amended by the Flood Disaster Protection Act of 1973, which made the purchase of flood insurance mandatory for the protection of property within SFHAs. In 1982, the Act was amended by the Coastal Barrier Resources Act (CBRA). The CBRA enacted a set of maps depicting the John H. Chafee Coastal Barrier Resources System in which federal flood insurance is unavailable for new or significantly improved structures. The program was further amended by the Flood Insurance Reform Act of 2004, with the goal of reducing "losses to properties for which repetitive flood insurance claim payments have been made."

In order for the Coeur d'Alene Tribe to enter the NFIP, discussions between the Tribe and FEMA Region X representatives must reach agreement on the implementation of policies, laws, and programs to be carried out by Coeur d'Alene Tribe to protect the structures and infrastructure located in the floodplain. At the same time, FEMA may launch additional floodplain mapping of the Coeur d'Alene Reservation to consistently define the floodplain.

While these programs are set in place, initial mapping of projected flood-impact areas has been completed as part of this Tribal Hazards Mitigation Plan assessment and can serve the Coeur d'Alene Tribe to establish floodplain protection areas. These projected flood impact areas would be replaced by FEMA-established FIRM maps if they are created, in case the Coeur d'Alene Tribe chooses to enter the NFIP.

4.4.13. Repetitive Loss

The primary objective of the Repetitive Loss Properties Strategy is to eliminate or reduce the damage to property and the disruption of life caused by repeated damages of the same properties. Although mostly recognized within the flood-risk category of losses, the repetitive loss category can be applied to properties that meet the following conditions:

- Four or more paid flood losses (by FEMA) of more than $1,000 each; or
- Two paid flood losses (by FEMA) within a 10-year period that, in the aggregate, equal or exceed the current value of the insured property; or
- Three or more paid losses (by FEMA) that, in the aggregate, equal or exceed the current value of the insured property.

Although there are no formally entered repetitive loss properties within the Coeur d'Alene Reservation, that lack of classification is completely attributable to the lack of participation in insurance coverage offered by FEMA for homeowners. Flood loss damages to personal property are a frequent event that can be witnessed several times each year. The Coeur d'Alene Tribe is not a participant in the National Flood Insurance Program.

4.4.14. Potential Mitigation Measures

In many western countries, rivers prone to floods are often carefully managed. Water management structures such as levees, reservoirs, and weirs have been used to prevent rivers from bursting over their banks. However, these structures only influence flood properties and do not alter the actual floodplain. The floodplain is a natural storage area used by the river to store the high-water levels as it drains downstream. When a levee is placed along a river, the effect is to remove this temporary storage area and displace the needed storage to other stream storage areas immediately upstream (backflow) and adjacent to the levee protected area, and eventually downstream of the protected area. These displacements often mean increased flooding impacts in areas other than those protected by the levee.

The potential exception to this flood-displacement problem occurs when a levee is placed upstream of a managed reservoir, a large lake, or the ocean. When managed well, a reservoir can be lowered in advance of seasonal floodwater accumulation and used to receive the increased flood-storage needs, if required. On the Coeur d'Alene Reservation the flow point for the St. Joe River system is Coeur d'Alene Lake, which can accept sizable amounts of water. A complication to the flood profile of Coeur d'Alene Lake is that another river system, the Coeur d'Alene River generally reaches a high-water level prior to the St. Joe River, thus causing Coeur d'Alene Lake levels to rise. This decreases the ability of Coeur d'Alene Lake to accept the high-water levels from the St. Joe River. Generally the progression of flood waters begins with the St. Maries River, followed by the Coeur d'Alene River, and the St. Joe River.

4.4.14.1. Post Flood Safety

Cleanup activities following floods often pose hazards to workers and volunteers involved in the effort. Potential dangers include electrical hazards, carbon monoxide exposure, musculoskeletal hazards, heat or cold stress, motor vehicle-related dangers, fire, drowning, and exposure to hazardous materials, or contaminated soils and sediment. Because flooded sites are unstable, cleanup workers might encounter sharp, jagged debris, biological hazards in the floodwater, exposed electrical lines, blood or other body fluids, animal, and human remains.

A flood-response plan has not been adopted by Coeur d'Alene Tribe for specifically dealing with flood activities on the Coeur d'Alene Reservation. This plan should be developed in continuation of this planning effort and is recommended in Table 74.

4.4.14.2. Benefits of Flooding

There are many disruptive effects of flooding on human settlements, infrastructure, and economic activities. However, flooding can bring benefits, such as making soil more fertile by providing nutrients in which it is deficient. Periodic flooding was essential to the productivity of lands for the Tribes of the region, who have relied, and still rely, on a productive river ecosystem for food supplies and fish spawning and rearing grounds.

4.4.14.3. Considerations Concerning Flood Policy

The stabilization of the floodplains of the Coeur d'Alene Reservation is essential to the functioning of the Coeur d'Alene Tribe in terms of the economy (especially related to agriculture and forestry), the home sites located adjacent to, and within the floodplains, and the infrastructure that provides water, sewer, power, and critical linkages between communities and to resources located outside the Reservation. This stabilization of the floodplains begins with an assessment of the current functioning of the wetlands within the Coeur d'Alene Reservation. The Coeur d'Alene Tribe has launched an effort to restore wetlands and riparian zones within the Coeur d'Alene Reservation.

Since the program's inception, specific areas have been targeted for restoring sites where subsurface tiles were placed to drain wetlands for use in agriculture. These sites are in a process of restoration to reestablish their normal functioning as riparian areas.

Efforts to solidify the position of the Coeur d'Alene Tribe to restrict human habitation within the floodplains from the standpoint of protecting fisheries and downstream flooding impacts has real and measurable benefits.

As previously discussed, the NFIP is a Federal Program that helps communities reduce flood risks and enables property owners and renters to buy flood insurance. Although the NFIP offers flood insurance to homeowners and renters, this insurance coverage does not reduce the occurrence of flooding. At this time, Reservation-wide FIRM maps of the Coeur d'Alene

Reservation have not been developed and discussions are on-going between the Coeur d'Alene Tribe and FEMA Region X to consider the entry of the Coeur d'Alene Tribe to the NFIP.

The Coeur d'Alene Tribe may decide to participate in the NFIP while enacting and enforcing measures to reduce future flood risks. At a minimum, these regulations govern construction in the SFHAs shown on the FIRM maps. In the interim period, while the FEMA-approved FIRM maps are not available, those areas shown on the Potential Food Impact Areas (developed for this planning effort) can be used by the Coeur d'Alene Tribe for internal policy development and implementation. Participation by homeowners in the FEMA insurance program is optional, but adherence to Coeur d'Alene Tribe Building Codes is not. It is recommended that these codes be updated to reflect NFIP guidelines on the Coeur d'Alene Reservation while using the existing data as a starting point. If FIRM maps are subsequently developed by FEMA and the Coeur d'Alene Tribe, then the use of the FEMA-approved FIRM maps can be adopted. In addition, many mortgage companies require NFIP coverage for homes in the SFHA when purchased through a mortgage loan.

These NFIP management regulations apply to new construction and substantial improvements to structures in the flood zone. Coeur d'Alene Tribe can consider implementing these measures while using the recently created Potential Flood Impact Areas maps to be updated when FEMA-derived NFIP maps are finalized. Structural improvements that lead to improved protection during flood events include a variety of techniques to elevate structures, so the ground floor is above the base-flood elevation (so called flood proofing). Small-scale levee construction is not a recognized flood mitigation technique for the NFIP program. Other potential mitigation measures are effective at reducing the negative impacts caused by flooding.

Floodplain Ordinances should be considered and enacted within Coeur d'Alene Reservation by the Coeur d'Alene Tribe. It is recommended that these ordinances define a substantial improvement as "any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the 'start of construction' of the improvement." These ordinances should require all new construction or substantial improvements be made using methods and practices that minimize flood damage to the structure while not negatively impacting the floodplain where the structure is located. The Coeur d'Alene Tribe exercises land use and building code jurisdiction within the reservation boundaries and could apply Floodplain Ordinance requirements (if implemented) to all building permit requests (Table 74).

4.4.14.4. Potential Mitigation Measures by Flood Hazard Type

Beaver Dam Floods: Several techniques have been developed to limit the financial losses experienced from beaver dam flooding of culverts, bridges, roads, and infrastructure. Many of these solutions are lethal to the beaver, and the Coeur d'Alene Tribe opposes the harvest of beaver seeing the benefit of the animal as a natural component of the environment. The Coeur d'Alene Tribe also recognizes the overwhelming benefit beaver dams have on fisheries. Some practitioners have experimented with protecting culverts with a device called a "Beaver Pipe" (Langlois and Decker 1997) developed in Massachusetts. The Beaver Pipe is installed through the culvert and extends into the water impoundment where intake is provided through a mesh filter and the pour point is extended well beyond the road surface it passes under to return the water to the stream channel. These devices require annual or quarterly maintenance and are not suitable to all culverts (Langlois and Decker 1997). Other efforts have installed protective "beaver fences" both upstream and downstream of culvert openings, but these structures require frequent maintenance in direct correlation with the amount of debris normally transported in the stream system, which is moderate-to-low on most Coeur d'Alene Reservation streams.

Riverine Floods: The mitigation of riverine flooding is mostly effective through the development of an early warning system designed to notify and evacuate people located at risk to rising waters. While family members, pets, and valuables can often be evacuated from homes and businesses, the structures rarely can be moved in an emergency. Equally at risk are the infrastructure components of the region, such as roads, bridges, water supply systems, power supply systems, and sewage treatment plants.

Another partially effective means of mitigating losses from riverine floods is the “flood proofing” of structures discussed in this section.

Flash Flooding: Because the nature of flash flooding greatly precludes advance warnings, these flood types often cause substantial damage and loss of life. Certain areas of Coeur d’Alene Reservation are more prone to these types of floods than others (such as the Benewah Valley), where lower-order streams often possess minimal flood-water storage areas. Larger-order streams, such as the St. Joe system, generally have a substantially larger storage area and can accept these increased volumes on a short-term basis.

Caution and respect for these flash-flood-prone areas is the best defense against losses from these flood types. Development of structures and infrastructure in these locations is not recommended.

Ice and Debris Jam Flooding: These floods will impact areas where excessive debris is available for the floodwaters to recruit and transport from the point of origination to downstream locations. Often debris dams are created where the channel is narrowed due to a road crossing (under or through a culvert), or because of a natural narrowing of the waterway from topographic bridge relief. Debris carried by the river creates a dam that restricts water flow and increases flooding around the entrapment. Ice jams are similar transient dams created by breaking ice and generally occur at the same pinch points as debris dams.

While natural topographic restrictions are difficult to moderate, ice and debris dams against bridges and culverts are possible to avert. Counter measures proposed by the US Department of Transportation (2008) are applicable for bridges and culverts alike, although a few are better applied to one situation than to another.

Culverts:

- **Debris Deflectors** are structures placed at the culvert inlet to deflect the major portion of the debris away from the culvert entrance. They are normally "V"-shaped in plan with the apex upstream.
- **Debris Racks** are structures placed across the stream channel to collect the debris before it reaches the culvert entrance. Debris racks are usually vertical and at right angles to the stream flow, but they may be skewed with the flow or inclined with the vertical.
- **Debris Risers** are a closed-type structure placed directly over the culvert inlet to cause deposition of flowing debris and fine detritus before it reaches the culvert inlet. Risers are usually built of metal pipe. Risers can also be used as relief devices in the event the entrance becomes completely blocked with debris.
- **Debris Cribs** are open crib-type structures placed vertically over the culvert inlet in log-cabin fashion to prevent inflow of coarse bed load and light floating debris.
- **Debris Fins** are walls built in the stream channel upstream of the culvert. Their purpose is to align the debris with the culvert so that the debris would pass through the culvert without accumulating at the inlet. This type of measure can also be used at a bridge.

- **Debris Dams and Basins** are structures placed across well-defined channels to form basins that impede the stream flow and provide storage space for deposits of detritus and floating debris.
- **Combination Devices** are a combination of two or more of the preceding debris-control structures at one site to handle more than one type of debris and to provide additional insurance against the culvert inlet becoming clogged.

The only type of non-structural measure available for ensuring culvert function is to provide emergency and annual maintenance. Although not always feasible for remote culverts or culverts with small drainage areas, maintenance could be a viable option for larger culverts with fairly large drainage basins. Emergency maintenance could involve removing debris from the culvert entrance and/or an existing debris-control structure. Annual maintenance could involve removing debris from within the culvert, at the culvert entrance, and/or immediately upstream of the culvert, or repairing any existing structural measures.

Bridges:

Various types of structural measures are also available for bridges. Some of the measures discussed above for the culvert structures can also be utilized at bridges. The various types include:

- **Debris Fins** are walls built in the stream channel upstream of the bridge to align large floating trees so that their length is parallel to the flow, enabling them to pass under the bridge without incident. This type of measure is also referred to as a "pier nose extension".
- **In-channel Debris Basins** are structures placed across well-defined channels to form basins that impede the stream flow and provide storage space for deposits of detritus and floating debris. These structures can be expensive to construct and maintain.
- **River-Training Structures** are structures placed in the river flow to create counter-rotating streamwise vortices in their wakes, thus modifying the near-bed flow pattern to redistribute flow and sediment transport within the channel cross-section. Examples of this type of structure include Iowa vanes, and impermeable and permeable spurs.
- **Crib Structures** are walls built between open-pile bents to prevent debris lodging between the bents. The walls are typically constructed of timber or metal.
- **Flood Relief Sections** are overtopping or flow through structures that divert excess flow and floating debris away from the bridge structure and through the structure.
- **Debris Deflectors** are structures placed upstream of the bridge piers to deflect and guide debris through the bridge opening. They are normally "V"-shaped in plan with the apex upstream. A special type of debris deflector is a hydrofoil. Hydrofoils are submerged structures placed immediately upstream of bridge piers that create counter-rotating streamwise vortices in their wakes to deflect and divert floating debris around the piers and through the bridge opening.
- **Debris Sweeper** is a polyethylene device that is attached to a vertical stainless steel cable or column affixed to the upstream side of the bridge pier. The polyethylene device travels vertically along the pier as the water surface rises and falls. It is rotated by the flow, causing the debris to be deflected away from the pier and through the opening.
- **Booms** are logs or timbers that float on the water surface to collect floating drift. Drift booms require guides or stays to hold them in place laterally. Booms are very limited in

use and their application is not widely used in urban areas, but they may be used in remote forestland areas.

- **Design Features** are structural features that can be implemented in the design of a proposed bridge structure. The first feature is freeboard, which is a safety precaution of providing additional space between the maximum water surface elevation and the low chord elevation of the bridge. The second feature is related to the type of piers and the location and spacing of the piers. Ideally, the piers should be a solid wall-type pier aligned with the approaching flow. They should also be located and spaced so that the potential for debris accumulation is minimized. The third feature involves the use of special superstructure design, such as thin decks, to prevent or reduce the debris accumulation on the structure when the flood stage rises above the deck. The last feature involves providing adequate access to the structure for emergency and annual maintenance.

There are generally two types of non-structural measures available for bridges. The first type of non-structural measure is emergency and annual maintenance. Emergency maintenance could involve removing debris from the bridge piers and/or abutments; placing riprap near the piers and abutments or where erosion is occurring due to flow impingement created by the debris accumulation; and/or dredging of the channel bottom. Annual maintenance could involve debris removal and repair to any existing structural measures.

The second type of non-structural measure is management of the upstream watershed. The purpose of this measure is to reduce the amount of debris delivered to the structure by reducing the sources of debris, preventing the debris from being introduced into the streams, and clearing debris from the stream channels. The type of management system implemented varies depending on the type of debris. For organic floating debris, the management system could involve removing dead and decayed trees and/or debris jams; providing buffer zones for areas where logging practices exist (such as provided for by the Idaho Forest Practices Act); implementing a cable-assisted felling of trees system; and stabilizing hillside slopes and stream banks.

Muddy Floods: Preventive or curative measures can be implemented to control muddy floods. Preventive measures include limiting runoff generation and sediment production at the source. For instance, farmers can implement alternative farming practices (e.g. reduced tillage) to increase runoff infiltration and limit erosion in their fields. Curative measures generally consist of installing retention ponds at the boundary between cropland and inhabited areas.

An alternative is to apply other measures that can be referred to as intermediate measures. Grass buffer strips along or within fields, a grassed waterway (in the thalwegs of dry valleys), and earthen dams are good examples of this type of measure. They act as a buffer within the landscape, detaining runoff temporarily and trapping sediments.

Implementation of these measures is best coordinated at the catchment scale. However, since there are few acres of farmland in the headwater areas of the Coeur d'Alene Reservation, these mitigation practices are not very practical here.

4.5. Earthquakes

In all parts of the Upper Columbia Plateau, the historical record of seismicity reveals at least a moderate threat from earthquakes. The Idaho Geological Survey (IGS) addresses earthquake concerns by studying faults and seismic activity, and by promoting earthquake education programs. The IGS works closely with other agencies in planning state and regional earthquake policy and response, and participates in regional organizations such as the Western States Seismic Policy Council (WSSPC).

4.5.1. Tribal Legends

Native accounts of a once-in-many-generations event like a great earthquake may be incorporated into preexisting myths and explanations of phenomena in a way that makes that event difficult to separate from the intertwined background. Native stories served many purposes, and were deeply embedded in the overarching Tribal cultures. Understanding the story motifs and characters that are most likely to be linked with earthquake stories, requires careful study and insightful interrogation of the material.

4.5.2. Geological Setting

Geological and seismological studies show that earthquakes are likely to happen in any of several active zones in the Upper Columbia Plateau. Idaho is ranked fifth highest in the nation for earthquake hazard. Only California, Nevada, Utah, and Alaska have a greater overall hazard. Idaho has experienced two substantial earthquakes in the last fifty years—the 1959 Hebgen Lake earthquake (Magnitude 7.5) and the 1983 Borah Peak earthquake (Magnitude 7.3). Both tremors caused fatalities and millions of dollars in damage.

The crust or surface of our planet is broken into large, irregularly shaped pieces called plates. The plates tend to pull apart or push together slowly, but with great force. Stresses build along edges of the plates until part of the crust suddenly gives way in a violent movement. This shaking of the crust is called an earthquake.

The crust breaks along uneven lines called faults. Geologists locate these faults and determine which are active and inactive. This helps identify where the greatest earthquake potential exists. Many faults mapped by geologists are inactive and have little earthquake-induced risk potential; others are active and have a higher earthquake-induced risk potential.

When the crust moves abruptly, the sudden release of stored force in the crust sends waves of energy radiating outward from the fault. Internal waves quickly form surface waves, and these surface waves cause the ground to shake. Buildings may sway, tilt, or collapse as the surface waves pass. Fault-line information used in this report was adopted from research completed by the IGS, a research agency of the University of Idaho (Breckenridge *et al.* 2003).

The constant interaction of crustal plates in western North America creates severe earthquakes. The Upper Columbia Plateau is situated where the Basin and Range and Rocky Mountain geomorphic provinces meet. Most of the Upper Columbia Plateau has undergone the effects of tremendous crustal stretching.

Earthquakes from the crustal movements in the adjoining states of Montana, Utah, and Nevada can also cause severe ground shaking in Idaho. Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated sediment and other unstable soil, as well as trailers and homes not tied to their foundations, are at risk because they can be shaken off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths, injuries, and extensive property damage.

Aftershocks are smaller earthquakes that follow the main shock and can cause further damage to weakened buildings. Aftershocks can occur in the first hours, days, weeks, or even months after the quake. Some earthquakes are actually foreshocks, and a larger earthquake might subsequently occur.

Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related injuries result from collapsing walls, flying glass, and falling objects as a result of the ground shaking, or people trying to move more than a few feet during the shaking (FEMA 2009).

4.5.3. Measuring an Earthquake

Earthquakes are measured in two ways. One determines the power; the other describes the physical effects. Magnitude is calculated by seismologists from the relative size of seismograph tracings. This measurement has been named the Richter scale, a logarithmic-numerical gauge of earthquake energy ranging from 1.0 (very weak) to 9.0 (very strong). A Richter scale earthquake of 5.0 is ten times stronger than a 4.0 earthquake. The Richter scale is most useful to scientists who compare the power in earthquakes. Magnitude is less useful to disaster planners and citizens, because power does not describe and classify the damage an earthquake can cause. The damage we see from earthquake shaking is due to several factors including distance from the epicenter and local rock types. Intensity defines a more useful measure of earthquake shaking for any one location. It is represented by the modified Mercalli scale (Table 29). On the Mercalli scale, a value of I is the least intense motion and XII is the greatest ground shaking. Unlike magnitude, intensity can vary from place to place. In addition, intensity is not measured by machines. It is evaluated and categorized from people's reactions to events and the visible damage to man-made structures. Intensity is more useful to planners and communities because it can by reasonably used to predict the effects of violent shaking for a local area.

Table 29. Modified Mercalli Earthquake Intensity Scale (IGS 2008).

Intensity	Description
I.	Only instruments detect the earthquake
II.	A few people notice the shaking
III.	Many people indoors feel the shaking. Hanging objects swing.
IV.	People outdoors may feel ground shaking. Dishes, windows, and doors rattle.
V.	Sleeping people are awakened. Doors swing, objects fall from shelves.
VI.	People have trouble walking. Damage is slight in poorly built buildings.
VII.	People have difficulty standing. Damage is considerable in poorly built buildings.
VIII.	Drivers have trouble steering. Poorly built structures suffer severe damage, chimneys may fall.
IX.	Well-built buildings suffer considerable damage. Some underground pipes are broken.
X.	Most buildings are destroyed. Dams are seriously damaged. Large landslides occur.
XI.	Structures collapse. Underground utilities are destroyed.
XII.	Almost everything is destroyed. Objects are thrown into the air.

4.5.4. Upper Columbia Plateau Geology

The diverse geology of the Upper Columbia Plateau is manifested by the rolling Palouse prairie on the west side, and foothills and steep forested mountains on the east side. The mountains are underlain by the Mesoproterozoic Belt Supergroup, with the Emerald Creek mining district, in the extreme southeastern corner of the Reservation south of Santa, situated in metamorphic rocks of the middle-Belt Wallace Formation. Miocene Columbia River basalts cover the low farming country in the north eastern part of the Reservation and along the eastern side of the Reservation. In addition to these consolidated sediments, there are a few terrace gravels of Tertiary age and the larger stream valleys contain some recent alluvium (Wagner 1949). Lacustrine and river sediments accumulated in valleys that had been dammed up by basalt lava flows. The world famous Clarkia fossil locality formed this way. The St. Joe fault, an Eocene feature related to continental extension and development of metamorphic core complexes, runs eastward through the northeast corner of the Reservation.

The geologic structure of Coeur d'Alene Reservation consists of four main types including 1) metamorphic structures, 2) basalt structures, 3) alluvial floodplain deposits, and 4) windblown fine silt and sand deposits. Metamorphic structures consist of many formations scattered across the region, mainly on the central and eastern side of the Reservation. These formations form the topographic relief seen in the relatively high elevations along the eastern side and northeastern reaches of the Reservation.

Granitic bedrocks are found across the Coeur d'Alene Reservation except in the highest elevations that are dominated by the aforementioned metamorphic structures. These granitic formations are estimated to have been formed during the Mesozoic to early Tertiary period (about 60-65 million years ago).

Alluvial deposits can be identified on all of the major and minor river systems on the Coeur d'Alene Reservation. Silt, sand, river gravel, and even peat make up this hydraulically transported alluvium. This material is common in the major river valleys where human developments have been concentrated, especially along the St. Joe River system.

Windblown loess deposits are observed along the western side of the Coeur d'Alene Reservation and make up a part of the Palouse Hills soil complex. These highly fertile soils are sometimes very deep and often located on moderate slopes where farming activities are successful.

4.5.5. Seismic Shaking Hazards

The USGS has gathered data and produced maps of the nation, depicting earthquake shaking hazards. This information is essential for creating and updating seismic design provisions of building codes. The USGS Shaking Hazard maps for the United States are based on current information about the rate at which earthquakes occur in different areas and on how far strong shaking extends from quake sources. These analyses estimate the level of horizontal shaking that have a 1 in 10 chance of being exceeded in a 50-year period. Shaking is expressed as a percentage of "g" (g is the acceleration of a falling object due to gravity). This analysis is based on seismic activity and fault-slip rates and takes into account the frequency of occurrence of earthquakes of various magnitudes. Locally, risk may be greater than that shown, because site geology may amplify ground motions.

Studies of ground shaking during previous earthquakes have led to better interpretations of the seismic threat to buildings. In areas of severe seismic shaking hazard, older buildings are especially vulnerable to damage. Older buildings are at risk even if their foundations are on solid bedrock, but are at greater risk if their foundations are not stable. Areas with high seismic shaking hazard can experience earthquakes with high intensity where weaker soils exist. Most populated areas on the Coeur d'Alene Reservation are located on or near alluvial deposits that provide poorer building site conditions during earthquakes. Older buildings may suffer damage even in areas of moderate ground shaking hazards (IGS 2008).

4.5.6. Earthquake Profile

Many populated places in the Upper Columbia Plateau are at risk to earthquakes, even small ones, because they were built on unconsolidated sediments that move easily in response to seismic waves. Seismic waves are the form of energy that ripples through Earth when an earthquake occurs. When seismic waves propagate through unconsolidated sediments, the sediments re-organize and move chaotically (like shaking a bowl of marbles). The danger is really two-fold because population centers often contain structures built near rivers below the foothills and mountains, that were then expanded into the foothills with new structures. Mountain foothills contain erosional remnants called alluvial fans. The alluvial fans may either slide down into the valley or simply shake about, creating new topography due to internal settling. These conditions are especially apparent along the eastern side of the Coeur d'Alene Reservation.

Many developments have been built within close proximity to river drainages, often placing the structures at risk to flooding. These zones typically are also found on unconsolidated sediments. The overwhelming majority of structures on the Coeur d'Alene Reservation are located on unconsolidated sediments that respond poorly to seismic shaking. For this reason, these earthquake hazards are more pronounced in the eastern side than the developments located along the western extent of the Reservation.

Ground motion is the shaking of the ground that causes buildings to vibrate. Large structures such as office buildings, dams, and bridges may collapse. Broken gas lines and fallen electrical wires may cause fires, while broken water lines can hinder the capability of controlling fires. Landslides can also be caused by earthquakes.

Geological and seismological studies in combination with local fault lines indicate that earthquakes are likely to occur within the Coeur d'Alene Reservation.

The 1991 Uniform Building Code (UBC), a nationwide industry standard, sets construction standards for different seismic zones in the nation. UBC seismic zone rankings for Idaho are among the highest in the nation. When buildings are built to these standards they have a better chance of withstanding earthquakes. In 2002 the International Building Code (IBC) adopted the 1991 UBC earthquake standards. The Coeur d'Alene Tribe operates with compliance to the 2006 International Building Code and the 2006 International Residential Code. Given the Reservation's risk level, this is adequate caution for all new construction.

The 2006 International Building Code provides an assessment that the area is in a site class 2-B, possessing a 17%-33% chance of experiencing a horizontal spectral response acceleration for 0.2 second period with a 2% probability of exceeding the norm in 50 years (USGS 2008).

More challenging for Coeur d'Alene Reservation residents is dealing with older structures that were built prior to development of the new standards and are not in compliance. There are two main risk categories on the Coeur d'Alene Reservation; 1) unreinforced masonry structures, and 2) brick or masonry chimneys on otherwise stable wood-frame structures. The risks presented by these two categories of construction will be discussed in greater detail in subsequent sections of this plan.

4.5.6.1. Past Earthquake Events

The Upper Columbia Plateau's high mountain ranges are striking evidence of these powerful earth movements over millions of years. This entire region has been shaped by seismic forces although the events are often viewed as once-in-a-lifetime events. Although less than frequent, these events can be dramatic and often are not well predicted.

4.5.6.1.1. Sandpoint 1942

An intensity VI shock, M4.6, on November 1, 1942, centered near Sandpoint, Idaho, affected 25,000 square miles of Washington, Montana, and Idaho. The Northern Pacific Railroad partially suspended operations to inspect the right-of-way for boulders and slides. Church services were interrupted, but only minor home damage was reported.

4.5.6.1.2. Wallace Earthquake 1957

A locally sharp shock was felt at Wallace on December 18, 1957, damaging the Galena Silver Mine and frightening miners working 3,400 feet underground.

4.5.6.1.3. Borah Peak, Idaho, October 28, 1983

The Borah Peak earthquake is the largest ever recorded in Idaho - both in terms of magnitude and in amount of property damage. It caused two deaths in Challis, about 200 kilometers northeast of Boise, and an estimated $12.5 million in damage in the Challis-Mackay area. A maximum MM intensity IX was assigned to this earthquake on the basis of surface faulting. Vibrational damage to structures was assigned intensities in the VI to VII range (EHP 2009).

Spectacular surface faulting was associated with this earthquake - a 34-kilometer-long northwest-trending zone of fresh scarps and ground breakage on the southwest slope of the Lost River Range. The most extensive breakage occurred along the 8-kilometer zone between West Spring and Cedar Creek. Here, the ground surface was shattered into randomly tilted blocks several meters in width. The ground breakage was as wide as 100 meters and commonly had four to eight *en echelon* scarps as high as 1-2 meters. The throw on the faulting ranged from less than 50 centimeters on the southern-most section to 2.7 meters south of Rock Creek at the western base of Borah Peak (EHP 2009).

Other geologic effects included rockfalls and landslides on the steep slopes of the Lost River Range, water fountains and sand boils near the geologic feature of Chilly Buttes and the Mackay Reservoir, increase or decrease in flow of water in springs, and fluctuations in well water levels. A temporary lake was formed by the rising water table south of Dickey (EHP 2009).

The most severe property damage occurred in the towns of Challis and Mackay, where 11 commercial buildings and 39 private houses sustained major damage and 200 houses sustained minor to moderate damage.

At Mackay, about 80 kilometers southeast of Challis, most of the commercial structures on Main Street were damaged to some extent; building inspectors condemned eight of them. Damaged buildings were mainly of masonry construction, including brick, concrete block, or stone. Visible damage consisted of severe cracking or partial collapse of exterior walls, cracking of interior walls, and separation of ceilings and walls at connecting corners. About 90 percent of the residential chimneys were cracked, twisted, or collapsed (EHP 2009).

At Challis, less damage to buildings and chimneys was sustained, but two structures were damaged extensively: the Challis High School and a vacant concrete-block building (100 years old) on Main Street. Many aftershocks occurred through 1983. Also felt in parts in Montana, Nevada, Oregon, Utah, Washington, Wyoming, and in the Provinces of Alberta, British Columbia, and Saskatchewan, Canada.

4.5.6.1.4. Cooper Pass Earthquake 1988 (near Mullan)

A M4.1 earthquake in 1988 on the Montana-Idaho border at Cooper Pass, 7 miles northeast of Mullan was felt over 3,000 square miles with an intensity of IV at Trout Creek, Montana, and Mullan, Idaho.

4.5.6.1.5. Hoyt Mountain Earthquakes March 7 and June 3, 1994

An earthquake at Hoyt Mountain (in Shoshone County within the St. Joe River valley) in 1994 was situated on a thrust-type fault, the only fault line of this type in the area of the earthquake. Hoyt Mountain is only 25 miles east of the Coeur d'Alene Reservation.

On March 7, 1994, an earthquake, M3.5, occurred along the St. Joe River Valley, near Hoyt Mountain and the community of Avery, approximately 30 miles east of the Coeur d'Alene Reservation. On June 3, a M2.9 aftershock occurred at the same location. The main shock, centered very close to Hoyt Mountain about 6 miles southwest of Avery, was the largest earthquake in the northern Idaho region since the 1988 M4.1 Copper Pass event, and one of only a few natural earthquakes in the region since a 1942 M4.6 Sandpoint event.

The initial Hoyt Mountain shock reached a "V" intensity and was felt locally at Marble Creek and Avery and as far west as St. Maries. There were no aftershocks until the M2.9 event almost three months later. Except for a lower magnitude, the aftershock was identical to the main shock in location and focal mechanism. The fault-plane solution indicates either (1) reverse slip, or (2) a low-angle thrust faulting on a plane striking north-northwest and dipping gently northeast. The faults in the area are part of the Lewis and Clark line of fractures that extends from near Coeur d'Alene, passing through the St. Maries area, and extending over 240 miles eastward to Helena, Montana (Sprenke *et al.* 1994).

The Hoyt Mountain earthquake was felt strongly in Hoyt, Marble Creek, and Avery where houses shook, dishes rattled, a lamp "walked on a table", and an outside basketball upright swayed. ON the Coeur d'Alene Reservation, the event was felt as far west as St. Maries. There were no reported structures damaged or lives lost from this event (Sprenke *et al.* 1994).

The M3.5 main shock, though small by most seismology standards, is certainly significant in the historic seismicity of the Upper Columbia Plateau.

4.5.6.1.6. Other Earthquakes in the Region

On September 22, 2003 a moderate Magnitude 3.3 earthquake was witnessed near Rathdrum, Idaho, approximately 25 miles north of the Coeur d'Alene Reservation. The quake was only 8.1 miles below the surface and caused no damage to the area (EHP 2009).

A magnitude 5.6 earthquake occurred approximately 14 miles north of Dillon, Montana, on July 26, 2005. Another magnitude 4.5 earthquake occurred about 35 miles northeast of Dillon, Montana, on May 8, 2007. These two events were 200 miles southeast of the Coeur d'Alene Reservation but both were felt by residents on the Reservation. The network of fault lines passing through the entire Upper Columbia Plateau link these areas in a profile of a seismic network. There have been no reports of damage (EHP 2009) from these quakes.

4.5.6.1.7. Rockburst Events

Because of over a century of deep mining activities in Shoshone County, rockbursts are an important risk exposure consideration. Rockbursts are the result of brittle fracturing of rock, causing it to collapse rapidly with violent expulsion of rock that can be 100 to 200 tons or more. This release of energy reduces the potential energy of the rock around the excavation. Further explanation gives rationalization that the changes brought about by the mine's redistribution of stress triggers latent seismic events (Marshak 2001).

The likelihood of rockbursts occurring increases as depth of the mine increases. Rockbursts are also affected by the size of the excavation, becoming more likely as the excavation size increases. Induced seismicity such as faulty mining engineering methods can trigger rockbursts. Other causes of rockbursts are the presence of faults, dykes, or joints in conjunction with mining activity, which are common occurrences (Monroe & Wicander 1997).

4.5.7. Fault Lines

In geology, a fault is a planar fracture or discontinuity in a volume of rock, across which there has been significant displacement. Large faults within the Earth's crust result from the action of tectonic forces. Energy release associated with rapid movement on active faults is the cause of most earthquakes. A fault line is the surface trace of a fault, the line of intersection between the fault plane and the Earth's surface (Tingley & Pizarro 2000).

Since faults do not usually consist of a single, clean fracture, geologists use the term 'fault zone' when referring to the zone of complex deformation associated with the fault plane. Across the Coeur d'Alene Reservation there are approximately 80 individual fault lines (Figure XLVIII).

The two sides of a non-vertical fault are known as the hanging wall and footwall. By definition, the hanging wall occurs above the fault and the footwall occurs below the fault (USGS 2000). Most of the seismic activity takes place where two or more plates meet. Plates may collide, pull apart, or scrape past each other. Because of friction and the rigidity of the rock, the rocks cannot simply glide or flow past each other. Rather, stress builds up in rocks and when it reaches a level that exceeds the strain threshold, the accumulated potential energy is released as strain, which is focused into a plane along which relative motion is accommodated; the fault (Tingley & Pizarro 2000).

All the stress and strain produced by moving plates builds up in the Earth's rocky crust until it cannot store the contained energy any more. Suddenly, the rock breaks and the two blocks move in opposite directions along a more or less planar fracture surface called a fault.

The sudden movement generates an earthquake at a point called the focus. The energy from the earthquake spreads out as seismic waves in all directions. The epicenter of the earthquake is the location where seismic waves reach the surface directly above the focus (USGS 2000).

4.5.7.1. Normal Fault

Faults are classified by how the two rocky blocks on either side of a fault move relative to each other. A normal fault drops rock on one side of the fault down relative to the other side (Figure XLIV).

4.5.7.2. Reverse Fault

Along a reverse fault one rocky block is pushed up relative to rock on the other side (Figure XLV).

4.5.7.3. Strike-slip fault

Strike-slip faults have a different type of movement than normal and reverse faults (Figure XLVI). The blocks that move on either side of a reverse or normal fault slide up or down along a dipping fault surface. The rocky blocks on either side of strike-slip faults scrape along side-by-side. The movement is horizontal and the rock layers beneath the surface are not moved up or down on either side of the fault.

Pure strike-slip faults do not produce fault scarps. There are other changes in the landscape that signal strike-slip faulting. Where the two massive blocks on either side of a strike-slip fault grind against each other, rock is weakened. Streams flowing across strike-slip faults are often diverted to flow along this weakened zone.

4.5.7.4. Real-life

In "real-life" faulting is not always exposed by such a simple pictures (Figure XLIV, Figure XLV, Figure XLVI). Usually faults do not have purely up-and-down or side-by-side movement as described here. It is much more common to have some combination of fault movements occurring together. For example, along California's famous San Andreas strike-slip fault system, about 95% of the movement is strike-slip, but about 5% of the movement is reverse faulting in some areas (USGS 2000).

Figure XLIV. Normal Fault.

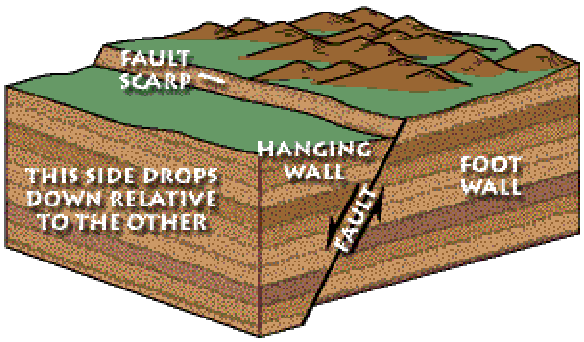


Figure XLV. Reverse Fault.

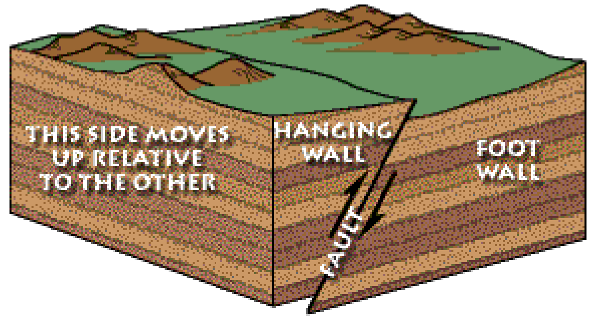


Figure XLVI. Strike-slip Fault

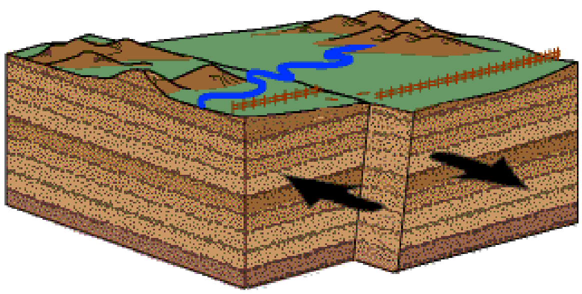


Figure XLIV, Figure XLV, Figure XLVI are all contributed by USGS (2000).

Within the Coeur d'Alene Reservation, the fault lines present are all categorized as "Normal Faults". These normal faults occur in places where the outer shell of the Earth's crust is being stretched. Normal faults can show different geometries. In some situations the faults can become gently dipping at depth so that they have a spoon (or listric) shape. Other normal faults are found in batches, dipping in the same direction, with rotated fault blocks between. These are termed domino faults and can be seen in the northeastern sections of the Coeur d'Alene Reservation (Figure XLVIII).

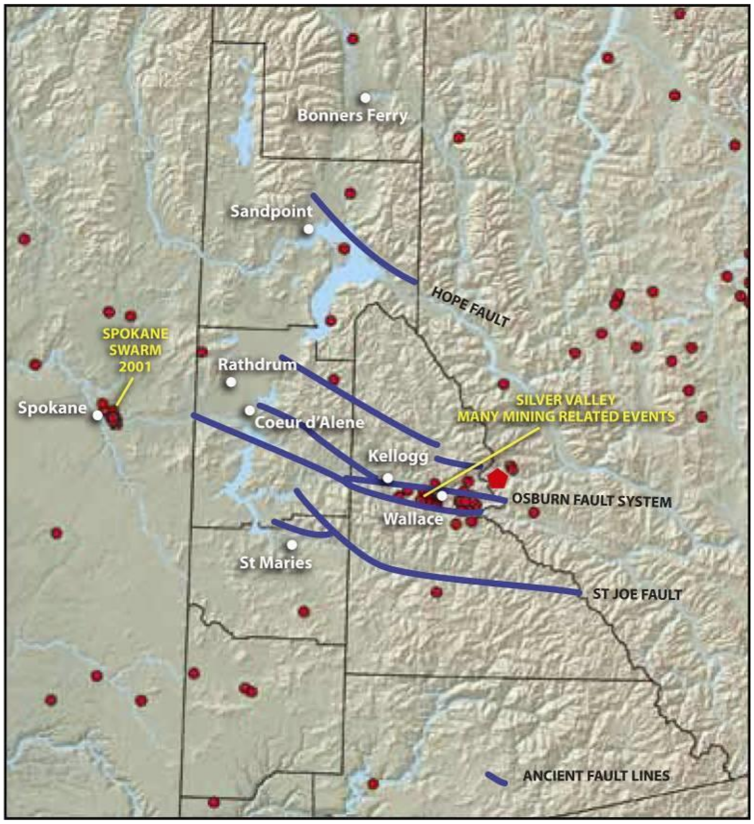
4.5.7.5. Lewis and Clark Fault Zone (IBHS 2010)

The Lewis and Clark Zone is a megashear in the earth's crust, up to 30 miles wide, which cuts some 240 miles through north Idaho and northwestern Montana (Figure XLVII). Geologic studies have shown that the North American plate has been sheared along this zone repeatedly over the past billion years. The most obvious manifestation of the zone is a series of valleys that follow brittle fault zones across the grain of the northern Rocky Mountains from Helena through Missoula, Montana, to Coeur d'Alene, Idaho. These valleys provided a natural transportation corridor through the mountains used in part by Lewis and Clark in 1806 and the Mullan Trail of the 1850s, and today by Interstate 90.

The St. Joe River is one such valley that follows the course of one of the fault lines in this zone (Figure XLVII).

Along the Lewis and Clark Zone in Idaho, many mining-related seismic events, called rockbursts, have occurred. The destructive 1935 magnitude 6.25 and 6.0 Helena Valley earthquakes occurred near the eastern end of the Lewis and Clark Fault Zone in Montana (IBHS 2010). The possibility that the western end of the zone is also capable of such large earthquakes, creates a considerable earthquake shaking hazard for the residents of Wallace, Kellogg, Coeur d'Alene, Rathdrum, Sandpoint and all of the Coeur d'Alene Reservation.

Figure XLVII. Lewis and Clark Fault Zone, including the St. Joe Fault Line (IBHS 2010).



4.5.8. Brick and Mortar vs. Seismic Shaking

4.5.8.1. Unreinforced Masonry Buildings

Masonry boasts a remarkable compressive strength (vertical loads) but is much lower in tensile strength (twisting or stretching), unless reinforced. The tensile strength of masonry walls can be increased by thickening the wall, or by building masonry "piers" (vertical columns or ribs) at intervals. Where practical, steel reinforcement also can be introduced vertically and/or horizontally to greatly increase tensile strength, though this is most commonly done with poured walls.

Early 20th century masonry construction techniques did not use the technology of reinforcement as is used today. Unreinforced masonry buildings are a type of structure where load-bearing walls, non-load-bearing walls, or other structures such as chimneys are made of brick, cinderblock, tiles, adobe, or other masonry material that is not braced by reinforcing beams (CSSC 2005). The term is used as a classification of certain structures for earthquake safety purposes, and is subject to some variation from place to place (ABAG 2003).

Unreinforced masonry buildings were constructed in an era when reinforcing was generally not used. Anchorage to floor and roof was generally missing and the use of low-strength lime mortar was common. Construction of reinforced masonry became common sometime between 1933 and 1955, depending on local codes and stringency of code enforcement. Within Benewah County and Kootenai County, unreinforced masonry buildings may have been erected as recently as 1975 and still met the conditions of county building codes.

Unreinforced masonry structures are vulnerable to collapse in an earthquake. One problem is that most mortar used to hold bricks together is not strong enough (CSSC 2005). Additionally, masonry elements may "peel" from the building and fall onto occupants in the building or pedestrians outside (Perkins 2004).

Building retrofits are relatively expensive, and may include tying building walls to the foundation, tying building elements (such as roof and walls) to each other, so the building moves as a single unit rather than creating internal shear during an earthquake, attaching walls more securely to underlying supports so they do not buckle and collapse, and bracing or removing parapets and other unsecured decorative elements (Perkins 2004, CSD 2008). Retrofits are generally intended to prevent injury and death to people, not to preserve the building itself (Perkins 2004).

Earthquake damage to unreinforced masonry structures can be severe and hazardous. The lack of reinforcement coupled with poor mortar and inadequate roof-to-wall ties can result in substantial damage to the building as a whole as well as to specific sections of it. Severely cracked or leaning walls are some of the most common earthquake damages. Also hazardous, but slightly less noticeable, is the damage that may occur between the walls, and roof and floor diaphragms. Separation between the framing and the walls can jeopardize the vertical support of roof and floor systems, which could lead to the collapse of the structure (ABAG 2003).

Although the Coeur d'Alene Reservation contains many buildings constructed from masonry materials that may or may not have been reinforced during or after initial construction, most of these structures are located in City municipalities. Many of the structures in St. Maries, for example, were built early in the 20th century. Today, many of the structures located in the "old town" area of St. Maries along College Ave. and are from an era that used materials and construction techniques that place them at extremely high risk to seismic shaking hazard destruction.

4.5.8.2. Brick Chimneys

Thousands of homes on the Coeur d'Alene Reservation are built with wood-frame construction techniques. These homes and businesses are typically considered resistant to seismic shaking hazards. However, many of these homes have incorporated a brick chimney appendage. Chimneys placed internally to the frame of the home are considered more resistant to loss from shaking hazards. Those that append the chimney to the side of the home are more at risk to falling bricks from earthquake-induced shaking.

When coupled with fault lines across the region and the periodic earthquakes in the region, much of the Coeur d'Alene Reservation is at risk to shaking losses. These losses could be greatly mitigated by reinforcing buildings that lack reinforcement. The goal of reinforcement is not to save the buildings, but to reduce the risk of damaging people in the structure and next to it when a shaking disaster strikes (ABAG 2003).

How to Identify unreinforced masonry buildings (CSSC 2005):

- Bricks or stone can be seen from the outside (unless the walls are covered with stucco).
- Brick walls have "header courses" of bricks turned endways every five or six rows.
- Structure is brick or masonry and is known to be built before 1933.

If visual inspection cannot determine these components from the outside, investigations behind electrical cover plates and electrical outlet boxes on an outside wall may reveal brick or other masonry materials. If the wall is concrete or concrete block, it is very difficult to find out if reinforcing steel was added during construction.

Other sources of verification:

- Look for copies of the structural plans, which may be on file with the Building Department, or

- Consult a licensed engineer to make the determination.

Suggestions:

- It is very expensive to shore up a house, remove damaged walls, and put in new walls.
- Consult a licensed architect or engineer to fix this problem.
- Another solution might involve
    - Tying the walls to the floor and roof.
    - Installing a steel frame and bolting the wall to it.

4.5.9. Probability of Future Events

The probability of earthquake events within the Coeur d'Alene Reservation is a 6% to 15% chance of exceeding 10% peak ground acceleration in 50 years (FEMA 2009). This places the Coeur d'Alene Reservation in the next-to-lowest national classification of likely damages due to earthquakes.

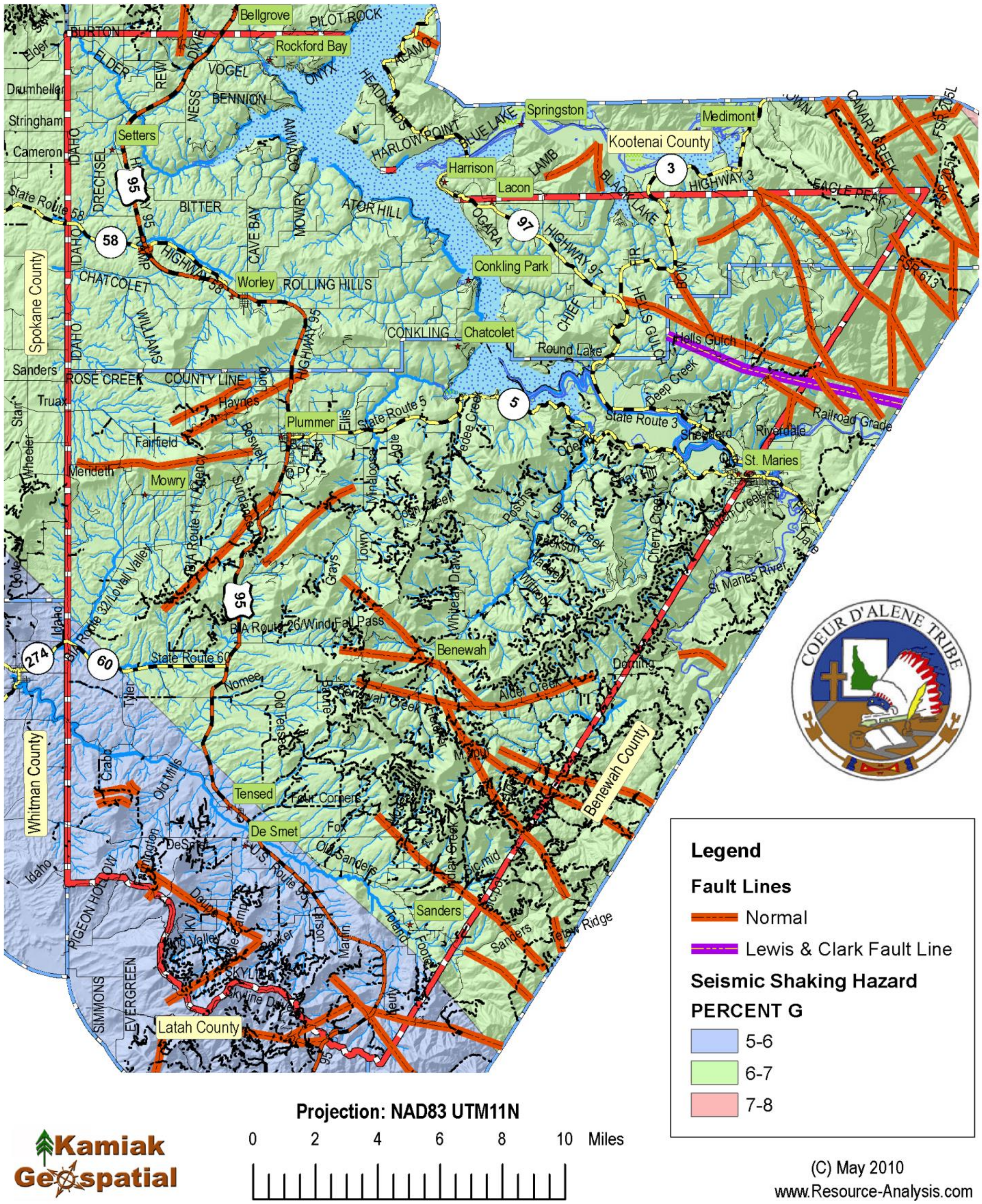
The Coeur d'Alene Reservation has a moderate probability of future earthquake events with those events expected to be seen as infrequently as once every 25 years and with Mercalli magnitudes of IV to VII (Table 29). Although the frequency and the intensity of expected earthquakes is low, the potential for a significant event is real, as indicated by other historical events within the "geologic neighborhood".

4.5.10. Resources at Risk

The exposure of resources on the Coeur d'Alene Reservation to earthquake damage is not localized to small areas. Literally, all of the Coeur d'Alene Reservation is exposed to losses potentially resulting from seismic shaking hazards and fault line tremors. Analysts have estimated that the seismic shaking hazards for all except the most southern part of the Reservation is in the range of moderate risk (6-7%G), encompassing most of the populated places. The most southern extent of the Reservation, including DeSmet, Tensed, and Sanders is in a lower-risk category (5-6%G).

These risk exposures are moderated by the relatively low occurrence of earthquakes of large scale in the region (Figure XLVIII).

Figure XLVIII. Fault lines and Seismic Shaking Hazards of the Coeur d'Alene Reservation.



While all structures are potentially at risk to damage from earthquakes on the Coeur d'Alene Reservation, a special category of structures are at increased risk. These are the previously discussed brick and masonry buildings and chimney structures found throughout the Coeur d'Alene Reservation but concentrated in St. Maries and to a lesser extent in Worley, Plummer, and DeSmet.

In most communities, wood-frame construction dominates the architectural scene. These structures are generally considered at lower risk to earthquake damage. A complete structure level inventory of masonry building construction date, reinforcement condition, or chimney stability has not been completed. A recommendation of this planning effort is to begin the process at the Tribal level to address risk exposure. As these inventories are created, increasing the structural integrity of external wall chimneys by reinforcement can begin.

The value of resources at risk to earthquake losses are partially explained by the seismic shaking hazard risks on the Coeur d'Alene Reservation. There are only two risk categories (6-7%G and 5-6%G) found within the Reservation (Figure XLVIII). Higher risks are witnessed to the east of the present day external boundaries of the Coeur d'Alene Reservation.

The vast majority of the value of all structures on the Coeur d'Alene Reservation (95%) is located within the higher-risk category of 6-7%G located in the northern 90% of the Reservation (Figure XLVIII). The communities with the highest concentration of privately owned structures in the higher seismic shaking category (6-7%G) include St. Maries, Rockford Bay, and Plummer, with values at risk of $45.2 million (719 structures), $45.0 million (703 structures), and $30.6 million (494 structures), respectively (Table 30). The same analysis is consistent for the non-privately owned structures where Plummer and St. Maries represent the highest concentration of structures in the highest category of seismic shaking hazards with $40.1 million (96 structures) and $12.1 million (30 structures), respectively (Table 30). These assessments include only structures located within the external boundaries of the Coeur d'Alene Reservation.

Table 30. Structure values and count, based on location and seismic shaking hazards.

	Privately Owned Structures			Non-Privately Owned Structures		
Community Name	**6-7%G**	**5-6%G**	**Count**	**6-7%G**	**5-6%G**	**Count**
AGENCY	$-	$-	0	$1,303,983	$-	7
BELLGROVE	$1,789,557	$-	28	$-	$-	0
BENEWAH	$10,569,542	$-	179	$-	$-	0
CHATCOLET	$10,856,722	$-	183	$2,750,000	$-	4
CONKLING PARK	$14,462,436	$-	233	$1,372,688	$-	5
DE SMET	$256,868	$2,078,998	47	$-	$15,247,304	42
HARRISON	$9,674,032	$-	171	$674,000	$-	5
HEYBURN STATE PARK	$-	$-	0	$8,600,000	$-	13
LACON	$6,119,520	$-	108	$112,680	$-	2
MEDIMONT	$7,752,370	$-	145	$-	$-	0
MOWRY	$2,974,175	$349,991	65	$304,000	$-	2
PLUMMER	$30,582,542	$-	494	$40,144,417	$-	96
ROCKFORD BAY	$44,967,030	$-	703	$1,060,424	$-	9
SANDERS	$3,129,516	$2,454,984	97	$304,000	$-	2
SETTERS	$5,359,908	$-	89	$12,000,000	$-	1
ST. MARIES	$45,222,390	$-	719	$12,171,841	$-	30
TENSED	$663,070	$6,190,560	127	$-	$2,269,387	13
WORLEY	$11,476,992	$-	190	$127,968,593	$-	82
Summary Count	**3,375**	**203**	**3,578**	**258**	**55**	**313**
Summary Value	**$289,323,901**	**$9,157,866**		**$208,766,626**	**$17,516,691**	

4.5.11. Potential Mitigation Activities

Seismic retrofitting is the modification of existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes. With better understanding of seismic demand on structures and with recent experiences with large earthquakes near urban centers, the need of seismic retrofitting is well acknowledged. Prior to the introduction of modern seismic codes in the U.S. during the late 1960s, many structures were designed without adequate detailing and reinforcement for seismic protection (Pampanin 2006). This is the case in much of northern Idaho. In view of the imminent problem, various research work has been carried out worldwide. Furthermore, state-of-the-art technical guidelines for seismic assessment, retrofit and rehabilitation have been published (FEMA P-420 2009).

Retrofit techniques are applicable for other natural hazards such as tornadoes, and severe winds from thunderstorms. While the current practice of seismic retrofitting is concerned with structural improvements to reduce the seismic hazard of using the structures, it is essential to reduce the hazards and losses from non-structural elements as well (FEMA P-420 2009). Methods of reducing hazards within schools, hospitals, homes, office buildings, and other commercial buildings, and general disaster preparation are found in related articles on household seismic safety published by FEMA. It is important to keep in mind that there is no such thing as an earthquake-proof structure, although seismic performance can be greatly enhanced through proper initial design or subsequent modifications (FEMA P-420 2009).

A Coeur d'Alene Tribal Comprehensive Building Plan and strategy for preparing for earthquakes should include (FEMA 2009):

- Assessment of seismic hazards to quantify and understand the threat;
- Adoption and enforcement of seismic building code provisions especially in reference to chimneys and brick or masonry buildings, including pre-existing structures;
- Implementation of land use and development policy to reduce exposure to earthquake hazards;
- Implementation of retrofit, redevelopment, and abatement programs to strengthen existing structures, especially the unreinforced masonry buildings;
- Implementation of reinforcement to extended brick and masonry chimney structures prone to collapse during seismic events;
- Support of ongoing public-education efforts to raise awareness and build support; and
- Development and continuation of collaborative public/private partnerships to build a prepared and resilient community.

The media can raise awareness about earthquakes by providing important information to the community. Here are some suggestions (FEMA 2009):

- Publish a special section in Council Fires with emergency information on earthquakes. Localize the information by printing the phone numbers of local emergency services offices, the American Red Cross, and hospitals.
- Conduct a week-long series on locating earthquake hazards in the home.
- Work with local emergency services and American Red Cross officials to prepare special reports for people with mobility impairments on what to do during an earthquake.
- Provide tips on conducting earthquake drills in the home, schools, and public buildings.
- Interview representatives of the gas, electric, and water companies about shutting off utilities.

4.6. Landslides & Mass Wasting

A landslide is a geological phenomenon that includes a wide range of ground movement such as rock falls, deep failure of slopes, and shallow debris flows. Although the action of gravity is the primary driving force for a landslide to occur, there are other contributing factors affecting the original slope stability. Typically, pre-conditional factors build up specific sub-surface conditions that make a slope prone to failure, although the actual landslide often requires a trigger before being released.

The term “landslide” covers a variety of processes and landforms known as rockslide, rockfall, debris flow, liquefaction, slump, earthflow, and mudflow. The IGS has identified and plotted over 3,000 landslides in Idaho for the USGS's national landslide appraisal. Landslides are a recurrent menace to waterways and highways and a threat to homes, schools, businesses, and other facilities.

Landslides may be triggered by other natural hazards such as earthquakes and floods. Weather and climate factors, such as melting snow and rain, that increase the water content of earth materials may fuel slope instability. The activities of urban and rural living with excavations, roads, drainage ways, landscape watering, logging, and agricultural irrigation may also disturb the stability of landforms. Late spring and early summer is slide season, particularly after days and weeks of greater than normal precipitation.

Landslides are costly. The entire Upper Columbia Plateau faces the challenge of maintaining major travel routes. Redirecting local and through traffic around a landslide is not an option in many places. Alternative routes often do not exist, and detours in steep terrain are difficult or impossible to construct. The unimpeded movement over roads—whether for commerce, public utilities, school, emergencies, police, recreation, or tourism—is essential to a normally functioning society. The disruption and dislocation caused by landslides can quickly jeopardize that freedom and vital services.

State Route 5 connects Plummer to St. Maries. State Routes 3 and 97 connect St. Maries to Harrison. These routes traverse steep canyon walls and a combination of lake valley bottoms, hilltop vistas, and steep slope grades. Falling rocks, mudslides, and earthflows are possible during most of the year when facilitated by triggering events such as freeze / thaw sessions over night / day cycles, heavy rains or snowfall, or uphill site disruptions.

Deep canyons drain toward the network of river systems and cut through the basalt flows that underlie the Coeur d'Alene Reservation. These flows are interbedded with loose, unstable sedimentary layers that are exposed in the deeply incised canyons. Exposure of this unconsolidated sedimentary layer increases landslide potential wherever these deposits are present on steep slopes. Weathering and climatic events lead to landslide activity, with the scale of the event largely dependent on the environmental conditions leading up to the event. Roads and structures in any area where logging roads or other roads have cut through steep basalt fields are also at increased risk.

The Hangman Creek watershed located in the southern portions of the Coeur d'Alene Reservation can be divided into three distinct geological regions; these are 1) a small section of its upper headwaters, 2) a long and broad valley, and 3) channeled scablands. In its headwaters, Hangman Creek flows through steep foothills. The topography here includes steep ridges and peaks dissected by deep, forested close-to-bedrock valleys, drained by rocky and steep streams, with a light covering of soil. After its mountainous headwaters, Hangman Creek passes through the much more flattened, Palouse Hills. Below the deep loess in the Palouse Hills, a basalt layer separates the creek from groundwater, which finally rises to meet the stream's surface elevation near Tekoa. Most of Hangman Creek flows in a broad and shallow, arid valley atop several hundred feet of alluvial deposits.

A documented landslide (SHELDUS, Table 22) occurred on January 15th, 2006, in the construction of U.S. Highway 95 north of Worley. This landslide occurred as a result of construction which disrupted the natural landscape. It resulted in approximately $7,500 in damages to the project. No injuries were reported.

Most of the landslides on the Coeur d'Alene Reservation recalled in memory by local residents and the Planning Committee members have occurred along County or Forest Service roads and may in some cases be a result of road construction or maintenance activities. A few re-occurring slide areas cause damage to the paved road surface and require cleanup of slide debris on a fairly regular basis – even annually or twice every three years (especially State Highway 97).

4.6.1. Types of Landslides

4.6.1.1. Debris flow

Slope material that becomes saturated with water may develop into a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses, and cars, blocking bridges and tributaries, and causing flooding along its path. Debris flow is often mistaken for flash flood, but they are entirely different processes.

Muddy-debris flows in alpine areas cause severe damage to structures and infrastructure and often claim human lives. Muddy-debris flows can start as a result of slope-related factors, and shallow landslides can dam streambeds, resulting in temporary water blockage. As the impoundments fail, a "domino effect" may be created, with a remarkable growth in the volume of the flowing mass as it takes up the debris in the stream channel. The solid-liquid mixture can reach densities of up to 3,350 pounds per cubic yard and velocities of up to 46 feet per second (Luino 2004; Arattano and Marchi 2005).

These processes normally cause the first severe road interruptions, due not only to deposits accumulated on the road, but in some cases to the complete removal of bridges, roadways, or railways crossing the stream channel. Damage usually derives from a common underestimation of mud-debris flows. In high-elevation valleys, for example, bridges are frequently destroyed by the impact force of the flow because their span is generally calculated to accommodate water discharge.

4.6.1.2. Earth flow

Earthflows are downslope, viscous flows of saturated, fine-grained materials, which move at any speed from slow to fast. Typically, they can move at speeds from 500 feet per hour to 15 miles per hour. Though these are a lot like mudflows, overall they are slower moving and are covered with solid material carried along by flow from within. Clay, fine sand and silt, and fine-grained, pyroclastic material are all susceptible to earthflows. The velocity of the earthflow is all dependent on how much water is contained in the flow itself. The greater the water content in the flow, the higher the velocity will be (Arattano and Marchi 2005).

These flows usually begin when the pore pressures in a fine-grained mass increase until enough of the weight of the material is supported by pore water to significantly decrease the internal shear strength of the material. This thereby creates a bulging lobe that advances with a slow, rolling motion. As these lobes spread out, drainage of the mass increases and the margins dry out, thereby lowering the overall velocity of the flow. This process causes the flow to thicken. The bulbous variety of earthflows is not that spectacular, but they are much more common than their rapid counterparts. This variety develops a sag at its head and is usually derived from slumping at the source.

Earthflows on the Coeur d'Alene Reservation can occur during periods of high precipitation, which saturates the ground and adds water content to the slope. Fissures that develop during the movement of clay-like material allow the intrusion of water into the earthflows. Water then increases the pore-water pressure and reduces the shearing strength of the material (Easterbrook 1999).

4.6.1.3. Debris avalanche and debris slide

A debris avalanche is a type of slide characterized by the chaotic movement of rocks, soil, and debris mixed with water or ice (or both). They are usually triggered by the saturation of thickly vegetated slopes, resulting in an incoherent mixture of broken timber, smaller vegetation and other debris (Easterbrook 1999). Debris avalanches differ from debris slides because their movement is much more rapid. This is usually a result of lower cohesion or higher water content and generally steeper slopes.

Debris slides generally begin with large blocks that slump at the head of the slide and then break apart as they move towards the toe. This process is much slower than that of a debris avalanche. In a debris avalanche this progressive failure is very rapid and the entire mass seems to somewhat liquefy as it moves down the slope. This is caused by the combination of the excessive saturation of the material, and very steep slopes. As the mass moves down the slope it generally follows stream channels, leaving behind a V-shaped scar that spreads out downhill. This differs from the more U-shaped scar of a slump. Debris avalanches can also travel well past the foot of the slope due to their tremendous speed (Schuster and Krizek 1978).

4.6.1.4. Sturzstrom

A sturzstrom is a rare, poorly understood type of landslide, typically with a long run-out. Often very large, these slides are unusually mobile, flowing very far over a low angle, flat, or even slightly uphill terrain. They are suspected of "riding" on a blanket of pressurized air, thus reducing friction with the underlying surface.

4.6.1.5. Shallow landslide

A shallow landslide is common where the sliding surface is located within the soil mantle or on weathered bedrock (typically to a depth from a few feet to many yards). They usually include debris slides, debris flow, and failures of road-cut slopes. Landslides occurring as single large blocks of rock moving slowly down slope are sometimes called block glides.

Shallow landslides can often happen in areas that have slopes with highly permeable soils on top of low-permeability bottom soils or hardpan. The low-permeability bottom soils trap the water in the shallower, highly permeable soils, creating high water pressure in the top soils. As the top soils are filled with water and become heavy, slopes can become very unstable and material will slide over the low permeability bottom soils. This can happen within the Coeur d’Alene Reservation where a slope with silt and sand as its top soil sits on top of bedrock. During an intense rainstorm, the bedrock will keep the rain trapped in the top soils of silt and sand. As the topsoil becomes saturated and heavy, it can start to slide over the bedrock and become a shallow landslide.

4.6.1.6. Deep-seated landslide

In deep-seated landslides the sliding surface is mostly deeply located below the maximum rooting depth of trees (typically to depths greater than 30 feet). Deep-seated landslides usually involve deep regolith, weathered rock, and/or bedrock and include large scale slope failure associated with translational, rotational, or complex movement.

4.6.2. Coeur d’Alene Reservation Landslide Prone Landscapes

All of these landslide types can occur on the Coeur d’Alene Reservation, although the sturzstrom variant is unlikely. The materials may move by falling, toppling, sliding, spreading, or flowing. Some landslides are rapid, occurring in seconds, whereas others may take hours, weeks, or even longer to develop. Although landslides usually occur on steep slopes, they also can occur in areas of low relief. Landslides can occur as ground failure of river bluffs, cut-and-fill failures that may accompany road construction and building excavations, collapse of mine-waste piles, and slope failures associated with quarries and open-pit mines.

The primary factors that increase landslide risk on the Coeur d’Alene Reservation are slope and certain soil characteristics. In general, the potential for landslide occurrence intensifies as slope increases on all soil types and across a wide range of geological formations.

Soil factors that increase the potential for landslide are soils developed from parent materials high in schist and granite, and soils that are less permeable, containing a resistive or hardpan layer. These soils tend to exhibit higher landslide potential under saturated conditions than do well-drained soils. To identify the high-risk soils on the Coeur d’Alene Reservation, the USDA Natural Resources Conservation Service (NRCS) State Soils Geographic Database (STATSGO) layers were used to identify the location and characteristics of all soils on the Reservation. This involved assembling together the datasets for the Coeur d’Alene Reservation and included in the Benewah County (ID607) database, the St. Joe river (parts of Benewah County and Shoshone County – ID608), and Kootenai County (ID606). The specific characteristics of each major soil type within each dataset were reviewed for all of the Coeur d’Alene Reservation.

Soils with very low permeability that characteristically have developed a hardpan layer or have developed from schist and granite parent material were selected as soils with potentially high landslide risk potential. High-risk soils magnify the effect of slope on landslide potential. Soils identified as having high potential landslide risk are further identified with increasing slopes corresponding to increasing landslide risk.

These factors were combined with vegetation characteristics (type of land cover) and canopy cover (vegetation density). Through this analysis, it was determined that while an evergreen forest is a relatively stable site against landslides, it is less stable when on steep slopes, and even more unstable where all vegetation has been removed (from logging or a wildfire, for example).

The features of the local topography are important to consider in terms of the potential to move under landslide forces. The top of an otherwise stable ridgeline is considered less prone to move than a similar combination of factors located lower on the hillside, or even near the bottom of the slope. In order to accommodate these factors, the amount of land surface located uphill of each site was factored into the risk profile for potential landslide occurrence.

To portray areas of probable landslide risk due to elevation, slope, vegetative cover, canopy coverage, and position on the hillside, data for these factors were combined into one predictive model called Landslide Prone Landscapes. This model shows the relative landslide risk on the Coeur d'Alene Reservation; it is based on the technique developed by Schlosser (2003 & 2005) and enhanced by Schlosser (2009). A Landslide Prone Landscapes assessment was completed for this Coeur d'Alene Reservation Tribal Hazards Mitigation Plan analysis (Figure XLIX).

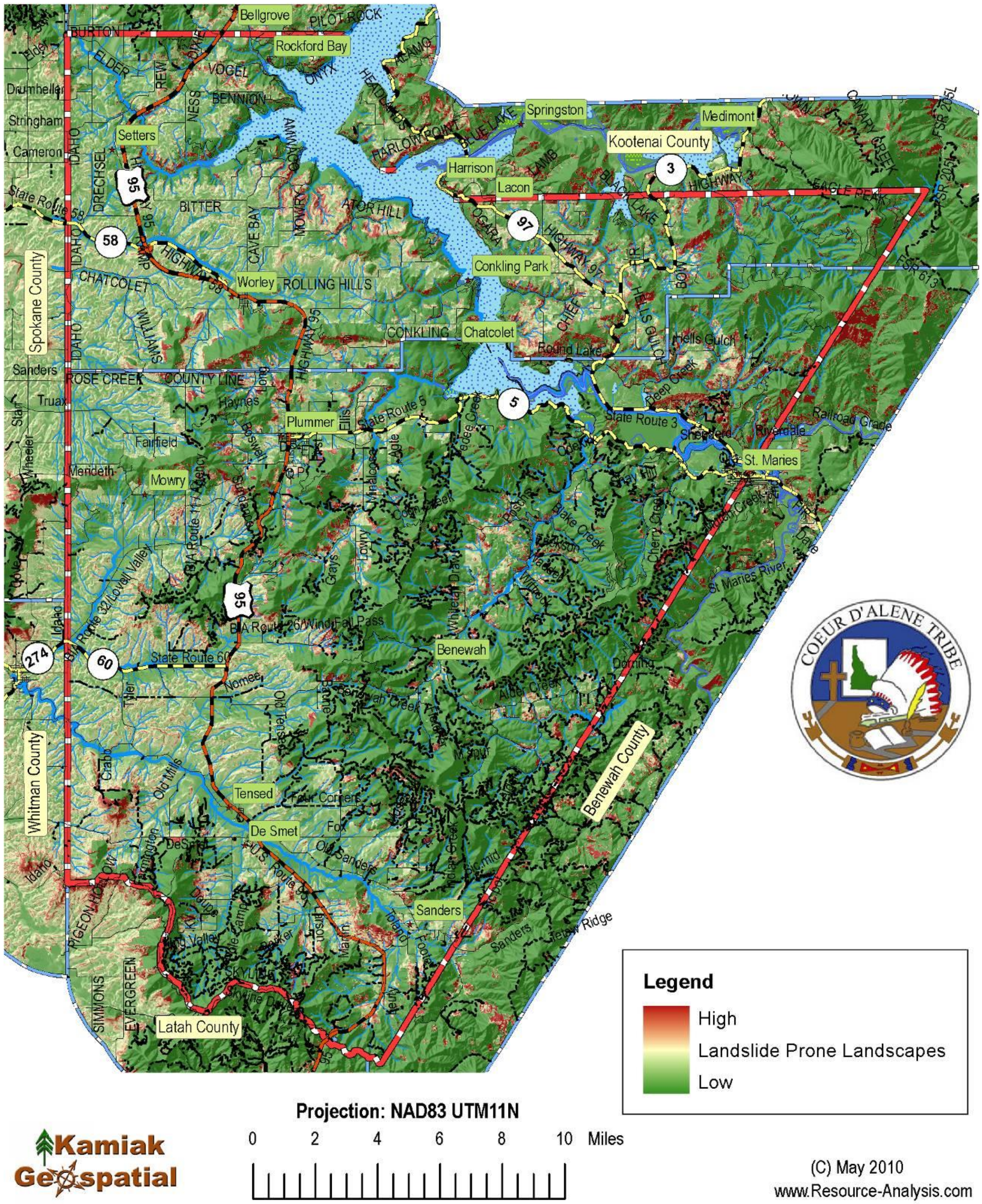
From the Landslide Prone Landscape profile produced, it is possible to depict areas of risk and their proximity to development and human activity. With additional field reconnaissance, the areas of high risk were further defined by overlaying additional data points identifying actual slide locations (although these data were relatively limited), thus improving the resolution by specifically identifying the highest-risk areas. This method of analysis builds on a method developed by the Clearwater National Forest in north-central Idaho (McClelland *et al.* 1997).

A risk-rating score of zero represents no relative risk and a score of one hundred is considered extreme risk. In practice, very few areas of the highest risk category (100) are found. This rating scale should be considered as nominal data, producing values that can be ordered sequentially, but the actual values are not multiplicative. This means that a site ranking 20 on this scale is not "twice as risky" as a site ranking 10. The scale provides relative comparisons between sites.

The analysis of all areas on the Coeur d'Alene Reservation reveals that a significant area of land is not subject to landslide risks without substantial surface disturbances. While these findings would seem to indicate that there is little or no risk of landslide on the Coeur d'Alene Reservation, that would be an incorrect interpretation. This assessment concludes that most slopes are relatively stable until they are disturbed by some activity. These activities could include road building, development, settlement, or mass vegetation characteristic changes. These activities may also involve a combination of several forces such as logging or wildfire followed by heavy rains, or other natural disasters on steep slopes. Once disrupted, sites can become unstable with little or no warning.

An illustrative example is the relatively stable slopes of State Route 97 between Harrison and St. Maries, which seasonally drops rocks onto the road surface because of freeze-thaw transitions between day and night. The slopes are stable, but the ice-wedging along cracks releases rocks to fall.

Figure XLIX. Landslide Prone Landscapes predicted on the Coeur d'Alene Reservation.



Landslides may occur on slopes steepened during construction, or on natural ground never disturbed. However, most slides occur in areas that have had sliding in the past. All landslides are initiated by factors such as weaknesses in the rock and soil, earthquake activity, the occurrence of heavy snow or rainfall, or construction activity that changes a critical factor involved with maintaining stability of the soil or geology of the area. A prime example of this includes previously stable slopes where home construction utilizing independent septic systems are added. The increased moisture in the ground, when coupled with an impermeable layer below the septic systems, leads to surface-soil movements and mass wasting (0).

Figure L. Development and construction uphill of this site, caused changes to subsurface water flows, leading to this landslide adjacent to State Hwy 97, near Harrison.

Stream and riverbank erosion, road building, or other excavation can remove the toe or lateral slope and exacerbate landslides. Seismic or volcanic activity often triggers landslides as well. Urban and rural developments with excavations, roads, drainage ways, landscape watering, logging, and agricultural irrigation may also disturb the solidity of landforms, triggering landslides. In general, land use changes that affect drainage patterns, increases erosion, or changes ground water levels can augment the potential for landslide activity.

Landslides are a recurrent menace to waterways and highways and a threat to homes, schools, businesses, and other facilities. The unimpeded movement over roads—whether for commerce, public utilities, school, emergencies, police, recreation, or tourism—is essential to a normally functioning landscape. The steep walls of the Reservation's roads along river drainages pose special problems. The disruption and dislocation of these or any other routes caused by landslides and rock fall can quickly jeopardize travel and vital services.

4.6.3. Probability of Future Events

In order to put these Landslide Prone Landscape numbers in terms of probability of occurrence, the Landslide Prone Landscapes rating score can be modified to represent a probability of a landslide event occurring during a given period of time. The lower the Landslide Prone Landscapes rating score, the lower the probability of witnessing a landslide event in that area. Directly, the Landslide Prone Landscapes rating score can be converted to a probability by stating the relative score as a probability of occurrence within a 50-year period. Using the conversion defined by the Extreme Value Theory (Castillo 1988), the 50-year landslide probability event would be stated as the Landslide Prone Landscapes rating score converted to a percent. Thus, a Landslide Prone Landscapes rating score of 25 represents a 25% probability of witnessing a 50-year landslide event. This conversion is intended for illustrative purposes only and the actual probability of occurrence on a particular site may differ from these estimates.

The probability of landslide events within the Coeur d'Alene Reservation is moderate-to-high and greatly dependent on topography, soils, hydrologic functioning, and human-induced land use changes. This places specific points within the Coeur d'Alene Reservation likely to experience damages due to landslides. Other locations, where topography is moderate and surface resources are maintained at stable conditions (native vegetation, sufficient drainage, etc.), landslides are not expected to occur.

Ordinarily, the Coeur d'Alene Reservation is expected to experience landslide events curtailing transportation networks, damaging structures, or blocking streams in a moderate frequency (occurrence about once every 5 to 25 years).

Further extrapolation of these data can be made in order to better understand the probability of future landslide events on the Coeur d'Alene Reservation. If the site is left undisturbed, the risk of future landslide events for each area evaluated can be estimated as the risk-rating score expressed in a percent (rating score of 15, expressed as 15%). This modified score can then be treated as an expression of the likelihood of that area experiencing a landslide event within the next 50-year period. Of course, certain areas that become modified for developments or road building may experience increased landslide periodicity in response to the modification. Off-site modifications, such as developments, logging, or wildfires can also modify this risk-rating scale to cause increased landslide occurrence downslope of the activity. In the same light, mitigation measures can be expected to decrease the likelihood of continued landslide events. This expression of potential probability of occurrence is based on anecdotal information and should be used for general reference only. A comprehensive landslide database should be created and maintained on the Coeur d'Alene Reservation, to better understand the conditions leading to major mass wasting events.

4.6.4. Resources at Risk

Using the approach implemented for assessing flood risk exposure on the Coeur d'Alene Reservation, the value of resources at risk to landslides has been completed. The Landslide Prone Landscapes risk-rating score was assigned to each structure (private and non-private) on the Coeur d'Alene Reservation, then grouped in reference to the closest community location. The individual structure values were summed together in these groups to reveal structural values that are at risk to landslides (tracking the Landslide Prone Landscape scores).

The modal score (value of the dataset mode – analogous to the mean) for these values was determined for each structure on the Coeur d'Alene Reservation. These "risk scores" for each structure were grouped into consolidated risk categories in units arranged for every tenth score. Thus, the consolidated risk score of 5 is the lowest-risk category (0-10), and is followed by consolidated risk category 15 (10-20), then 25 (20-30), and so forth. The higher the consolidated risk category, the higher the comparative risk to structures.

Next, community closeness was determined for each structure (the closest community place), placing each in only one community area based on location. These structure-risk values were summed by community area to record the value of assessed improvements linked with the Landslide Prone Landscapes modal score. The resulting tabular summary provides insights to where risks are present in combination with improvement values (Table 31, Table 32, Figure LI).

It is important to understand that the risk assessment is not considering the structure to be at-risk. The risk analysis is considering the risk on the land where the structure is located. Through reasoning, it can be extrapolated that the land's risk rating will translate directly to the risk of the structure or structures on the land.

The results of this analysis demonstrate that 57% of the value of private improvements on the Coeur d'Alene Reservation ($171 million) are located within the lowest-ranked Landslide Prone Landscapes areas (0-10). Approximately 97% of non-private structures are located on these low-risk sites ($220 million). As the relative landslide risk scores increase, the sum of the value of structures decreases. Only 6% of all parcel improvements are located on sites with an average Landslide Prone Landscape of 30 or greater, and only 1% of the total value of improvements are located on sites scoring greater than 50 (Table 31, Table 32, Figure LI).

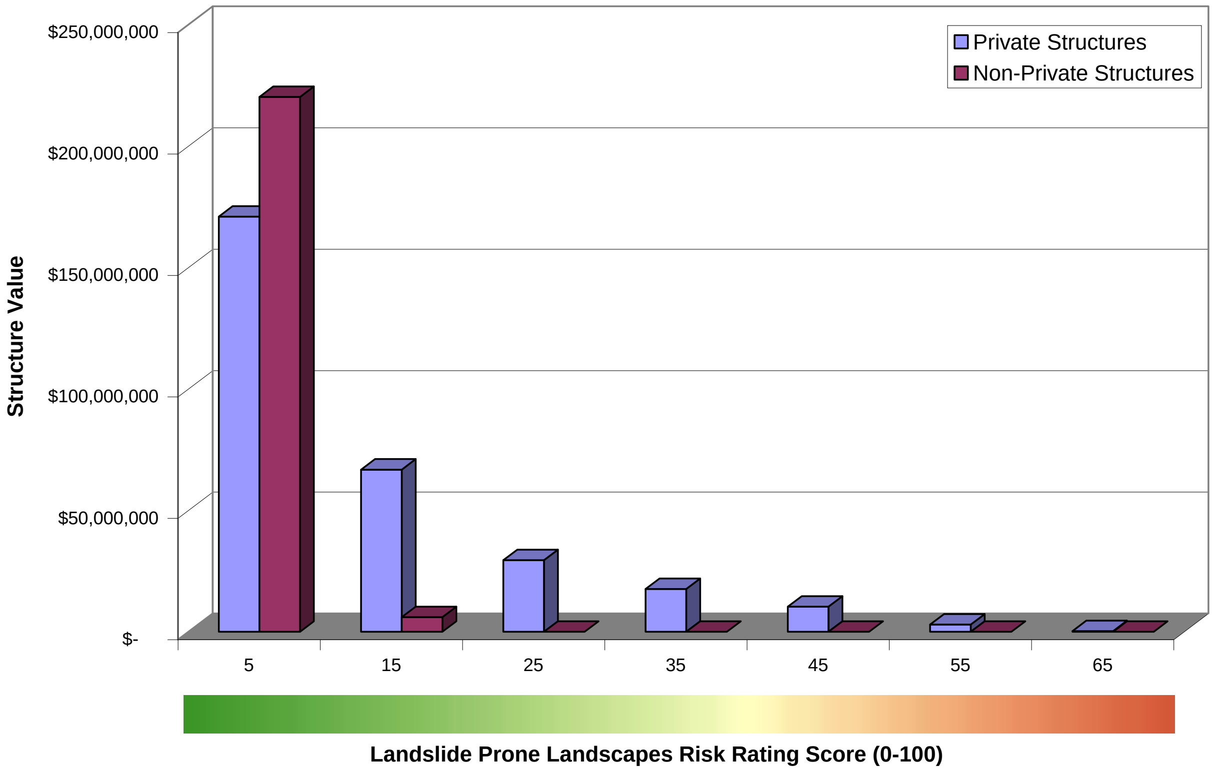
Table 31. Landslide Prone Landscapes Risk Rating (0-100) for private structures, arranged by Community.

Community Name	0-10 (5)	10-20 (15)	20-30 (25)	30-40 (35)	40-50 (45)	50-60 (55)	60+ (65)	Number of Structures
	Landslide Prone Landscape Risk Rating (0-100)							
BELLGROVE	$803,181	$518,133	$206,220	$262,023	$-	$-	$-	28
BENEWAH	$4,094,303	$3,617,187	$2,321,065	$569,267	$157,790	$62,680	$-	179
CHATCOLET	$6,140,046	$3,022,123	$1,414,123	$328,900	$148,900	$156,250	$560	183
CONKLING PARK	$10,310,111	$3,862,239	$1,121,068	$79,056	$-	$-	$-	233
DE SMET	$1,908,360	$201,277	$163,406	$75,600	$-	$-	$-	47
HARRISON	$8,107,099	$560,945	$799,450	$282,068	$320,350	$182,010	$-	171
LACON	$1,780,196	$2,109,058	$1,065,460	$752,696	$70,800	$110,710	$-	108
MEDIMONT	$4,082,714	$2,741,445	$775,836	$728,736	$350,609	$92,020	$-	145
MOWRY	$2,588,916	$506,100	$65,270	$66,620	$-	$-	$-	65
PLUMMER	$20,209,649	$9,158,934	$2,950,966	$942,050	$-	$-	$-	494
ROCKFORD BAY	$28,749,806	$6,791,659	$4,916,652	$3,701,497	$2,215,415	$404,174	$125,640	703
SANDERS	$2,613,624	$1,653,128	$617,618	$-	$212,320	$-	$-	97
SETTERS	$3,548,226	$875,368	$159,561	$144,000	$270	$-	$-	89
ST. MARIES	$23,792,801	$10,496,599	$7,720,577	$3,532,715	$1,546,200	$769,380	$167,530	719
TENSED	$6,702,693	$549,707	$9,350	$100,250	$-	$-	$-	127
WORLEY	$8,966,115	$2,240,398	$79,312	$270,707	$-	$-	$-	190
Count	**2,158**	**752**	**384**	**169**	**81**	**29**	**5**	**3,578**
Value	**$170,931,123**	**$66,772,740**	**$29,534,735**	**$17,629,257**	**$10,379,859**	**$2,947,733**	**$286,320**	

Table 32. Landslide Prone Landscapes Risk Rating (0-100) for non-private structures, arranged by Community.

Community Name	Landslide Prone Landscape Risk Rating (0-100) 0-10 (5)	10-20 (15)	20-30 (25)	30-40 (35)	40-50 (45)	50-60 (55)	60+ (65)	Number of Structures
AGENCY	$1,303,983	$-	$-	$-	$-	$-	$-	7
CHATCOLET	$2,750,000	$-	$-	$-	$-	$-	$-	4
CONKLING PARK	$1,370,688	$2,000	$-	$-	$-	$-	$-	5
DE SMET	$15,176,744	$70,560	$-	$-	$-	$-	$-	42
HARRISON	$674,000	$-	$-	$-	$-	$-	$-	5
HEYBURN STATE PARK	$8,600,000	$-	$-	$-	$-	$-	$-	13
LACON	$-	$78,680	$-	$-	$34,000	$-	$-	2
MOWRY	$152,000	$152,000	$-	$-	$-	$-	$-	2
PLUMMER	$40,144,417	$-	$-	$-	$-	$-	$-	96
ROCKFORD BAY	$1,050,424	$10,000	$-	$-	$-	$-	$-	9
SANDERS	$304,000	$-	$-	$-	$-	$-	$-	2
SETTERS	$12,000,000	$-	$-	$-	$-	$-	$-	1
ST. MARIES	$6,826,841	$5,345,000	$-	$-	$-	$-	$-	30
TENSED	$2,269,387	$-	$-	$-	$-	$-	$-	13
WORLEY	$127,567,227	$401,366	$-	$-	$-	$-	$-	82
Count	**300**	**12**	**0**	**0**	**1**	**0**	**0**	**313**
Value	**$220,189,711**	**$6,059,606**	**$-**	**$-**	**$34,000**	**$-**	**$-**	

Figure LI. Landslide Prone Landscapes Risk Rating (0-100) arranged by group scores and ownership category.



4.6.5. General Landslide Hazards Mitigation Strategies

A number of techniques and practices are available to reduce and cope with losses from landslide hazards. Careful land development can reduce losses by avoiding the hazards or by reducing the damage potential. Following a number of approaches used individually or in combination to mitigate or eliminate losses can reduce landslide risk.

4.6.5.1. Establish a Reservation Landslide Hazard Identification Program

The Coeur d'Alene Tribe should embark on a program to document all landslides, bank failures, "washouts", and man-made embankment failures. Each failure should be located on a map with notations about time of failure, repair (if made), and descriptions of the damaged area. Entering this mapping data into the Tribe's Geospatial Data Library of disaster related information would aid future disaster assessments. These records would be instrumental to further develop the predictive power of the Landslides Prone Landscape assessment on the Coeur d'Alene Reservation and the region.

4.6.5.2. Restrict Development on Landslide Prone Landscapes

Land-use planning is one of the most effective and economical ways to reduce landslide losses by avoiding the hazard and minimizing the risk. This is accomplished by removing or converting existing development or discouraging or regulating new development in unstable areas. Buildings should be located away from known landslides, debris flows, steep slopes, streams and rivers, intermittent stream channels, and the mouths of mountain channels. On the Coeur d'Alene Reservation, restrictions on land use should be imposed and enforced by the Coeur d'Alene Tribe Public Works Department.

4.6.5.3. Standardize Codes for Excavation, Construction, and Grading

Excavation, construction, and grading codes have been developed for construction in landslide-prone areas; however, there is no nationwide standardization. Instead, Tribal governments apply design construction criteria that fit their specific needs. The Federal Government has developed codes for use on Federal projects. Federal standards for excavation and grading often are used by other organizations in both the public and private sectors.

4.6.5.4. Protect Existing Development

Control of surface-water and ground-water drainage is the most widely used and generally the most successful slope-stabilization method. Stability of a slope can be increased by removing all or part of a landslide mass or by adding earth buttresses placed at the toes of potential slope failures. Retaining walls, piles, caissons, or rock anchors are commonly used to prevent or control slope movement. In most cases, combinations of these measures are most effective.

4.6.5.5. Post Warnings and Educate the Public about Areas to Avoid

Warnings against hazard areas may include the identification of, and posted signs at, the following locations: (a) existing / old landslides, (b) on or at the base of slopes, (c) in or at the base of a minor drainage hollow, (d) at the base or top of an old fill or steep cut slope, and (e) on developed hillsides where leach field septic systems are used. In addition to identifying these at-risk landscapes, it will also serve to begin an educational dialog with landowners on the Coeur d'Alene Reservation, enlightening residents and visitors to the risks associated with landslides.

4.6.5.6. Utilize Monitoring and Warning Systems

Monitoring and warning systems are utilized to protect lives and property, not to prevent landslides. However, these systems often provide warning of slope movement in time to allow the construction of physical measures that will reduce the immediate or long-term hazard. Site-specific monitoring techniques include field observation and the use of various ground-motion instruments, trip wires, radar, laser beams, and vibration meters. Data from these devices can be sent via telemetry for real-time warning. Development of regional real-time landslide warning systems is one of the more significant areas of landslide research (Fragaszy 2002).

4.6.5.7. Public Education

Residents can increase their personal awareness by becoming familiar with the land around their home and community. People can learn about slopes where landslides or debris flows have occurred in the past or are likely to occur in the future. These activities are especially useful for areas where existing structures and improvements are in locations with high risk Landslide Prone Landscape rating scores (Table 31, Table 32).

Educate the public about telltale signs that a landslide is imminent so that personal safety measures may be taken. Some of these signs include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before.
- New cracks or unusual bulges in the ground, street pavements, or sidewalks.
- Soil moving away from foundations, and ancillary structures such as deck-sand patios tilting and/or moving relative to the house.

- Sticking doors and windows, and visible open spaces indicating jams and frames out of plumb.
- Broken water lines and other underground utilities.
- Leaning telephone poles, trees, retaining walls or fences.
- Sunken or dropped-down roadbeds.
- Rapid increase in a stream or creek water levels, possibly accompanied by increased turbidity (soil content).
- Sudden decrease in creek water levels even though rain is still falling or just recently stopped.

Residents or Tribal representatives who live and work in landslide-prone areas should follow these recommendations prior to a storm event:

- Watch the patterns of stormwater drainage on slopes and note places were runoff water converges, increasing flow over soil-covered slopes. Watch the hillsides around your home and community for any signs of land movement, such as small landslides or debris flows or progressively tilting trees.
- Develop emergency response and evacuation plans for individual communities and for travel routes. Individual homeowners and business owners should be encouraged to develop their own evacuation plan.

4.7. Expansive Soils and Expansive Clays

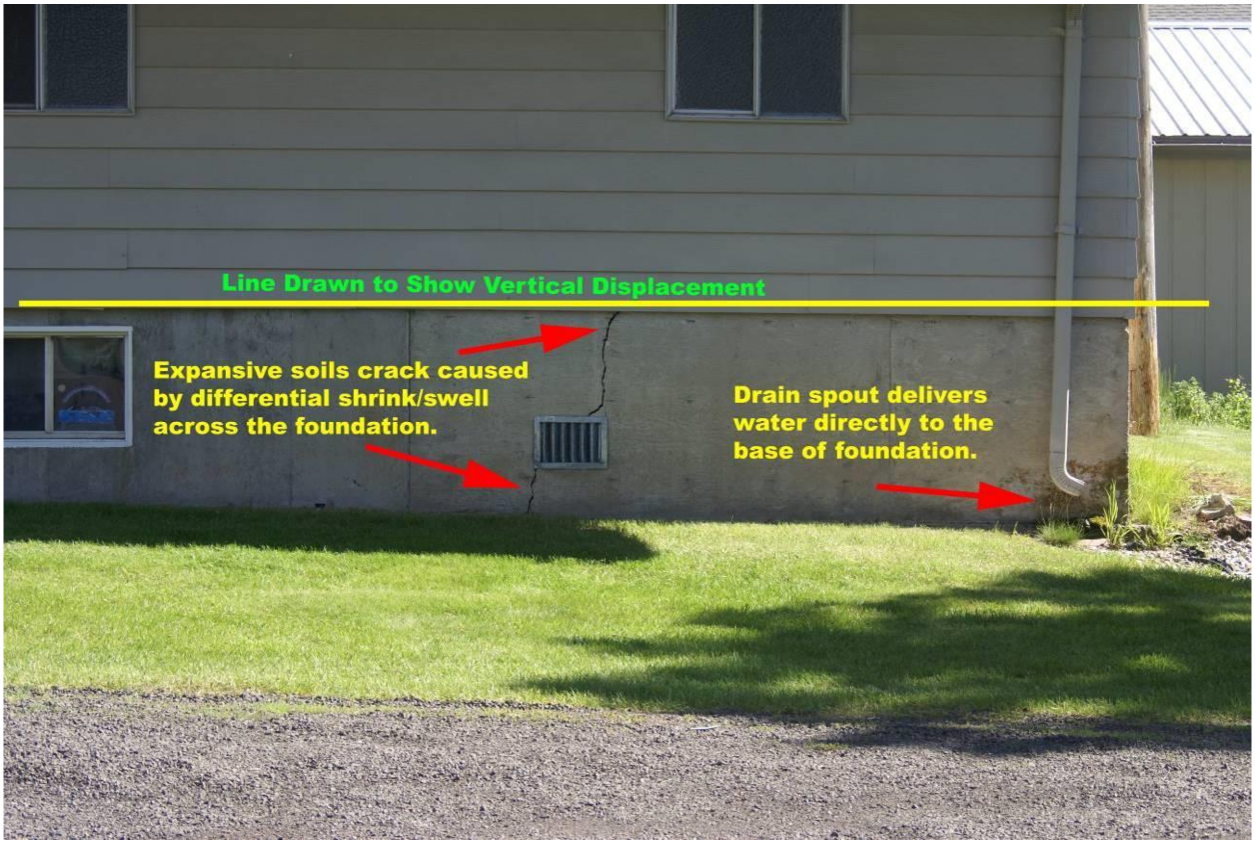
Expansive soils and expansive clays are substrates that are subject to large-scale settlement or expansion when wetted or partially dried (Bekey 1989). Expansive soils contain minerals such as smectite clays that are capable of absorbing water. When these soils absorb water they increase volume. The more water these soils absorb the more their volume increases. Expansions of ten percent or more are not uncommon. This change in volume can exert enough force on a building or other structure resting on top of them to cause damage (GES 2010).

Expansive soils such as clay, claystone, and shale can "swell" in volume when wetted and then shrink when dried (Bekey 1989). This volumetric expansion and contraction can cause houses and other structures to heave, settle, and shift unevenly, resulting in damage that is sometimes severe (PCI 2010). Cracks in building foundations, along floors and within basement walls are typical types of damage done by these swelling soils. Damage to the upper floors of the building can occur when motion in the structure is significant (GES 2010).

Expansive soils will also shrink when they dry out (Bekey 1989). This shrinkage can remove support from buildings or other structures and result in damaging subsidence. Fissures in the soil caused from differential expansion and contraction can also develop. These fissures can facilitate the deep penetration of water when moist conditions or runoff occurs. This produces a cycle of shrinkage and swelling that places repetitive stress on structures (PCI 2010).

When expansive soils are present they will generally not cause a problem if their water content remains constant. The situation where greatest damage occurs is when there are significant or repeated moisture content changes. An example of this condition has been documented in Worley, on the Coeur d'Alene Reservation (Figure LII). The rain gutter spills onto the ground at the edge of the foundation, artificially super-wetting the soil during rainfall periods, leading to soil swelling. When these soils dry in the summer, the soils shrink. This home (Figure LII) has already experienced the detrimental effects of the swelling (wet periods) and shrinking (dry periods) by forming a vertical foundation crack.

Figure LII. Home with a basement, in Worley, placed on Expansive Soils.



With significant real estate development in the region in the past 30 years, the problems caused by expansive soils have become painfully obvious. Homeowners have literally lost their homes due to extensive damage and the high costs of repair. In some cases, class-action lawsuits have been brought against builders and developers for failure to follow the recommendations of soils engineers, or for failure to properly disclose the potential risks associated with purchasing a home built on expansive soil (PCI 2010), and from buyer and seller ignorance about the potential risks.

4.7.1. Extent of the Risk

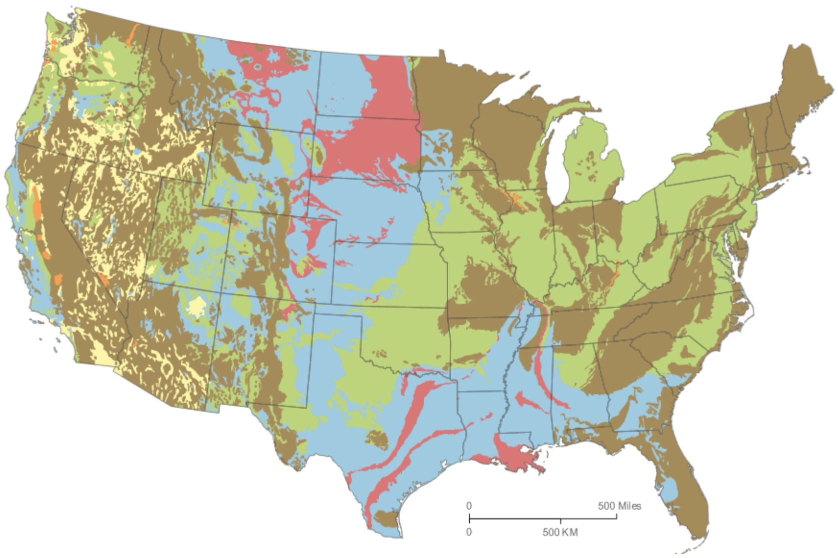
Expansive soils are present throughout the world and are known in every US state. Every year they cause billions of dollars in damage. The American Society of Civil Engineers estimates that ¼ of all homes in the United States have some damage caused by expansive soils (Snethen 1980). In a typical year in the United States they cause a greater financial loss to property owners than earthquakes, floods, hurricanes and tornadoes combined (GES 2010).

Even though expansive soils cause enormous amounts of damage, most people have never heard of them. This is because their damage is done slowly and not generally attributed to a specific event. The damage done by expansive soils is often attributed to poor construction practices or a misconception that all buildings experience this type of damage as they age (GES 2010).

The Upper Columbia Plateau is at variable levels of risk to factors leading to damages from expansive soils and expansive clays (Bekey 1989). Although clay content in the soil is a major contributing factor to expansive soil reactions, the content of Loess Soils is equally problematic. This region was greatly impacted by the Missoula Flood at the end of the last glacial period

12,000 years ago when wind-borne soils were blown up the Columbia Plateau and into the region. This wind-borne soil is called Loess Soils, and while they contribute greatly to the successful farming of the Palouse, they also lead to substantial risks from expansive soils characteristics (Figure LIII). Site inspections of houses, roads, and other infrastructure components reveals potential signs of prolonged damages consistent with expansive soils and expansive clays (cracked foundations, uneven road surfaces).

Figure LIII. Swell Potential of Reactive Clay Soils in the USA (PCI 2010, reproduced using [USGS 1989] data).



- Unit contains abundant clay having high swelling potential
- Part of unit (generally less than 50%) consists of clay having high swelling potential
- Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
- Unit contains little or no swelling clay
- Data insufficient to indicate clay content of unit and/or swelling potential of clay (Shown in westernmost states only)

Figure LIII shows the geographic distribution of soils which are known to have expandable characteristics with clay minerals that can cause damage to foundations and structures. It also includes soils that have a clay mineral composition which can potentially cause damage. Soils are composed of a variety of materials, most of which do not expand in the presence of moisture. However, a number of clay minerals are expansive. These include: smectite, bentonite, montmorillonite, beidellite, vermiculite, attapulgite, nontronite, illite and chlorite. There are also some sulfate salts that will expand with changes in temperature and moisture. When a soil contains a large amount of expansive minerals it has the potential of significant expansion. When the soil contains very little expansive minerals it has little expansive potential (PCI 2010).

Bekey (1989) reported four general soil types, beyond just the clay influenced types, that are most prone to expansive soils characteristics:

1. Loess – wind-deposited or eolian silt, termed loess, blankets extensive parts of Upper Columbia Plateau and is a prevalent soil type within the western side of the Coeur d'Alene Reservation.
2. Peat – a very common surface and sub-surface material identified within the eastern side of the Coeur d'Alene Reservation, especially along river valleys and within floodplains. Because of the physical properties of peat, any compression loading on peat results in settlement at the surface. In normal events, roughly half of the settlement

occurs within 6 months to 2 years following construction. The balance of the settlement compaction can take an additional 20 years to be fully seen. Unfortunately, the rate of settlement is not consistent as expansion and contraction will neither be equal nor constant. A common technique used to manage construction of roads and structures on the top of peat materials has been to overtop the material with a fill dirt. When this has been applied, the high organic matter of the peat is trapped under the less permeable layer leading, in many cases, to a bearing capacity failure. Other attempts have combined peat capping with an overtopping layer of rock. Many of these approaches have been met with variable levels of success. Construction within or adjacent to many of lowlands face challenges of peat-related expansive soils.

3. Hydrocompaction – Hydrocompaction occurs when a dry, underconsolidated silty and clayey soil, in an arid or semiarid environment, loses strength on wetting and, as a result, settles or collapses. Although these soil types (silty and clayey soil) are uncommon on the Coeur d'Alene Reservation, the physical conditions of arid or semiarid are not common.
4. Expansive Clay Soils – Expansive clay soils develop at the top of deeply weathered rocks composed on illite and montmorillonite clays. These clay types are common where volcanic ash and feldspar-rich parent materials are seen. Although these conditions are witnessed across the region, the past glaciation (Section 4.2) has transported most of the potentially expansive weathered soil away from its point of origin. Unfortunately, the glaciation that removed the top layer of materials, deposited those sediments at the termination of the glacier and then along the retreat path as it moved up in elevation during its melt. This has left scattered deposits that may hold pockets of expansive clays, especially near (but not necessarily adjacent to) glacier-formed river systems such as the St. Joe River.

4.7.2. Linear Extensibility / Expansive Soils

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change (NRCS 2010).

For each soil layer, the linear extensibility attribute is recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this analysis the "most restrictive" element has been selected for each soil type.

Several soil surveys have been combined for this analysis (Figure LIV, Figure LV). The most relevant are Soil Survey ID606 (Kootenai County) and Soil Survey ID608 (Coeur d'Alene Reservation/Benewah County). All surrounding Soil Survey data from Latah County, the Benewah County / St. Joe River / Shoshone County Soil Survey, Whitman County and Spokane Counties (Washington) were combined for display purposes. Edge matching of these analyses reveals several discontinuities in the risk projection (Figure LIV, Figure LV). These "abrupt changes" in the risk profile are a result of differing ages of the surveys with the Coeur d'Alene Reservation being the most recent data, and Spokane County the oldest.

NRCS soil-survey data has been used to determine the extent of expansive soils and expansive clays within the Coeur d'Alene Reservation (Figure LIV, Figure LV). Rating class terms in this analysis indicate the extent to which the soils are limited by expansive soils and expansive clays that affect building site development.

Two different analyses of exposure to risk have been derived for this effort. The first determines suitability for **'homes without basement, and light commercial'** structures. This is accomplished by analyzing the soil characteristics from a depth of 10 inches to 40 inches (Figure LIV). Each soil type characteristic is evaluated for linear extensibility and given a rating scale from zero (0) to thirty (30).

The second analysis determines suitability for **'homes with a basement, and heavy commercial'** structures. This is accomplished by analyzing the soil characteristics from a depth of 10 inches to 60 inches (Figure LV). Each soil type characteristic is evaluated for linear extensibility and given a rating scale from zero (0) to thirty (30).

A cursory review of Figure LIV and Figure LV allows the reader to observe the elevated risks adjacent to the floodplain of the St. Joe River, and the elevated risks where the wind-deposited or eolian silt (loess), blankets extensive parts of the west side of the Coeur d'Alene Reservation. Additional risks are observed near Setters where clay content is extensive near the surface, and linear extensibility is extreme.

The expansive soils and expansive clays limitations can be overcome or minimized by special planning, design, and installation. Fair performance and moderate maintenance can be expected where appropriate actions are taken and where risks are lower.

Dwellings are single-family houses of three stories or less. For dwellings without basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet.

The ratings used here for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (expansive soils potential), and compressibility. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Small commercial buildings are structures that are less than three stories high and do not have basements. The foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper.

In response to sites with expansive soils, stabilization efforts have included the complete removal attempts of the problem materials, or isolation of the expansive soils by an adequate cap of non-expansive, relatively impervious fill material (Bekey 1989). Where the construction project involves hillsides or the edges of cliffs (such as along the rocky shores of Coeur d'Alene Lake), a combination of partial material removal and the installation of a buttress fill have been used to limit potential sliding of the structure (Bekey 1989). These efforts around the globe have been met with variable levels of success and some notable failures.

Figure LIV. Linear Extensibility Percent (Expansive Soils) for Homes without a Basement and Light Commercial Structures (soil depths 10" to 40").

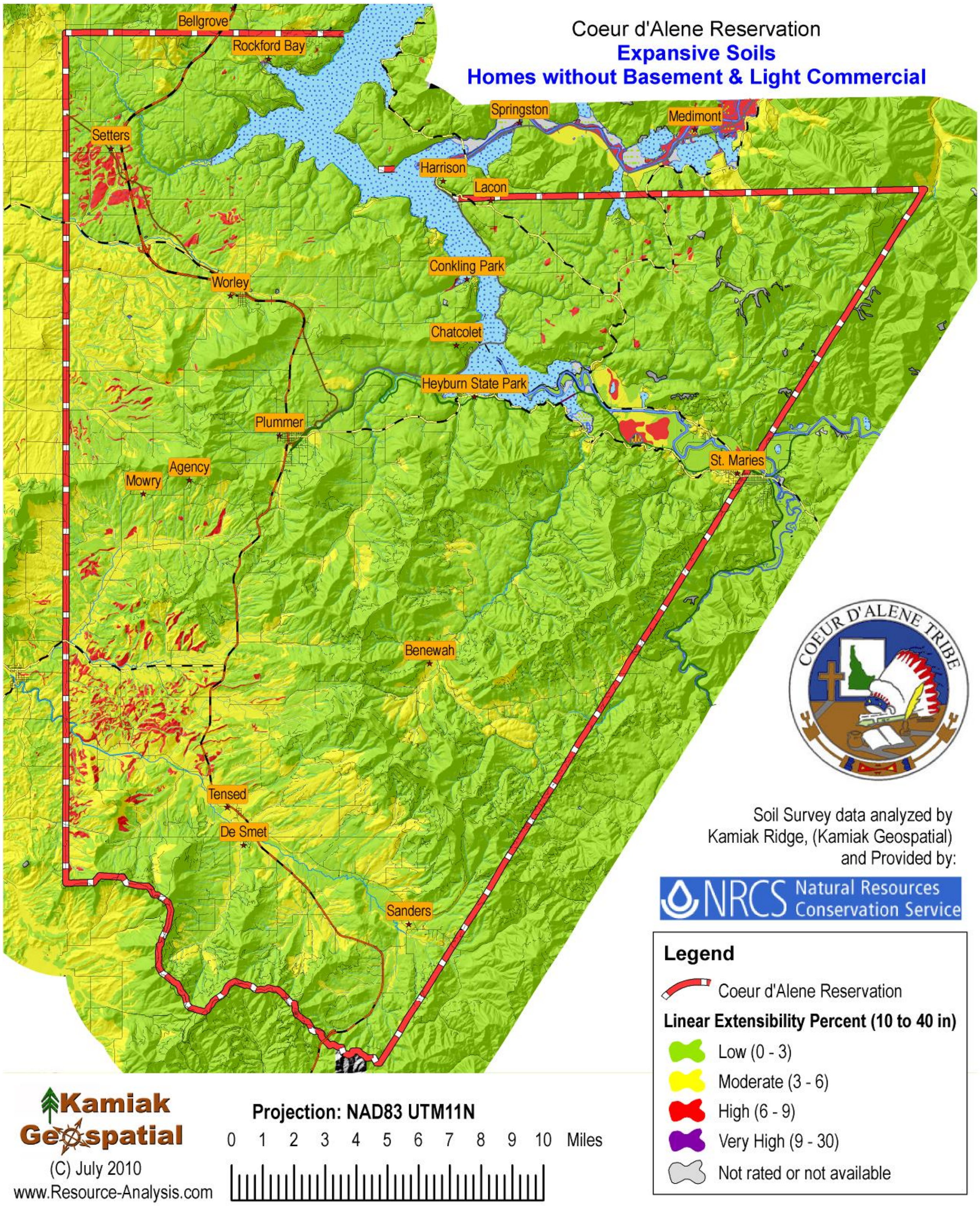
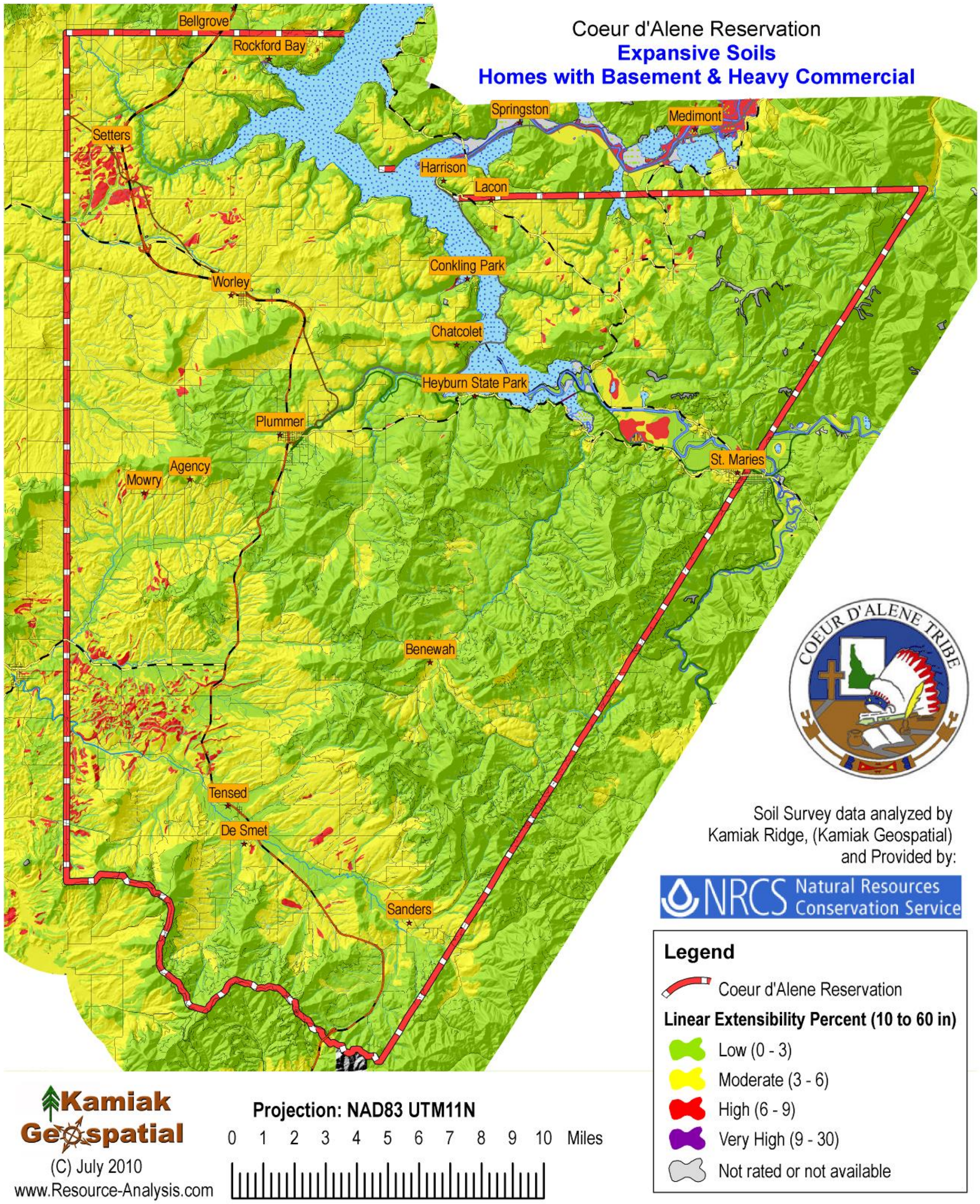


Figure LV. Linear Extensibility Percent (Expansive Soils) for Homes with a Basement and Heavy Commercial Structures (soil depths 10” to 60”).



4.7.3. Resources at Risk

Using the approach implemented for assessing risk exposure from other natural hazards on the Coeur d'Alene Reservation, the value of resources at risk to expansive soils and expansive clays has been completed. The linear extensibility risk-rating score was assigned to each structure (private and non-private) on the Coeur d'Alene Reservation, then grouped in reference to the closest community location. The individual structure values were summed together in these groups to reveal structural values that are at risk to expansive soils.

For the purposes of this assessment, all structures were evaluated based on the **'homes with a basement, and heavy commercial'** structures assessment (Figure LIV). This risk rating is slightly elevated for the structures that are single-storey and without a basement, but the overall assessment will illustrate where existing risks are acute (Table 33 & Table 34).

Based on this assessment (Table 33), approximately 62% of the total value ($184 million), and 59% of the total number (2,118 structures), of privately owned structures are located in the lowest expansive soils risk category (0-3%). An additional 40% of structures (1,437 structures), representing approximately 37% of the total private structure value ($111 million) are located on the moderate-risk scale to expansive soils. About 23 privately owned structures (1%), on the Coeur d'Alene Reservation, representing a total appraised value of $2.7 million, are located within areas determined to possess high-risk classifications to expansive soils. There are no privately owned structures located on the very high-risk category within the Coeur d'Alene Reservation.

Table 33. Privately owned structures by community location, values at risk from Expansive Soils.

	Linear Extensibility Extent: Private Structures				
Community Name	**Low (0-3%)**	**Moderate (3-6%)**	**High (6-9%)**	**Very High (>9%)**	**Count**
BELLGROVE	$ 362,032	$1,427,525	$ -	$ -	28
BENEWAH	$7,185,352	$3,636,940	$ -	$ -	179
CHATCOLET	$6,390,681	$4,820,221	$ -	$ -	183
CONKLING PARK	$ 10,457,441	$4,775,203	$ 139,830	$ -	233
DE SMET	$1,117,917	$1,026,161	$ 204,565	$ -	47
HARRISON	$ 10,103,992	$ 147,930	$ -	$ -	171
LACON	$3,468,276	$2,420,644	$ -	$ -	108
MEDIMONT	$5,252,002	$3,475,338	$44,020	$ -	145
MOWRY	$1,142,572	$2,062,994	$21,340	$ -	65
PLUMMER	$ 14,551,122	$18,710,477	$ -	$ -	494
ROCKFORD BAY	$ 39,756,922	$6,921,751	$ 226,170	$ -	703
SANDERS	$2,189,959	$2,906,731	$ -	$ -	97
SETTERS	$ 401,211	$4,213,499	$ 112,715	$ -	89
ST. MARIES	$ 27,579,160	$20,174,352	$ 272,290	$ -	719
TENSED	$5,637,387	$1,723,953	$ 660	$ -	127
WORLEY	$ 356,424	$11,200,108	$ -	$ -	190
Count	**2,118**	**1,437**	**23**	**0**	**3,578**
Value	**$ 184,847,781**	**$110,948,220**	**$2,685,766**	**$ -**	**$298,481,767**

Additional findings indicate that approximately 24% of the total value ($54.3 million), and 44% of the total number (139 structures), of non-privately owned structures are located in the lowest expansive soils risk category (0-3%) (Table 34). An additional 56% of structures (174 structures), representing approximately 76% of the total non-private structure value ($172.0 million) are located on the moderate-risk scale to expansive soils. There are no non-privately owned structures located on the high- or very high-risk category lands within the Coeur d'Alene Reservation.

Table 34. Non-privately owned structures by community location, values at risk from Expansive Soils.

	Linear Extensibility Extent: Private Structures				
Community Name	**Low**	**Moderate**	**High**	**Very High**	**Count**
AGENCY	$ 90,000	$1,213,983	$ -	$ -	7
CHATCOLET	$2,750,000	$ -	$ -	$ -	4
CONKLING PARK	$ 146,900	$1,225,788	$ -	$ -	5
DE SMET	$2,500,000	$12,747,304	$ -	$ -	42
HARRISON	$ 672,000	$2,000	$ -	$ -	5
HEYBURN STATE PARK	$8,600,000	$ -	$ -	$ -	13
LACON	$ 112,680	$ -	$ -	$ -	2
MOWRY	$ 152,000	$ 152,000	$ -	$ -	2
PLUMMER	$ 14,023,324	$26,121,093	$ -	$ -	96
ROCKFORD BAY	$ 484,770	$ 575,654	$ -	$ -	9
SANDERS	$-	$ 304,000	$ -	$ -	2
SETTERS	$ 12,000,000	$ -	$ -	$ -	1
ST. MARIES	$9,490,209	$2,681,632	$ -	$ -	30
TENSED	$2,269,387	$ -	$ -	$ -	13
WORLEY	$ 972,087	$126,996,506	$ -	$ -	82
Count	**139**	**174**	**0**	**0**	**313**
Value	**$ 54,263,357**	**$172,019,960**	**$ -**	**$ -**	**$226,283,317**

The determination of absolute risk of existing structures to expansive soils and clays within the Coeur d'Alene Reservation is difficult to ascertain. Although structures may have been built where linear extensibility percent ratings are high, construction techniques to deal with the problem before beginning construction may have taken place. It is possible to build large structures where linear extensibility percent ratings are high, while still enjoying decades (even more than a century) of life for the structure. Conversely, it is possible to build structures on low-risk rated expansive soil sites, but exacerbate problems by artificially modifying the soil moisture regime (e.g., by draining rain gutters directly onto the soils at the base of the foundation – see Figure LII).

It is advisable that all new construction on the Coeur d'Alene Reservation incorporate expansive soils building techniques while selecting building sites, and determining building architecture characteristics.

4.7.4. Probability of Future Events

Expansive soils represent a physical property of soils that is not dependent on outside factors to realize risks (such as an earthquake or flood). When the at-risk soil components are exposed to compression, wetting and drying, the damages to the structure placed on top of those soils can be realized. If recommended building techniques are not employed during initial construction, then damages are frequently seen. The "laissez-faire builder" may desire to "take a chance" with this disaster not affecting the house built on expansive soils, but if those actions lead to the conditions needed for damage, then the probability of damage is nearly 100% chance of failure within a 10 year period.

4.7.5. Dealing with Damages

Geotechnical engineering and structural engineering have come a long way in the last 20 years, and specific foundation systems have been devised to help counteract some of the problems for buildings inherent with expansive soils. However, the risk of damage to homes can be minimized but cannot always be eliminated (PCI 2010). Because the damages from expansive soils are variable, and often are difficult to visually confirm by the untrained eye, professional inspections of existing structures and of potential building sites is strongly recommended throughout the Coeur d'Alene Reservation.

It is possible to build successfully and safely on expansive soils if stable moisture content can be maintained or if the building can be insulated from any soil-volume change that occurs. The recommended procedures are as follows (GES 2010):

- Professional geotechnical engineering testing to identify any problems,
- Design to minimize moisture-content changes and insulate from soil-volume changes,
- Build in a way that will not change the conditions of the soil,
- Maintain a constant moisture environment after construction,
- Ensure adequate surface-water drainage around building sites and off the site,
- Avoid construction on expansive soils and expansive clays.

Expansive soil conditions are made worse if water collects around a building's foundation. Rainfall and surface-water drainage should run off the property to mitigate the worsening soil condition. Rain gutters and downspouts should direct water away from the structure, discharging it no closer than 3 feet from the foundation (PCI 2010). This drainage should also be conscious of the neighboring structures so that surface water drainage from one building is not diverted into another structure. Well-designed communities will facilitate this stormwater and surface-water drainage to avoid diversions into other structures and into at-risk infrastructure.

The question of the extent of the possible damages to the structures on the Coeur d'Alene Reservation is amplified by annual precipitation received across the Coeur d'Alene Reservation each year (Figure XXXIV and Table 23).

4.8. Radon Risk from Soils

Radon is a naturally occurring colorless, odorless, tasteless radioactive gas that is formed from the normal radioactive decay of uranium. Uranium is present in small amounts in most rocks and soil. It slowly breaks down to other products such as radium, which breaks down to radon. Some of the radon moves to the soil surface and enters the air, while some remains below the soil surface and enters the groundwater (water that flows and collects underground). Uranium has been around since the earth was formed and has a very long half-life (4.5 billion years), which is the amount of time required for one-half of uranium to break down. Uranium, radium, and thus radon, will continue to exist indefinitely at about the same levels as they do now (ATSDR 1990).

Radon also undergoes radioactive decay and has a radioactive half-life of about 4 days. This means that one-half of a given amount of radon will be changed or decayed to other products every 4 days. When radon decays, it divides into two parts. One part is called radiation, and the second part is called a daughter. The daughter, like radon, is not stable; and it also divides into radiation and another daughter. Unlike radon, the daughters are metal and easily attach to dust and other particles in the air. The dividing of daughters continues until a stable, nonradioactive daughter is formed (ATSDR 1990).

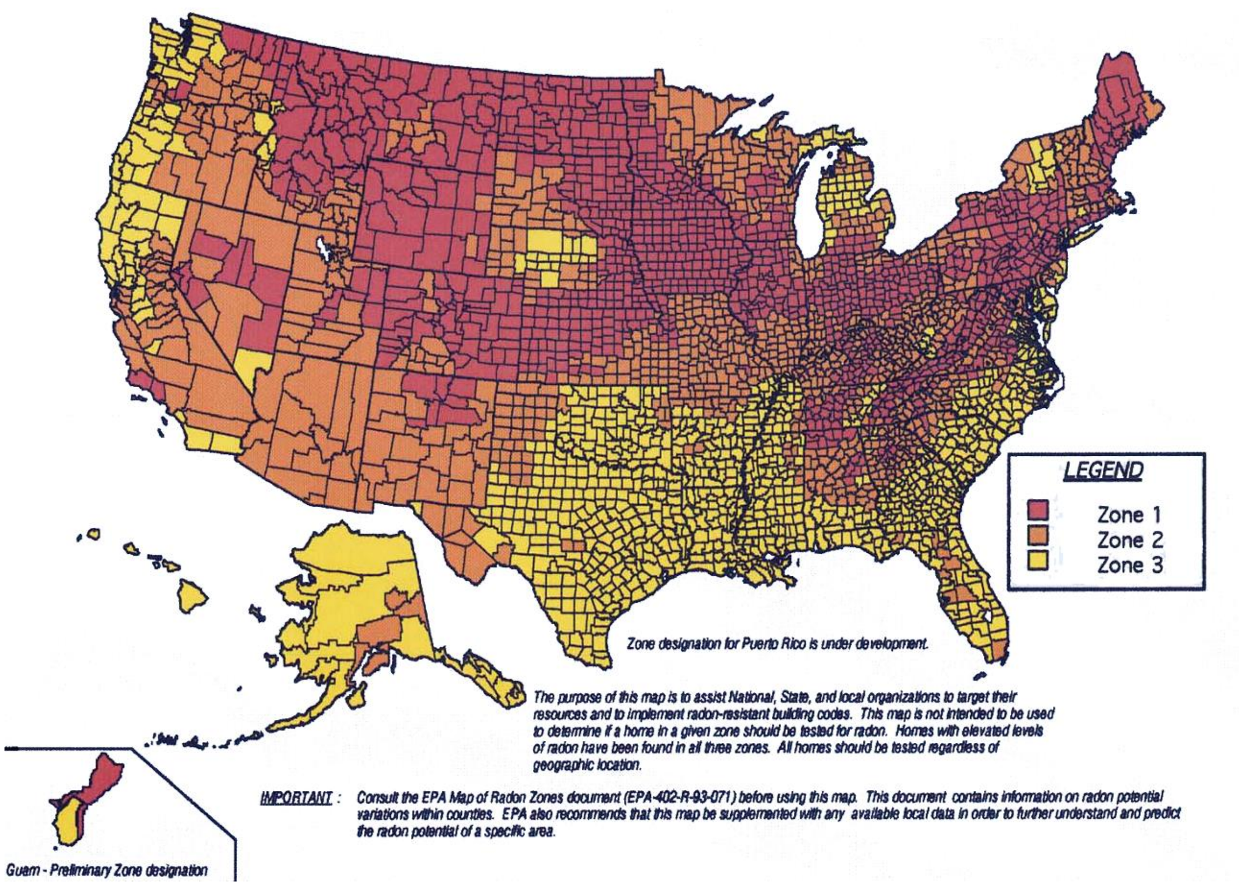
During the decay process, alpha, beta, and gamma radiations are released. Alpha particles can travel only a short distance and cannot go through human skin. Beta particles can penetrate skin, but they cannot go all the way through a human body. Gamma radiation, however, can go all the way through a body. Thus, there are several types of decay products that result from radon decay (EPA 2009).

Radon is responsible for the majority of the public exposure to ionizing radiation. It is often the single largest contributor to an individual's background radiation dose, and is the most variable from location to location. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as attics, and basements. It can also be found in some spring waters and hot springs (EPA 2009). Epidemiological evidence shows a clear link between breathing high concentrations of radon and incidence of lung cancer. Thus, radon is considered a significant contaminant that affects indoor air quality worldwide. According to the USEPA, radon is the second most frequent cause of lung cancer, after cigarette smoking, causing 21,000 lung cancer deaths per year in the United States (EPA 2009).

4.8.1. Extent of the Risk

Radon is a decay product of uranium, which is relatively common in the Earth's crust, but generally concentrated in ore-bearing rocks scattered around the world. Every square mile of surface soil, to a depth of 6 inches, contains approximately 1 gram of radium, which releases radon in small amounts to the atmosphere (ATSDR 1990). On a global scale, it is estimated that 2,400 million curies of radon are released from soil annually (ATSDR 1990, EPA 2009). Most of the US continental batholith presents high risks of radon release from the soil (Figure LVI).

Figure LVI. EPA Map of Radon Zones by County, in the US.



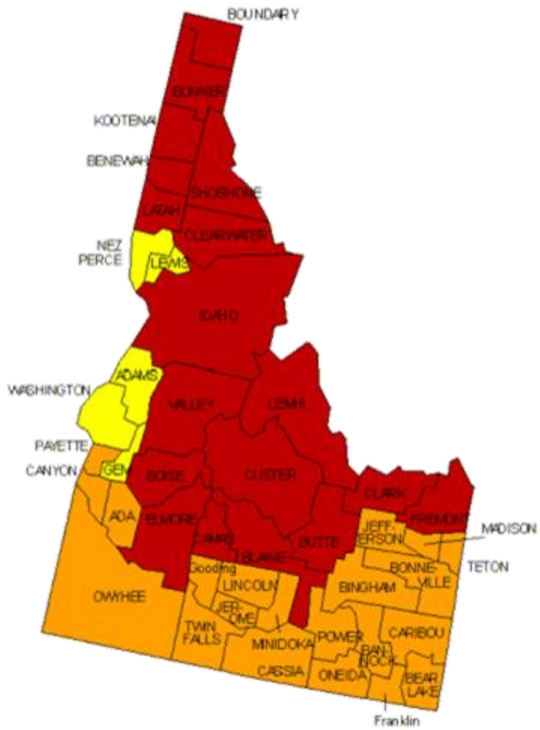
Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (pico curies per liter) (red zones)	**Highest Potential**
Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L (orange zones)	**Moderate Potential**
Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L (yellow zones)	**Low Potential**

4.8.2. Coeur d'Alene Reservation Radon Exposure

Maps of impacted areas have been developed by the EPA and states using five factors to determine radon potential: 1) indoor radon measurements; 2) geology; 3) aerial radioactivity; 4) soil permeability; and, 5) foundation type. Radon potential assessment is based on geologic provinces. Radon Index Matrix is the quantitative assessment of radon potential. Geologic Provinces were adapted to county boundaries for the Map of Radon Zones (Figure LVI, Figure LVII).

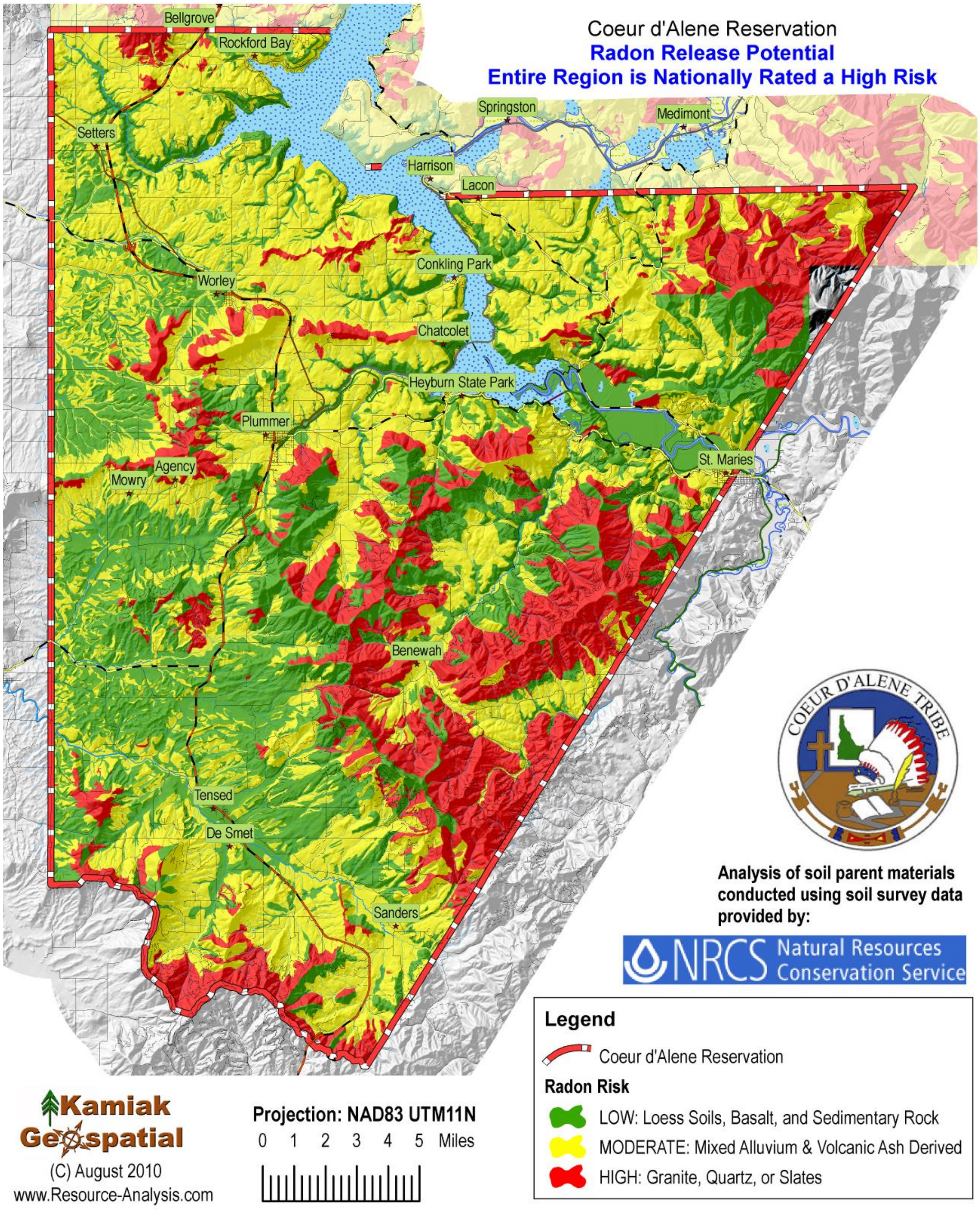
The purpose of these maps is to assist National, State, Tribal, and local organizations to target their resources and to implement radon-resistant building codes. These maps are not intended to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. All homes should be tested regardless of geographic location.

Figure LVII. Radon Zones for Idaho (EPA 2009).



Although five criteria have been identified to determine radon exposure, this effort has targeted a major vector of radon contact on the Coeur d'Alene Reservation: soil type parent materials (geologic criteria). The NRCS Soil Surveys for the Coeur d'Alene Reservation (Benewah County ID607 and Kootenai County ID606) were used to determine the source of soil parent materials and their transport mechanism (e.g., glacial, volcanic, wind, sedimentation, etc.). Rankings of the type of radon exposure were evaluated and given relative risk ratings (Figure LVIII). This should be viewed as representing only the geologic component and variation of the risk, in an area of high risk.

Figure LVIII. Radon geologic exposure potential based on soil parent materials derived from NRCS Soil Survey data.



- All homes should be tested for radon, regardless of geographic location or zone designation.
- There are many thousands of individual homes with elevated radon levels in Zone 2 and 3. Elevated levels can be found in Zone 2 and Zone 3.
- EPA also recommends that these maps be supplemented with any available local data in order to further understand and predict the radon potential of a specific area.
- These maps should not be used in lieu of testing during real estate transactions.

4.8.3. Radon Exposure Mechanisms

4.8.3.1. Residential

Typical domestic exposures are of approximately 100 Bq/m^3 indoors. Depending on how houses are built and ventilated, radon may accumulate in basements and attics. Radon concentrations in the same location may differ by a factor of two over a period of 1 hour. Also, the concentration in one room of a building may be significantly different than the concentration in an adjoining room (ATSDR 1990).

The geometric mean of radon measurements is generally used for estimating the "average" radon concentration in an area (Tuia *et al.* 2006). The mean concentration ranges from less than 10 Bq/m^3 to over 100 Bq/m^3 in some European countries (UT 2009). Typical geometric standard deviations found in studies concludes that the radon concentration in buildings within the highest risk zones (like the Coeur d'Alene Reservation) is expected to be more than a hundred times the mean concentration for 2 to 3% of the cases (Tuia *et al.* 2006).

The highest average radon concentrations in the United States are found in Iowa and in the Appalachian Mountain areas in southeastern Pennsylvania (Figure LVI). Iowa has the highest average radon concentrations in the United States due to significant glaciation that ground the granitic rocks from the Canadian Shield and deposited it as soils making up the rich Iowa farmland (Figure XXIX). Many cities within the state, such as Iowa City, have passed requirements for radon-resistant construction in new homes. In a few locations, uranium tailings have been used for landfills and were subsequently built on, resulting in possible increased exposure to radon (ATSDR 1990).

4.8.3.2. Industrial production

Radon commercialization is regulated, but it is available in small quantities for the calibration of radon measurement systems, at a price of almost $6,000 per milliliter of radium solution (which only contains about 15 picograms of actual radon at a given moment) (NIST 2008).

4.8.4. Human Health at Risk

Radon has been classified by International Agency for Research on Cancer as being carcinogenic to humans (DHHS 2005), and as a gas that can be inhaled, lung cancer is a particular concern for people exposed to high levels of radon for sustained periods of time.

4.8.4.1. Commercial Exposure

During the 1940s and 50s, when safety standards requiring expensive ventilation in mines were not widely implemented, radon exposure was linked to lung cancer among non-smoking miners of uranium and other hard rock materials in what is now the Czech Republic, and later among miners from the southwestern United States.

Since that time, ventilation and other measures have been used to reduce radon levels in most affected mines that continue to operate. In recent years, the average annual exposure of uranium miners has fallen to levels similar to the concentrations inhaled in some homes. This has reduced the risk of occupationally induced cancer from radon, although health issues may persist for those who are currently employed in affected mines and for those who have been employed in them in the past (Darby *et al.* 2005).

Radon exposure (actually radon progeny) has been directly linked to lung cancer from numerous case-control studies performed in the United States, Europe and China. One of the most comprehensive radon studies performed in the United States found a 50% increased lung cancer risk even at the protracted exposures at the EPA's action level of 4 pCi/L. North American and European Pooled analyses further support these findings (Tuia *et al.* 2006).

The effects of radon if ingested are similarly unknown, although studies have found that its biological half-life ranges from 30–70 minutes, with 90 percent removal at 100 minutes.

4.8.4.2. Domestic Exposure

Radon is considered the second leading cause of lung cancer and leading environmental cause of cancer mortality by the United States Environmental Protection Agency. The United Nation's World Health Organization (WHO) says that radon is a worldwide health risk in homes. Dr. Maria Neira of WHO said that "Most radon-induced lung cancers occur from low and medium dose exposures in people's homes. Radon is the second most important cause of lung cancer after smoking in many countries." (EPA 2009). The United States Environmental Protection Agency encourages that action in homes be taken at concentrations as low as 74 Bq/m3 (2 pCi/L).

Lung cancer kills thousands of Americans every year. Smoking, radon, and secondhand smoke are the leading causes of lung cancer. Although lung cancer can be treated, the survival rate is one of the lowest for those with cancer. From the time of diagnosis, between 11 and 15 percent of those afflicted will live beyond five years, depending upon demographic factors. In many cases lung cancer can be prevented.

Smoking is the leading cause of lung cancer. Smoking causes an estimated 160,000 cancer deaths in the U.S. every year (American Cancer Society 2004). And the rate among women is rising. A smoker who is also exposed to radon has a much higher risk of lung cancer.

Radon is the number one cause of lung cancer among non-smokers, according to EPA estimates. Overall, radon is the second leading cause of lung cancer. Radon is responsible for about 21,000 lung cancer deaths every year. About 2,900 of these deaths occur among people who have never smoked (EPA 2009).

Secondhand smoke is the third leading cause of lung cancer and responsible for an estimated 3,000 lung cancer deaths every year (American Cancer Society 2004).

4.8.4.3. Coeur d'Alene Reservation Exposure Tests

The Coeur d'Alene Tribe, with funding provided by the EPA, conducted an Environmental Action Plan Project; assessment of environmental concerns, published in July 2000 (CdA-EAP 2000). Findings of this section are summarized from published reports contained within that document.

The Coeur d'Alene Tribe conducted radon testing on the Coeur d'Alene Reservation during the first half of 1998. A total of 169 homes were tested for radon using protocols identified by the USEPA. From those homes tested, a total of seven sites (measured during 12 tests), returned results above the EPA action level of 4 pC/L. The Coeur d'Alene Tribe repeated tests on those sites above the EPA action level, and on two of the seven sites, the results indicated below the EPA action level. The other five sites again returned radon concentration levels above the EPA action level for mitigation. The effort concluded that approximately 16% of all tests conducted on the Coeur d'Alene Reservation exceeded the national average of 1.5 pC/L for radon, and about half of the tests returned results of less than 0.5 pC/L (CdA-EAP 2000).

Comprehensive extrapolation of these test results would extend the findings of the effort to conclude that of the 169 radon tests conducted, approximately 7% (12 total) exceeded EPA action levels. Repeated testing of those sites exceeding the action level of 4.0 pC/L, resulted in a potentially false-positive response on two out of the seven sites (28.5%). The remaining five sites showed repeated above action-level results (71.5%), seemingly confirming the high concentrations a second time.

The concern with these results is the so-called "false positive" first test resulting in a positive indication the first time, and then returning a negative indication the second time. While it is not uncommon to see large fluctuations in radon concentrations within one structure, within a few hours of the tests, it does raise the concern that a similar share of the "below action-level" results (during the first tests) may be considered "false negatives". If a similar rate of potentially 'false positive' results is applied to the potential for a 'false negative' result (28.5%), then the reviewer may allocate the potential for the 28.5% of the 157 structures (45 homes) returning negative results during the first test, may have been erroneously determined to be below action-level concentrations. This extrapolation of these potential for false positives and false negatives should not in any way diminish the efforts completed by the Coeur d'Alene Tribe and published in 2000, but serve to reinforce the challenge of reliably measuring radon concentrations in homes and other structures. These findings are not uncommon when conducting repeated testing in moderate- and high-risk areas.

The recommendations stemming from these findings settles on the importance of repeated testing of homes that have not received pre-construction mitigation measures, or that have the characteristics leading to potential exposure. The cost of the testing is low, especially when considering the loss of life and safety that could result from radon exposure.

4.8.5. Probability of Future Events

Radon is formed as part of the normal radioactive decay chain of uranium. Uranium has been around since the earth was formed and its most common isotope has a very long half-life (4.5 billion years), which is the amount of time required for one-half of uranium to break down. Uranium, radium, and thus radon, will continue to occur for millions of years at about the same concentrations as they do now.

Radon concentration varies wildly from place to place; even within the same building. The Coeur d’Alene Reservation is located within a zone of risk exposure rated the highest in Idaho and the highest in the USA. While there is some degree of variability in these estimates within the Coeur d’Alene Reservation (Figure XXIX), these identifications of potentially low exposure should not be interpreted as low risk. The variations of risk exposure are made to show the soil parent materials as the source of potential radon emissions.

All homes and businesses on the Coeur d’Alene Reservation should take precautions against radon gas exposure on existing structures and new construction.

4.8.6. Dealing with Damages

There are relatively simple tests for radon gas, but these tests are not commonly done, even in areas of known systematic hazards. Radon test kits are commercially available. The short-term radon test kits used for screening purposes are inexpensive, in many cases free. The kit includes a collector that the user hangs in the lowest livable floor of the house for 2 to 7 days. The user then sends the collector to a laboratory for analysis. Long term kits, taking collections for up to one year, are also available. An open-land test kit can test radon emissions from the land before construction begins (EPA 2009).

Radon levels fluctuate naturally, due to factors like transient weather conditions, so an initial test might not be an accurate assessment of a home's average radon level. Therefore, a high result (over 4 pCi/L) justifies repeating the test before undertaking more expensive abatement projects. Measurements between 4 and 10 pCi/L warrant a long-term radon test. Measurements over 10 pCi/L warrant only another short-term test so that abatement measures are not unduly delayed. Purchasers of real estate are advised to delay or decline a purchase if the seller has not successfully abated radon to 4 pCi/L or less within the structure.

Because the half-life of radon is only 3.8 days, removing or isolating the source will greatly reduce the hazard within a few weeks. Another method of reducing radon levels is to modify the building's ventilation. Generally, the indoor radon concentrations increase as ventilation rates decrease (ATSDR 1990). In a well ventilated place, the radon concentration tends to align with outdoor values (typically 10 Bq/m3, ranging from 1 to 100 Bq/m3) (EPA 2009).

Radon levels in indoor air can be lowered in a number of ways, from sub-slab depressurization to increasing the ventilation rate of the building. The four principal ways of reducing the amount of radon accumulating in a house are: (EPA 2009, UT 2009)

- Sub-slab depressurization (soil suction) by increasing under-floor ventilation;
- Improving the ventilation of the house and avoiding the transport of radon from the basement into living rooms;
- Installing a radon sump system in the basement;
- Installing a positive pressurization or positive supply ventilation system.

According to the EPA's "A Citizen's Guide to Radon", the method to reduce radon "primarily used is a vent-pipe system and fan, which pulls radon from beneath the house and vents it to the outside", which is also called sub-slab depressurization, active soil depressurization, or soil suction. Generally indoor radon can be mitigated by sub-slab depressurization and exhausting such radon-laden air to the outdoors, away from windows and other building openings. "EPA generally recommends methods that prevent the entry of radon. Soil suction, for example, prevents radon from entering your home by drawing the radon from below the home and venting it through a pipe, or pipes, to the air above the home where it is quickly diluted" and "EPA does not recommend the use of sealing alone to reduce radon because, by itself, sealing has not been shown to lower radon levels significantly or consistently" according to the EPA's "Consumer's Guide to Radon Reduction: How to fix your home" (EPA 2001).

Positive-pressure ventilation systems can be combined with a heat exchanger to recover energy in the process of exchanging air with the outside, and simply exhausting basement air to the outside is not necessarily a viable solution as this can actually draw radon gas into a dwelling. Homes built on a crawl space may benefit from a radon collector installed under a "radon barrier" (a sheet of plastic that covers the crawl space) (EPA 2001, EPA 2009). For crawlspaces, the EPA states “An effective method to reduce radon levels in crawlspace homes involves covering the earth floor with a high-density plastic sheet. A vent pipe and fan are used to draw the radon from under the sheet and vent it to the outdoors. This form of soil suction is called sub-membrane suction, and when properly applied is the most effective way to reduce radon levels in crawlspace homes.” (EPA 2001).

All homes on the Coeur d’Alene Reservation are exposed to the potential for radon gas emissions. All homes should be tested for radon concentrations as described here and appropriate steps should be taken to ensure human health is maintained.

4.9. Wildland Fire

4.9.1. Tribal Legends

Several native legends explain the introduction of fire to the people. Coyote holds a prominent role in the acquisition of fire and instructing the people how to extract it (©1996 StoneE Producktions: http://www.ilhawaii.net/~stony/lore06.html).

4.9.1.1. How Coyote Stole Fire

Long ago, when man was newly come into the world, there were days when he was the happiest creature of all. Those were the days when spring brushed across the willow tails, or when his children ripened with the blueberries in the sun of summer, or when the goldenrod bloomed in the autumn haze.

But always the mists of autumn evenings grew more chill, and the sun's strokes grew shorter. Then man saw winter moving near, and he became fearful and unhappy. He was afraid for his children, and for the grandfathers and grandmothers who carried in their heads the sacred tales of the tribe. Many of these, young and old, would die in the long, ice-bitter months of winter.

Coyote, like the rest of the People, had no need for fire. So he seldom concerned himself with it, until one spring day when he was passing a human village. There the women were singing a song of mourning for the babies and the old ones who had died in the winter. Their voices moaned like the west wind through a buffalo skull, prickling the hairs on Coyote's neck.

"Feel how the sun is now warm on our backs," one of the men was saying. "Feel how it warms the earth and makes these stones hot to the touch. If only we could have had a small piece of the sun in our teepees during the winter."

Coyote, overhearing this, felt sorry for the men and women. He also felt that there was something he could do to help them. He knew of a faraway mountain-top where the three Fire Beings lived. These Beings kept fire to themselves, guarding it carefully for fear that man might somehow acquire it and become as strong as they. Coyote saw that he could do a good turn for man at the expense of these selfish Fire Beings.

So Coyote went to the mountain of the Fire Beings and crept to its top, to watch the way that the Beings guarded their fire. As he came near, the Beings leaped to their feet and gazed searchingly round their camp. Their eyes glinted like bloodstones, and their hands were clawed like the talons of the great black vulture.

"What's that? What's that I hear?" hissed one of the Beings.

"A thief, skulking in the bushes!" screeched another.

The third looked more closely, and saw Coyote. But he had gone to the mountain-top on all fours, so the Being thought she saw only an ordinary coyote slinking among the trees.

"It is no one, it is nothing!" she cried, and the other two looked where she pointed and also saw only a grey coyote. They sat down again by their fire and paid Coyote no more attention.

So he watched all day and night as the Fire Beings guarded their fire. He saw how they fed it pine cones and dry branches from the sycamore trees. He saw how they stamped furiously on runaway rivulets of flame that sometimes nibbled outwards on edges of dry grass. He saw also how, at night, the Beings took turns to sit by the fire. Two would sleep while one was on guard; and at certain times the Being by the fire would get up and go into their teepee, and another would come out to sit by the fire.

Coyote saw that the Beings were always jealously watchful of their fire except during one part of the day. That was in the earliest morning, when the first winds of dawn arose on the mountains. Then the Being by the fire would hurry, shivering, into the teepee calling, "Sister, sister, go out and watch the fire." But the next Being would always be slow to go out for her turn, her head spinning with sleep and the thin dreams of dawn.

Coyote, seeing all this, went down the mountain and spoke to some of his friends among the People. He told them of hairless man, fearing the cold and death of winter. And he told them of the Fire Beings, and the warmth and brightness of the flame. They all agreed that man should have fire, and they all promised to help Coyote's undertaking.

Then Coyote sped again to the mountain-top. Again the Fire Beings leaped up when he came close, and one cried out, "What's that? A thief, a thief!"

But again the others looked closely, and saw only a grey coyote hunting among the bushes. So they sat down again and paid him no more attention.

Coyote waited through the day, and watched as night fell and two of the Beings went off to the teepee to sleep. He watched as they changed over at certain times all the night long, until at last the dawn winds rose.

Then the Being on guard called, "Sister, sister, get up and watch the fire."

And the Being whose turn it was climbed slow and sleepy from her bed, saying, "Yes, yes, I am coming. Do not shout so."

But before she could come out of the teepee, Coyote lunged from the bushes, snatched up a glowing portion of fire, and sprang away down the mountainside.

Screaming, the Fire Beings flew after him. Swift as Coyote ran, they caught up with him, and one of them reached out a clutching hand. Her fingers touched only the tip of the tail, but the touch was enough to turn the hairs white, and coyote tail-tips are white still. Coyote shouted, and flung the fire away from him. But the others of the People had gathered at the mountain's foot, in case they were needed. Squirrel saw the fire falling, and caught it, putting it on her back and fleeing away through the tree-tops. The fire scorched her back so painfully that her tail curled up and back, as squirrels' tails still do today.

The Fire Beings then pursued Squirrel, who threw the fire to Chipmunk. Chattering with fear, Chipmunk stood still as if rooted until the Beings were almost upon her. Then, as she turned to run, one Being clawed at her, tearing down the length of her back and leaving three stripes that are to be seen on chipmunks' backs even today. Chipmunk threw the fire to Frog, and the Beings turned towards him. One of the Beings grasped his tail, but Frog gave a mighty leap and tore himself free, leaving his tail behind in the Being's hand---which is why frogs have had no tails ever since.

As the Beings came after him again, Frog flung the fire on to Wood. And Wood swallowed it.

The Fire Beings gathered round, but they did not know how to get the fire out of Wood. They promised it gifts, sang to it and shouted at it. They twisted it and struck it and tore it with their knives. But Wood did not give up the fire. In the end, defeated, the Beings went back to their mountain-top and left the People alone.

But Coyote knew how to get fire out of Wood. And he went to the village of men and showed them how. He showed them the trick of rubbing two dry sticks together, and the trick of spinning a sharpened stick in a hole made in another piece of wood. So man was from then on warm and safe through the killing cold of winter.

Figure LIX. Youth Art Contest, 12 and Younger, Second Place Winner: Brianna Pluff.

4.9.2. Wildfires in Coeur d'Alene Country

A wildfire, also known as a wildland fire, forest fire, brush fire, or vegetation fire, is an uncontrolled fire often occurring in wildland areas, but also with the potential to consume houses and agricultural resources. Common causes are numerous and can include lightning, human carelessness, slash-and-burn farming, arson, volcanic activity, pyroclastic clouds, and underground coal fire. Heat waves, droughts, and cyclical climate changes such as El Niño can also dramatically increase the risk of wildfires (NWCG 1998).

Wildfires are common in climates that are sufficiently moist to allow the growth of trees but feature extended dry, hot periods, such as can be found in most of the Upper Columbia Plateau in late summer months. Wildfires can be particularly intense during days of strong winds and periods of drought. Fire prevalence is also high during the summer and autumn months, when fallen branches, leaves, grasses, and scrub dry out and become more flammable (NWCG 1998).

Wildfires are considered a natural part of the ecosystem of numerous forestlands and rangelands, where some plants have evolved to tolerate fires through a variety of strategies such as fire-resistant seeds and reserve shoots that sprout after a fire (Agee 1993). Smoke, charred wood, and heat are common fire cues that stimulate the germination of seeds (Agee 1998). Exposure to smoke from burning plants can even promote germination in some types of plants (Barrett 1979).

Natural fire ignition from lightning, as well as human carelessness or arson, are the two main causes for most wildfires in the Upper Columbia Plateau. These fires threaten homes located within the Wildland-Urban Interface (WUI), a zone of transition between developed areas and undeveloped wildland. However, structure fires can also threaten wildlands when these homes are located without a vegetation buffer, allowing the structure fire to spread to forestland or rangeland vegetation, then back to other homes in the area.

4.9.3. Wildfire Threats on the Coeur d'Alene Reservation

Fires can be categorized by their fuel type as follows:

- **Smoldering:** involves the slow combustion of surface fuels without generating flame, spreading slowly and steadily.
- **Crawling:** surface fires that consume low-lying vegetation such as grass, leaf litter, and debris.
- **Ladder:** fires that consume material between low-level vegetation and tree canopies, such as small trees, low branches, vines, and invasive plants.
- **Crown:** fires that consume low-level surface fuels, transition to ladder fuels, and also consume suspended materials at the canopy level. These fires can spread at an incredible pace through the top of a forest canopy, burning entire trees in groups, and can be extremely dangerous (sometimes called a Firestorm).

Smoldering fires involve the slow combustion of surface fuels without generating flame, while spreading slowly and steadily. They can linger for days or weeks after flaming has ceased, resulting in potential large quantities of fuel consumed. They heat the duff and mineral layers, affecting the roots, seeds, and plant stems in the ground. These are most common in peat bogs, but not exclusive to that vegetation.

Wildfires may spread by jumping or spotting, as burning materials are carried by wind or firestorm conditions. Burning materials can jump over roads, rivers, or even firebreaks and start distant fires. The powerful updraft caused by a large wildfire will draw in air from the surrounding area. These self-generated winds can also lead to the phenomenon known as a firestorm.

4.9.4. History

Wildland fire management in the Interior West over the past hundred years has created a modified role for wildland fire. Because of a national awareness of wildfire impacts, forest managers increased protective measures to stop wildfires as soon as they are discovered.

Indigenous wildland fires of this region were allowed to burn unchecked with a fire-return interval ranging from as few as five years to as many as a couple hundred years between fire events (Brown 1995, IFPC 2005). In those locations where fires were a frequent "visitor", the fire intensity was commonly low, and supported by surface fuels such as grasses, forest litter and debris. Occasionally, the fires would torch into single trees (via ladder fuels) or small groups of trees, but rarely were they sustained in the tree crowns (crown fire). Fire intensities created a mosaic of burned and un-burned areas located relatively close to each other.

In less frequent fire-return interval sites, the natural-condition wildfires would burn with more intensity but a lower periodicity. The tree species occupying these sites would often be tolerant of some level of fire activity and sometimes regenerated by fire activity (such as ponderosa pine). These sites experienced wide-scale fires on a return interval of 60 to 120 years between wildfire events.

Other sites witnessed fire reoccurrence very infrequently (as much as 200 years between fire returns), where trees and other vegetation would thrive in the inter-fire period only to be destroyed by the next large event, commonly called a "Stand Replacing Fire" (Brown 1995).

Prior to about 1920, the lack of a well-developed road system in most of this region hindered fire protection services from accessing fires, while they were still small enough to logistically control with hand tools. As the road system of the region was developed through increased timber harvesting activities, fire-response time was greatly aided. After World War II, wildland firefighting agencies added two more features to their anti-incendiary tool-belt: air attack and smoke jumpers.

Both of these tools increased the effectiveness of the wildland firefighters, mainly employed by the USFS, Idaho Department of Lands, forest products companies, and others, to control fires while still small. Fire-suppression efforts were so successful that the number of acres burning annually in north Idaho was only a small fraction of the region's historical average. For instance, the Idaho Panhandle National Forest area averaged 31,000 acres burned each year from 1542 to 1931 (estimated). The average number of acres burned annually between 1969 and 1998 was only 665 (IFPC 2005).

A parallel sequence of events occurred with this scenario. Technology to track lightning strikes as they occur improved critical quick response time in North America in the late 1960s (Brookhouse 1999). Lightning detection systems are able to record various characteristics of lightning strikes, including the type of strike (cloud-to-ground, cloud-to-cloud), polarity, intensity, and approximate location of the discharge. Each lightning strike emanates a radio signal that has a unique signature. USFS and BLM research has been instrumental in establishing lightning detection systems all across the Inland Northwest and all of the United States. The first lightning detectors in this region came into operation in 1968, with the location of ground strikes plotted manually. This manual form of triangulation was replaced by linking detectors to computers. This system is called "Automated Lightning Detection System" (ALDS).

This synergistic combination of resources and technology greatly reduced the average wildland fire size and therefore reduced risks to both the ecosystem and the rural and urban populations living in or near forestlands (such as all communities on the Coeur d'Alene Reservation).

This break in the natural fire cycle introduced by large-scale and effective firefighting led to the accumulation of natural fuels on sites, where fire previously had re-occurred on a semi-predictable cycle. Other disruptions to the natural fire cycle included the introduction of exotic plant diseases, such as the white pine blister rust in 1910, which decimated millions of acres of western white pine (Worrall 2007). By 1940 white pine blister rust was epidemic across the region, infecting over 95% of the standing western white pine. Today, the amount of western white pine growing within the upper Columbia Plateau is only 7% of what it was in 1965 (IFPC 2005).

While wildland fire spread in the region has been drastically reduced, debris and normal forest fuels continue to accumulate in the forest. When fire does occur, it can burn hotter and longer than it did historically. These "out-of-natural historic range of variability" fires are witnessed each summer across the nation.

With extensive urbanization of rangelands and forestlands, these fires often involve destruction of homes located in the WUI. On many occasions, wildfires have caused large-scale damage to private and public property, destroying many homes and causing deaths, particularly when they have reached urban fringe communities (Figure VII).

4.9.5. Wildland Fire History

Throughout the Upper Columbia Plateau, wildfires have been observed on a continuous and frequent cycle in all forested and rangeland ecosystems. Many homes have been built within the WUI, leading to losses of private and public structures from wildfires. The reverse is also true, as homes have ignited and then spread to surrounding rangelands and forestlands, causing the loss of adjacent homes and natural ecosystems.

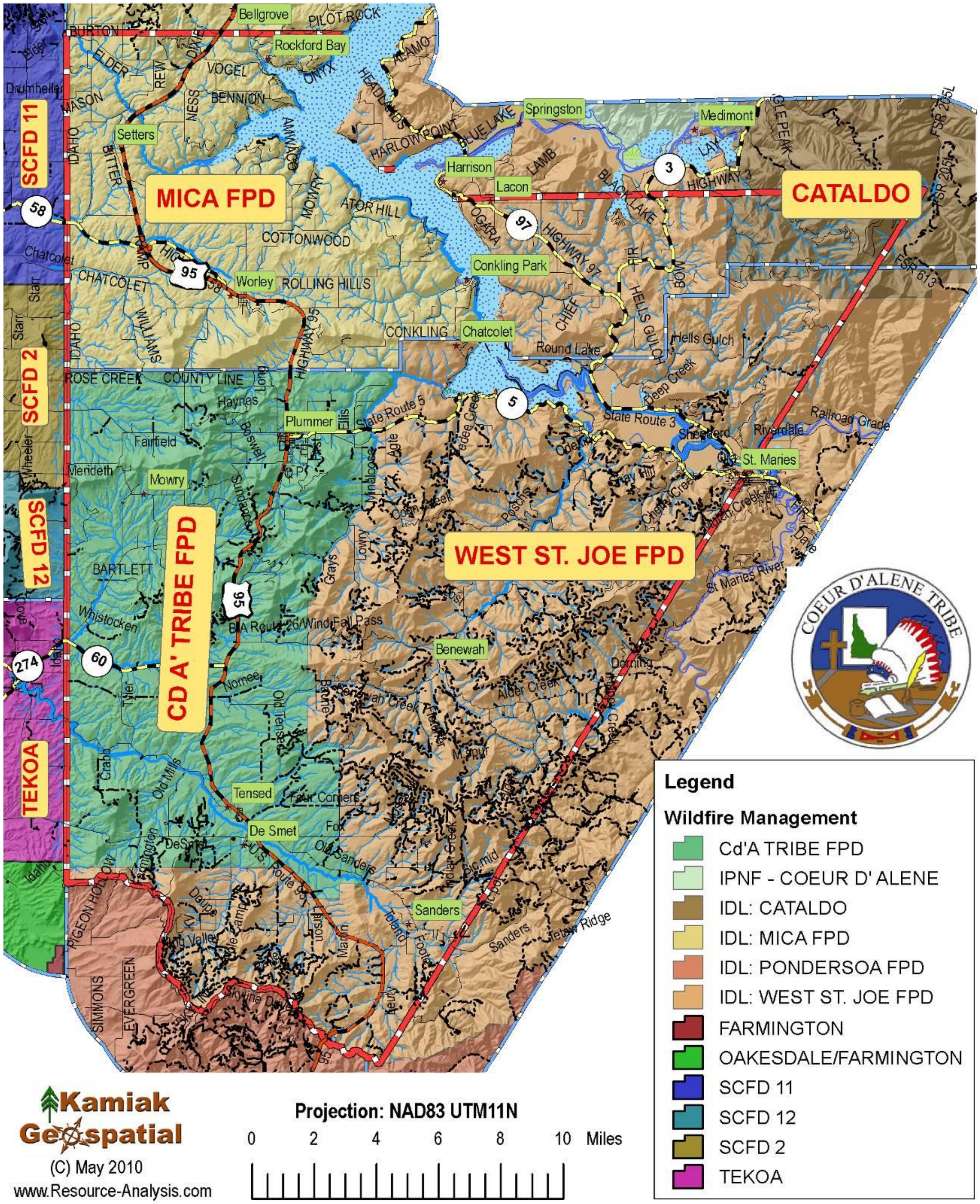
Wildfire events that have impacted the Coeur d'Alene Reservation and surrounding areas are summarized in Table 35.

Table 35. Significant Idaho wildland fires recorded in and near the Coeur d'Alene Reservation.

Year	Disaster Declarations (1976-2000)	WUI Impact	Comments
1889			Legacy Fire dated 1898, burned 320,373 acres in North Idaho, including 395 acres on the Coeur d'Alene Reservation (IPNF 2009).
1900			Legacy Fire dated 1900, burned 61,300 acres in North Idaho, including 21,242 acres on the Coeur d'Alene Reservation (IPNF 2009).
1910	-	X	Eighty-five lives lost; fire consumes 1/6 of North Idaho forests, destroying many communities. The 1910 Wildfire burned approximately 68,169 acres on the Coeur d'Alene Reservation (IBHS 2007).
1919			Legacy Fire dated 1919, burned 133,375 acres in North Idaho (IPNF 2009).
1922			Legacy Fire dated 1922, burned 79,843 acres in North Idaho (IPNF 2009).
1924			Legacy Fire dated 1924, burned 28,304 acres in North Idaho (IPNF 2009).
1927			Legacy Fire dated 1927, burned 31,908 acres in North Idaho (IPNF 2009).
1929			Legacy Fire dated 1929, burned 107,726 acres in North Idaho, including 879 acres on the Coeur d'Alene Reservation (IPNF 2009).
1931			Legacy Fire dated 1931, burned 84,822 acres in North Idaho (IPNF 2009).
1932			Legacy Fire dated 1932, burned 3,027 acres in North Idaho, including 78 acres on the Coeur d'Alene Reservation (IPNF 2009).
1965			Legacy Fire dated 1960, burned 79,843 acres in North Idaho, including 1,407 acres on the Coeur d'Alene Reservation (IPNF 2009).
1967	-		Ten counties in Panhandle affected; 50,000 acres burned in nine hours, and a total wildfire size of 79,843 acres (IBHS 2007).
1985	State (2)		Two State-wide declarations (July and August) (IBHS 2007).
1986	State		State-wide declaration (IBHS 2007).
1989	State	X	The worst fires since 1910 burn thousands of acres in south central Idaho, partially destroying the town of Lowman and leading to State-wide declaration (IBHS 2007).
1992	State (2)	X	One life lost in the worst fire season in Idaho history to date; one of two State-wide declarations was for an unusual spring event (April) (IBHS 2007).
1994	State	X	One life lost and one home lost; summer wildfires burn a total of over 750,000 acres resulting in a State-wide declaration (IBHS 2007).
2000	State, Federal	X	More than 1,500 individual fires (IBHS 2007).
2007	State	X	1,394 Fires, 1,972,643 acres (IBHS 2007).

Within the Coeur d'Alene Reservation, wildfire management is administered by the Coeur d'Alene Tribe and the IDL (Figure LX). While the USFS and BLM have significant landholdings adjacent to the Coeur d'Alene Reservation, the IDL is the lead agency for wildfire initial attack and suppression on much of the Coeur d'Alene Reservation. The Coeur d'Alene Tribe administers initial attack in cooperation with the IDL for much of the southwestern portions of the Reservation (Figure LX).

Figure LX. Wildfire Protection Management within the Coeur d'Alene Reservation.



The IDL and BIA maintain databases of wildfire ignitions and final fire size, in addition to several other wildfire attributes. A review of information in the BIA and IDL wildfire databases reveal that approximately 131 acres burned by wildfires each year on the Coeur d'Alene from an average of approximately 14 ignitions per year (Table 36).

Approximately 35% of ignitions on the Coeur d'Alene Reservation were recorded in the IDL database as lightning-caused wildfires between 1984 and 2008 (Table 37). The BIA managed database includes a place to record identical data, but the cells are not populated with values. However, the BIA database records a general cause as 'human' or 'natural' ignition sources. According to that database, approximately 13% of the ignitions were 'natural' causes (generally lightning), and the remaining 87% were 'human' ignition sources between 1985 and 2008.

Debris burning that escaped to become a wildfire accounted for 30 ignitions (24% of the total), in the IDL wildfire database, while miscellaneous ignitions accounted for another 25 wildfires (20% of the total) in the IDL wildfire database between 1984 and 2008. These statistics (Table 37) are fairly representative of a WUI interface region although the percent of total non-lightning caused ignitions is relatively high. Generally, it is feasible in this region to have ignitions caused by lightning totaling 75% of all ignitions, and non-lightning caused ignitions accounting for only 25% of the total. Instead, these relative proportions are almost completely reversed, with 35% caused by lightning and 65% from human sources.

Table 36. Wildfire ignition and extent history 1984-2008, on the Coeur d'Alene Reservation.

	Acres Burned		Number of Wildfire Ignitions		Combined Total		Average Fire Size (acres ÷ ignitions)
Year	BIA database	IDL database	BIA database	IDL database	Acres	Ignitions	
1984		5.0		7	5.0	7	0.7
1985	4.0	4.0	1	2	8.0	3	2.7
1986	0.0	1.0	1	3	1.0	4	0.3
1987	4.4	24.0	2	7	28.4	9	3.2
1988	0.0	0.0	1	2	-	3	-
1989	3.0	0.0	2	1	3.0	3	1.0
1990	0.0	3.0	0	1	3.0	1	3.0
1991	0.6	3.0	2	5	3.6	7	0.5
1992	1.5	28.0	3	9	29.5	12	2.5
1993	68.4	42.0	6	2	110.4	8	13.8
1994	182.7	68.0	13	16	250.7	29	8.6
1995	223.4	0.0	4	4	223.4	8	27.9
1996	516.2	113.0	9	8	629.2	17	37.0
1997	84.2	5.0	7	2	89.2	9	9.9
1998	50.3	9.0	13	6	59.3	19	3.1
1999	38.8	0.0	10	8	38.8	18	2.2
2000	15.3	0.0	9	4	15.3	13	1.2
2001	28.1	0.0	14	0	28.1	14	2.0
2002	117.5	7.0	14	4	124.5	18	6.9
2003	134.2	12.0	25	7	146.2	32	4.6
2004	39.1	0.0	6	3	39.1	9	4.3
2005	556.3	7.0	25	2	563.3	27	20.9
2006	109.9	32.0	19	7	141.9	26	5.5
2007	28.5	523.0	23	7	551.5	30	18.4
2008	7.1	185.0	5	7	192.1	12	16.0
Totals	**2,213.5**	**1,071.0**	**214**	**124**	**3,284.5**	**338**	**9.7**

Conversely, the number of acres burned each year on the Coeur d'Alene Reservation demonstrate that the wildfire suppression efforts are performing exceptionally well. This is a fire-adapted ecosystem where large wildfires have been witnessed. During the past 25 years, wildfire-suppression efforts have kept the average fire size to about 130 acres per year.

Wildfire-suppression costs have been recorded for each ignition responded to be the IDL on the Coeur d'Alene Reservation. For comparative purposes these annual suppression costs have been adjusted for inflation to represent 2010 dollars (Table 37). Based on these expenditures, the IDL has recorded the expense, adjusted to 2010 dollars, of approximately $74,500 each year to provide initial attack and suppression on the Coeur d'Alene Reservation. Expressing these costs on a per-acre basis is not feasible because many of the ignitions cost resources to provide initial attack, but did not lead to a wildfire extent (fire put out before it burned acres of land).

These annual costs have been extrapolated to estimate the wildfire suppression costs for both the IDL and the BIA, by determining the annual cost per ignition attributed by the IDL, and multiplying it by the total number of ignitions (BIA and IDL) on the Reservation each year (Table 37). Based on this approach, the average annual suppression cost on the Coeur d'Alene Reservation is approximately $203,000 (2010 dollars). This method of extrapolation should not be considered a reliable source of determining to suppression costs on the Coeur d'Alene Reservation. For instance, initial attack costs cannot compare to the costs of a sustained wildfire-suppression effort. However, using only acres burned as a cost indicator would fail to quantify the costs of the initial attack.

These estimates are illustrative of the need for initial attack and resources to fight wildfires through sustained suppression efforts. These numbers also fail to quantify the resources and efforts to implement pre-disaster mitigation projects in the form of residential education about wildfire safety and the extensive WUI treatments around homes and infrastructure in the Coeur d'Alene Reservation.

Table 37. Idaho Department of Lands wildfire cause, cost of suppression, and extrapolation to all wildfires on the Coeur d'Alene Reservation 1984-2008.

Year	IDL Database Number of Fires	IDL Database Acres Burned	Number of Ignitions by Cause: Lightning	Campfire	Smoking	Debris Burning	Arson	Equipment Use	Railroad	Children	Misc.	IDL Cost adjusted to 2010	IDL Cost / Ignition	Est. cost per year IDL & BIA
1984	7	5	0	0	0	1	1	0	0	0	5	$10,655	$1,522	$10,655
1985	2	4	0	2	0	0	0	0	0	0	0	$10,091	$5,046	$15,137
1986	3	1	0	0	0	1	0	2	0	0	0	$1,668	$556	$2,223
1987	7	24	1	1	0	1	0	0	0	0	4	$30,532	$4,362	$39,255
1988	2	0	1	0	0	0	0	0	0	1	0	$2,501	$1,250	$3,751
1989	1	0	0	0	1	0	0	0	0	0	0	$630	$630	$1,890
1990	1	3	0	0	0	0	0	0	0	0	1	$6,224	$6,224	$6,224
1991	5	3	3	0	0	0	0	0	0	0	2	$4,190	$838	$5,867
1992	9	28	3	0	1	2	0	1	0	0	2	$55,072	$6,119	$73,429
1993	2	42	0	0	0	2	0	0	0	0	0	$9,557	$4,778	$38,227
1994	16	68	7	1	1	5	0	1	0	0	1	$231,910	$14,494	$420,337
1995	4	0	3	0	0	0	0	0	0	1	0	$3,664	$916	$7,327
1996	8	113	6	0	0	0	0	0	0	0	2	$6,819	$852	$14,491
1997	2	5	2	0	0	0	0	0	0	0	0	$8,610	$4,305	$38,746
1998	6	9	0	1	0	2	0	1	0	0	2	$9,541	$1,590	$30,213
1999	8	0	7	0	0	0	0	1	0	0	0	$4,637	$580	$10,434
2000	4	0	0	0	0	0	0	0	0	1	3	$1,050	$263	$3,413
2001	0	0	0	0	0	0	0	0	0	0	0	$0	$0	$-
2002	4	7	0	0	0	1	2	0	0	0	1	$3,586	$897	$16,139
2003	7	12	5	0	0	2	0	0	0	0	0	$33,459	$4,780	$152,955
2004	3	0	2	0	0	0	0	0	0	0	1	$5,385	$1,795	$16,156
2005	2	7	0	0	0	1	0	0	0	0	1	$24,655	$12,327	$332,837
2006	7	32	3	0	0	4	0	0	0	0	0	$39,374	$5,625	$146,245
2007	7	523	0	0	0	4	0	2	0	1	0	$1,307,485	$186,784	$5,603,508
2008	7	185	0	0	0	4	1	1	1	0	0	$51,449	$7,350	$88,199
Total	**124**	**1,071**	**43**	**5**	**3**	**30**	**4**	**9**	**1**	**4**	**25**	**$1,862,745**	**$15,022**	**$283,106**
	Percent by Cause		**35%**	**4%**	**2%**	**24%**	**3%**	**7%**	**1%**	**3%**	**20%**			
Average/Year	**5**	**42.8**										**$74,510**		

4.9.6. Analysis Tools to Assess Wildfire Risk Exposure

Analysis tools to assess the risk exposure to wildland fires on the Coeur d'Alene Reservation are numerous. Each analysis tool has specific applications to unique needs and can be considered in light of the site being addressed; none of them will replace professional expertise of fire behavior analysts on the ground. These techniques are presented for consideration of the risk exposure to Coeur d'Alene Reservation residents. Wildland fire is arguably one of the most widespread hazards affecting the Coeur d'Alene Reservation.

4.9.6.1. Mean Fire Return Interval

Broad-scale alterations of historical fire regimes and vegetation dynamics have occurred in many landscapes in the U.S. through the combined influence of land management practices, fire exclusion, ungulate herbivory, insect and disease outbreaks, climate change, and invasion of non-native plant species. The LANDFIRE Project (LANDFIRE 2007) produces maps of simulated historical fire regimes and vegetation conditions using the LANDSUM landscape succession and disturbance dynamics model. The LANDFIRE Project also produces maps of current vegetation and measurements of current vegetation departure from simulated historical reference conditions. These maps support fire and landscape management planning outlined in the goals of the National Fire Plan, Federal Wildland Fire Management Policy, and the Healthy Forests Restoration Act.

The Simulated Historical Mean Fire Return Interval data layer (LANDFIRE MFRI 2006) quantifies the average number of years between fires under the presumed historical fire regime. This data layer is derived from vegetation and disturbance dynamics simulations using LANDSUM (Keane *et al.* 2002, Keane *et al.* 2006, Pratt *et al.* 2006). LANDSUM simulates fire dynamics as a function of vegetation dynamics, topography, and spatial context in addition to variability introduced by dynamic wind direction and speed, frequency of extremely dry years, and landscape-level fire-size characteristics. This layer is intended to describe one component of simulated historical fire regime characteristics in the context of the broader historical time period represented by the LANDFIRE Biophysical Settings layer and LANDFIRE Biophysical Settings Model Documentation.

Mean fire return interval is calculated from the simulation length divided by the number of fires that were measured on each pixel. The simulations used to produce this layer were 10,000 years in duration to observe the most complete representation of the fire regime characteristics within spatially complex landscapes, given computational limitations. However, it is important to note that these simulations are not intended to accurately represent the last 10,000 years of measurable history, which includes spatially and temporally dynamic factors such as climate change, vegetation species dispersal, and anthropogenic influences on vegetation and fire characteristics.

Simulated historical mean fire return intervals were classified into 22 categories of varying temporal length to preserve finer detail for more frequently burned areas and less detail for rarely burned areas. Additional data layer values were included to represent Water, Snow / Ice, Barren land, and Sparsely Vegetated areas. Vegetated areas that never burned during the simulations were included in the category "Indeterminate Fire Regime Characteristics"; these vegetation types either had no defined fire behavior or had extremely low probabilities of fire ignition (Keane *et al.* 2002).

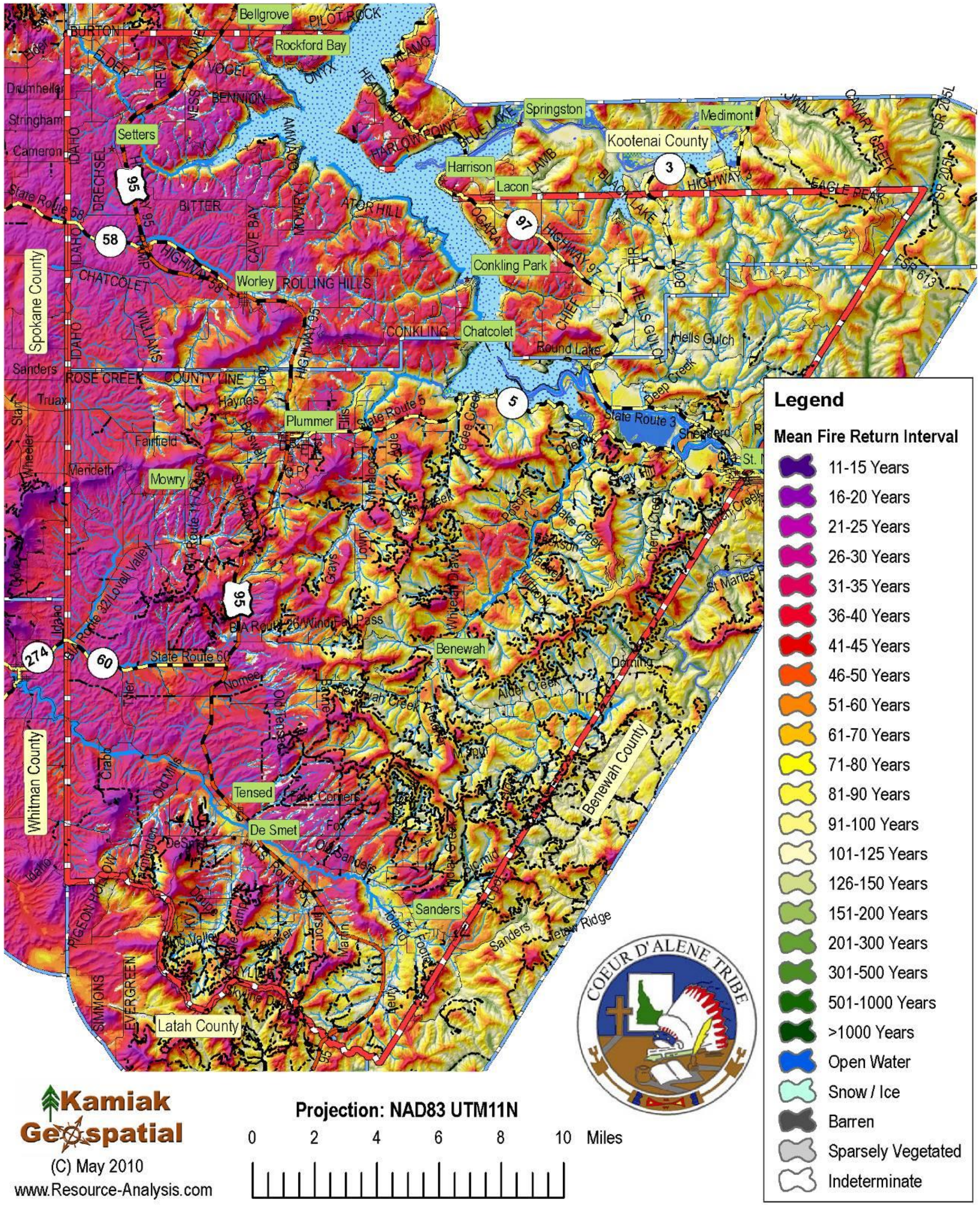
The results of the Mean Fire Return Interval analysis on the Coeur d'Alene Reservation (Table 38) reveals that almost 70% of the land area on the Coeur d'Alene Reservation is subject to a return interval of under 80 years, while the other half of the land area is exposed to mean fire return intervals of greater than 80 years and up to 200 years. Almost 90% of the land area is subject to mean fire return intervals of under 150 years (Table 38). The data are extremely variable, with the largest land area category, representing 12% of the total land area (40,800 acres), situated in the mean fire return interval of 31-35 years. These data indicate that the role of wildland fire is highly variable and operating on temporal scales exceeding most planning efforts.

The spatial distribution of these data is shown in Figure LXI. An investigative study of these maps demonstrates the variability and distribution of this analysis component to understanding the role of wildland fire in this region.

Table 38. Mean Fire Return Intervals on the Coeur d'Alene Reservation.

Mean Fire Return Interval		Acres	Percent of Total Area
11-15 Years		48	0.01%
16-20 Years		1,473	0.42%
21-25 Years		8,529	2.45%
26-30 Years		33,105	9.53%
31-35 Years		40,792	11.74%
36-40 Years		31,501	9.07%
41-45 Years		23,336	6.72%
46-50 Years		19,567	5.63%
51-60 Years		32,687	9.41%
61-70 Years		25,208	7.26%
71-80 Years		20,511	5.90%
81-90 Years		18,219	5.24%
91-100 Years		14,117	4.06%
101-125 Years		24,759	7.13%
126-150 Years		11,109	3.20%
151-200 Years		6,482	1.87%
201-300 Years		1,770	0.51%
301-500 Years		624	0.18%
501-1000 Years		292	0.08%
>1000 Years		201	0.06%
Water		12,435	3.58%
Snow / Ice		121	0.03%
Barren		192	0.06%
Sparsely Vegetated		214	0.06%
Indeterminate Fire Regime Characteristics		20,165	5.80%
(LANDFIRE 2007)	**Total**	**347,458**	

Figure LXI. Mean Fire Return Interval (LANDFIRE MFRI 2006) for the Coeur d'Alene Reservation.



4.9.6.2. Fire Prone Landscapes

Schlosser *et al.* (2002), developed a methodology to assess the location of fire prone landscapes on forested and non-forested ecosystems in the western US. This assessment technique has been completed for tribal- and county-level fire mitigation plans and FEMA hazard mitigation plans, for Bureau of Indian Affairs and BLM Fire Management Plans and

Environmental Assessments on over 45 project areas in Idaho, Montana, Nevada, Oregon, and Washington to determine fire prone landscape characteristics.

The goal of developing the Fire Prone Landscapes (FPL) analysis is to make inferences about relative risk factors across large geographical regions for wildfire spread. This analysis uses the extent and occurrence of past fires as an indicator of characteristics for a specific area and its propensity to burn in the future. Concisely, if a certain combination of vegetation cover type, canopy closure, aspect, slope, and position on the hillside, have burned with a high frequency in the past, then it is reasonable to extrapolate that they will have the same tendency in the future, unless mitigation activities are conducted to reduce this potential.

The basis of the analysis technique is to bring all of these factors together in a geospatial model (GIS layers) to determine the area of each combination of input variables that is available to burn, and then determine how much of this area actually burned in past fire events. For this analysis, the areas of Benewah County, Shoshone County, Latah County, and Kootenai County were considered in order to guarantee a robust sample area.

Past fire extents represent those locations on the landscape that have previously burned during a wildfire. Past fire extent maps were obtained from a variety of sources for the north Idaho area including the USFS Panhandle National Forest and the USFS Clearwater National Forest, IDL, BIA, and BLM.

The maximum derived FPL rating score for the Coeur d'Alene Reservation was 80, with a low of 0 (Coeur d'Alene Lake). Table 39 details the distribution of these categories while Figure LXII graphically displays these results. The data are distributed into two modes of distribution with the first occurring at FPL rankings of 11-20 and the second at 61-70 (Table 39).

The FPL analysis is an appropriate tool for assessing the risk in the WUI to people, structures, and infrastructure. This analysis tool geographically shows where landscape components combine to create conditions where past fires have burned. It does not show predicted rate of spread or burn intensity, but it does show where resources are potentially at-risk to wildfire loss. Thus, FPL data are useful for community protection prioritization and WUI home defensibility precedence.

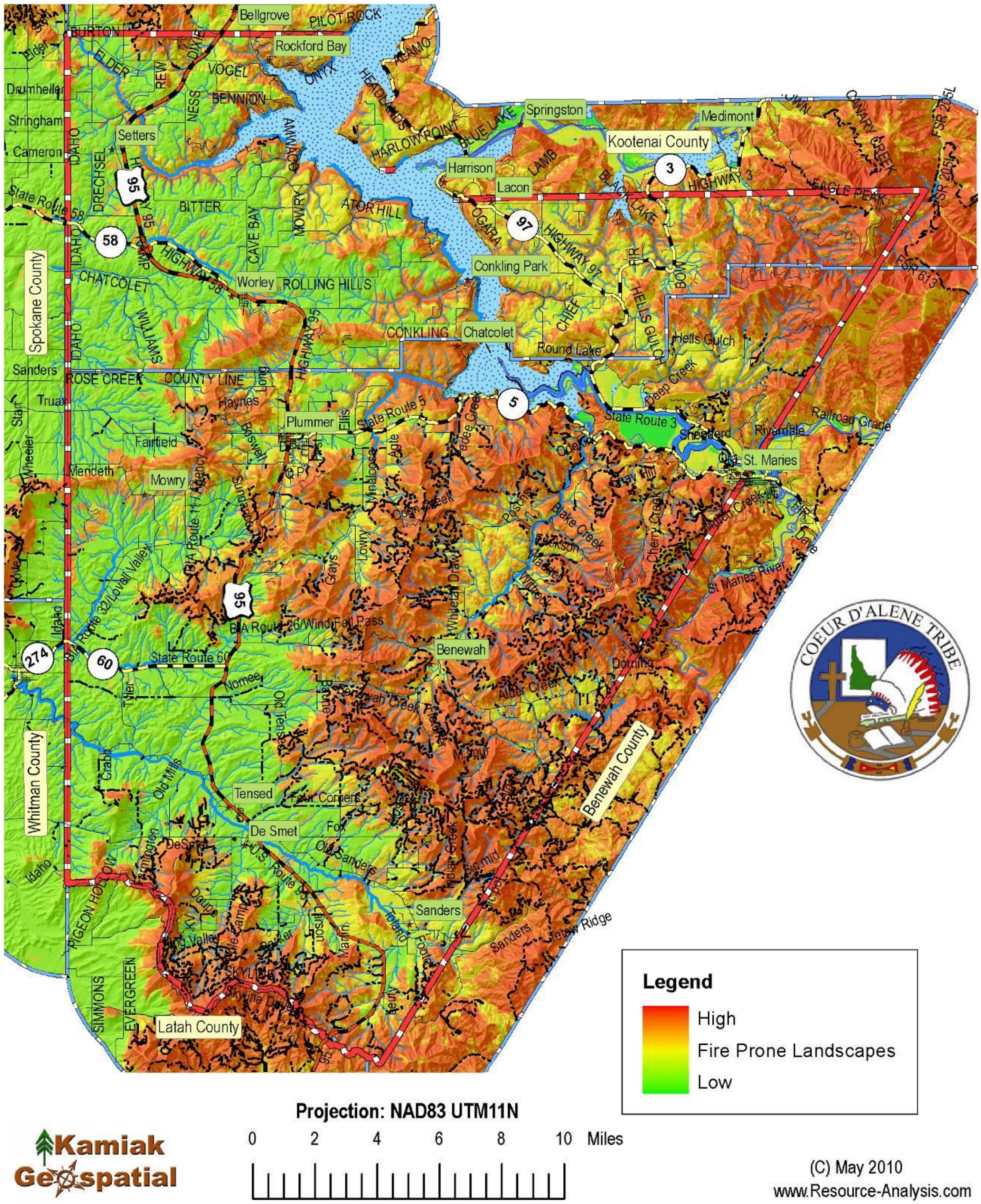
Table 39. Fire Prone Landscapes Analysis Results on the Coeur d'Alene Reservation.

Risk Category	Acres	Percent
0	13,288	4%
1-10	-	0%
11-20	97,078	28%
21-30	13,126	4%
31-40	32,946	9%
41-50	32,042	9%
51-60	40,660	12%
61-70	84,884	24%
71-80	33,428	10%
81-90	-	0%
91-100	-	0%
Total	347,451	

The risk values developed in this analysis should be considered **ordinal data**, that is, while the values presented have a meaningful ranking, they do not have consistent scale between numbers. Rating in the "40" range is not necessarily twice as "risky" as rating in the "20" range. These category values also do not correspond to a rate of fire spread, a fuel loading indicator, or measurable potential fire intensity. Each of those scales is greatly influenced by weather, seasonal and daily variations in moisture (relative humidity), solar radiation, and other factors. The risk rating presented here serves to identify where certain constant variables are present, aiding in identifying where fires typically spread into the largest fires across the landscape.

A risk-rating score of zero represents no relative risk and a score of one hundred is considered extreme risk. In practice, very few areas of the highest risk category (100) are found. This rating scale should be considered as nominal data producing values which can be ordered sequentially, but the actual values are not multiplicative. The scale provides relative comparisons between sites.

Figure LXII. Fire Prone Landscapes of the Coeur d'Alene Reservation.



4.9.6.3. Historic Fire Regime

The USFS, Northern Fire Plan Cohesive Strategy Team, in Kalispell, Montana, completed an analysis of Historic Fire Regime (HFR) in 2002 and revised it again in 2005 for distribution to land managers and analysts. This report uses those data and GIS layers to represent HFR (NFPCST 2005). These data are used for the analysis of the Historic Fire Regime within the Coeur d'Alene Reservation for this analysis effort.

In the fire-adapted ecosystems of the Upper Columbia Plateau, fire is undoubtedly the dominant process in terrestrial systems that constrains vegetation patterns, habitats, and ultimately, species composition. Land managers seek to understand HFR (that is, fire frequency and fire severity prior to settlement by Euro-Americans) to be able to define ecologically appropriate goals and objectives for an area. Moreover, managers strive to grasp the spatially explicit knowledge of how historic fire regimes vary across the landscape.

Many ecological assessments are enhanced by the characterization of the historical range of variability which helps managers understand: (1) how the driving ecosystem processes vary from site to site; (2) how these processes affected ecosystems in the past; and (3) how these processes might affect the ecosystems of today and the future. Obviously, HFR is a critical component for characterizing the historical range of variability in the fire-adapted ecosystems of the Upper Columbia Plateau. Furthermore, understanding ecosystem departures provides the necessary context for managing sustainable ecosystems. Land managers need to understand how ecosystem processes and functions have changed prior to developing strategies to maintain or restore sustainable systems. In addition, the concept of departure is a key factor for assessing risks to ecosystem components. For example, the departure from historical fire regimes may serve as a useful proxy for the potential of severe fire effects from an ecological perspective.

The Simulated Historical Fire Regime Groups (LANDFIRE HFRG 2006) data layer categorizes simulated mean fire-return intervals and fire severities into five fire regimes defined in the Interagency Fire Regime Condition Class Guidebook (Hann *et al.* 2004). The classes are defined as:

- Fire Regime I: 0 to 35 year frequency, low-to-mixed severity
- Fire Regime II: 0 to 35 year frequency, replacement severity
- Fire Regime III: 35 to 200 year frequency, low-to-mixed severity
- Fire Regime IV: 35 to 200 year frequency, replacement severity
- Fire Regime V: 200+ year frequency, any severity

This data layer is derived from vegetation and disturbance dynamics simulations using LANDSUM (Keane *et al.* 2002, Keane *et al.* 2006, Pratt *et al.* 2006). LANDSUM simulates fire dynamics as a function of vegetation dynamics, topography, and spatial context in addition to variability introduced by dynamic wind direction and speed, frequency of extremely dry years, and landscape-level fire size characteristics. This layer is intended to describe one component of simulated HFR characteristics in the context of the broader historical time period represented by the LANDFIRE Biophysical Settings layer and LANDFIRE Biophysical Settings Model Documentation.

Fire is the dominant disturbance process that manipulates vegetation patterns in the Upper Columbia Plateau. The HFR data were prepared to supplement other data necessary to assess integrated risks and opportunities at regional and subregional scales. The HFR theme was derived specifically to estimate an index of the relative change of a disturbance process, and the subsequent patterns of vegetation composition and structure.

A historical (natural) fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Coarse scale definitions for natural (historical) fire regimes have been developed by Hardy *et al.* (2001) and Schmidt *et al.* (2002) and interpreted for fire and fuels management by Hann and Bunnell (2001).

As the scale of application becomes finer these five classes may be defined with more detail, or any one class may be split into finer classes, but the hierarchy to the coarse scale definitions should be retained.

General Limitations

These data were derived using fire history information from a variety of different sources. These data were designed to characterize broad scale patterns of HFR for use in regional and subregional assessments. Any decisions based on these data should be supported with field verification, especially at scales finer than 1:100,000. Although the resolution of the HFR theme is a 30 meter cell size, the expected accuracy does not warrant their use for analyses of areas smaller than about 10,000 acres (for example, assessments that typically require 1:24,000 data).

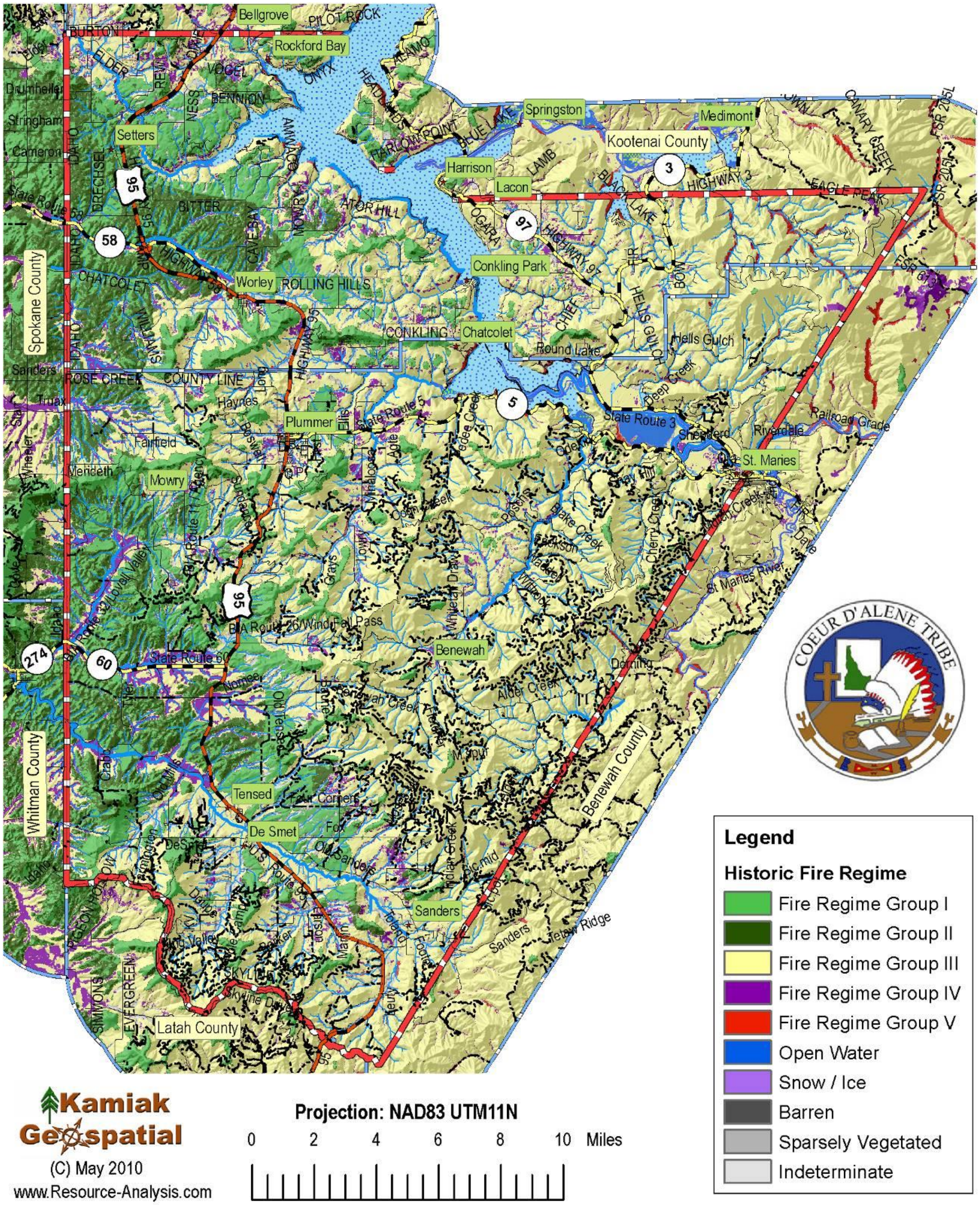
HFR identified in the Coeur d'Alene Reservation are presented in Table 40 and these data labels should be considered nominal data (they are not continuous-scale measurements). The HFR is shown graphically in Figure LXIII.

Table 40. Historic Fire Regime Group Analysis or the Coeur d'Alene Reservation.

Fire Regime	Description	Acres	Percent
Fire Regime Group I	<= 35 Year Fire Return Interval, Low-and-Mixed Severity	52,103	15%
Fire Regime Group II	<= 35 Year Fire Return Interval, Replacement Severity	33,421	10%
Fire Regime Group III	35 - 200 Year Fire Return Interval, Low-and-Mixed Severity	205,727	59%
Fire Regime Group IV	35 - 200 Year Fire Return Interval, Replacement Severity	19,242	6%
Fire Regime Group V	> 200 Year Fire Return Interval, Any Severity	2,086	1%
Water	Water	12,431	4%
Snow / Ice	Snow / Ice	118	0%
Barren	Barren	176	0%
Sparsely Vegetated	Sparsely Vegetated	202	0%
Indeterminate Fire Regime Characteristics	Indeterminate Fire Regime Characteristics	21,953	6%
(LANDFIRE 2007)	Total	347,458	

The most commonly represented HFR on the Coeur d'Alene Reservation (59% of land area, 205,727 acres) is Regime III, characterized by 35 to 200 year fire return intervals and low or mixed severity fires (Table 40). The next most represented historic fire regime is Regime I, characterized by low-or-mixed severity fires of a short interval occurring as frequently as once every 35 years (Table 40).

Figure LXIII. Historic Fire Regime Groups on the Coeur d'Alene Reservation (LANDFIRE 2006).



4.9.6.4. Fire Regime Condition Class

The USFS Northern Fire Plan Cohesive Strategy Team, in Kalispell, Montana, completed an analysis of Fire Regime Condition Class in 2002 and revised it again in 2005 for distribution to land managers and analysts (NFPCST 2005). Since that time, the LANDFIRE (2007) project has revised this analysis substantially to include new and insightful data analysis techniques. These data are used for the analysis of Fire Regime Condition Class (FRCC) on the Coeur d'Alene Reservation for this analysis effort.

A FRCC is a classification of the amount of current departure from the natural fire regime (Hann and Bunnell 2001). Coarse-scale FRCC classes have been defined and mapped by Hardy *et al.* (2001) and Schmidt *et al.* (2001). They include three condition classes for each fire regime. The classification is based on a relative measure describing the degree of departure from the historical natural fire regime. This departure results in changes to one (or more) of the following ecological components: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances (e.g. insect and disease mortality, grazing, and drought). All wildland vegetation and fuel conditions or wildland fire situations fit within one of the three classes.

The three classes (nominal data) are based on low (FRCC 1), moderate (FRCC 2), and high (FRCC 3) departure from the central tendency of the natural (historical) fire regime (Hann and Bunnell 2001, Hardy *et al.* 2001, Schmidt *et al.* 2002). The central tendency is a composite estimate of vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated natural disturbances. Low departure is considered to be within the natural (historical) range of variability, while moderate and high departures are outside this range.

Characteristic vegetation and fuel conditions are considered to be those that occurred within the natural (historical) fire regime. Uncharacteristic conditions are considered to be those that did not occur within the natural (historical) fire regime, such as invasive species (e.g. weeds, insects, and diseases), "high-graded" forest composition and structure (e.g. large trees removed in a frequent surface fire regime), or repeated annual grazing that maintains grassy fuels across relatively large areas at levels that will not carry a surface fire. Determination of the amount of departure is based on comparison of a composite measure of fire-regime attributes (vegetation characteristics; fuel composition; fire frequency, severity and pattern) to the central tendency of the natural (historical) fire regime. The amount of departure is then classified to determine the FRCC. A simplified description of the FRCC and associated potential risks are presented in Table 41. FRCC is displayed graphically in Figure LXIV.

Table 41. Fire Regime Condition Class Definitions.

Fire Regime Condition Class	Description	Potential Risks
FRCC I	Sites are determined to be within the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation and fuel characteristics. Composition and structure of vegetation and fuels are similar to the natural (historical) regime. Risk of loss of key ecosystem components (e.g. native species, large trees, and soil) is low.
FRCC II	Moderate departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	Fire behavior, effects, and other associated disturbances are moderately departed (more or less severe). Composition and structure of vegetation and fuel are moderately altered. Uncharacteristic conditions range from low to moderate. Risk of loss of key ecosystem components is moderate.
FRCC III	High departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	Fire behavior, effects, and other associated disturbances are highly departed (more or less severe). Composition and structure of vegetation and fuel are highly altered. Uncharacteristic conditions range from moderate to high. Risk of loss of key ecosystem components is high.

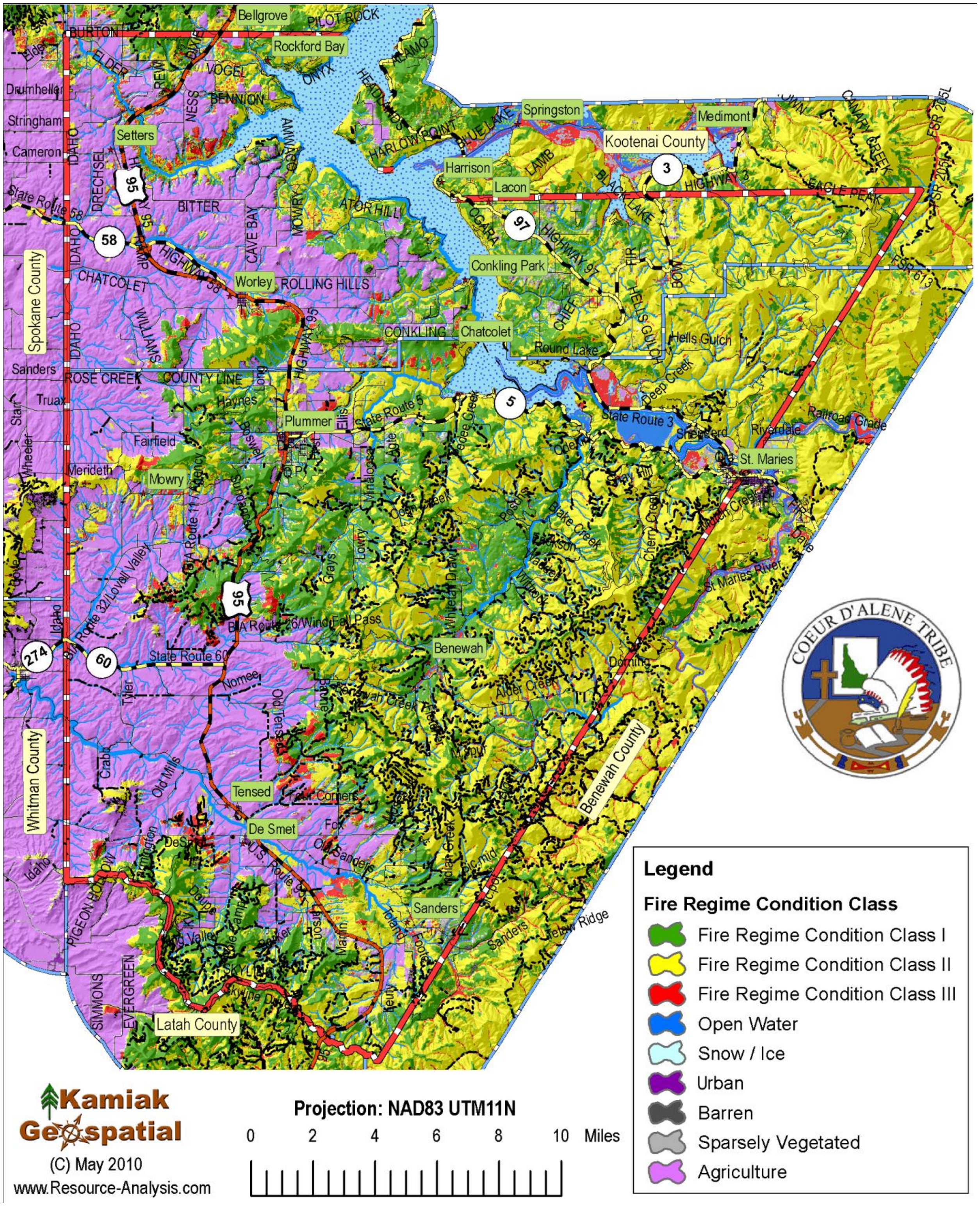
An analysis of FRCC on the Coeur d'Alene Reservation shows that approximately 21% of the land area is in FRCC I (low departure from historical), just about 37% is in FRCC II (moderate departure), with 5% of the area in FRCC III (Table 42).

Table 42. FRCC by Area on the Coeur d'Alene Reservation.

Fire Regime Condition Class		Acres	Percent of Area
Fire Regime Condition Class I	Low Vegetation Departure	72,508	21%
Fire Regime Condition Class II	Moderate Vegetation Departure	129,737	37%
Fire Regime Condition Class III	High Vegetation Departure	15,922	5%
Water		12,428	4%
Snow / Ice		120	0%
Urban		1,488	0%
Barren		158	0%
Sparsely Vegetated		160	0%
Agriculture		86,717	25%
Indeterminate Fire Regime Characteristics		28,220	8%
(LANDFIRE 2007)	**Total**	**347,458**	

These data represent a substantial adjustment to the USFS Northern Fire Plan Cohesive Strategy Team (Kalispell, Montana) analysis of Fire Regime Condition Class in 2002 (NFPCST 2005). The LANDFIRE (2007) data used in this analysis provide a substantially improved analysis basis and updated input data, leading to a better assessment of derivative data for both HFR and FRCC.

Figure LXIV. Fire Regime Condition Class on the Coeur d'Alene Reservation (LANDFIRE 2006).



4.9.6.5. Application of Assessment Tools Presented

The introduction of this section included a statement that each wildfire analysis tool has an appropriate application for illuminating different wildfire management questions. Mean Fire Return Interval, HFR, and FRCC were developed by the federal land management agencies (LANDFIRE 2007) in order to quantify vegetation characteristic departures from historical conditions. These assessments become extremely valuable tools in ecosystem restoration efforts when attempting to return the natural cycle of vegetation, fire, wildlife, soil and water processes, and other ecosystem management questions. Neither Historic Fire Regime nor Current Condition Class can be taken independently from the other; they are an integrated set of analysis tools.

The Fire Prone Landscapes assessment tool was developed specifically to address WUI wildfire risk challenges. This tool is not intended to illuminate the departure from historical conditions. This tool sheds a light of understanding on fire risk based on topographic and vegetative conditions. Where areas possess a high risk rating and those high risk ratings are continuous over large areas (seen as a large “splash of red” on the maps - Figure LXII) surrounding or adjacent to homes and infrastructure, a wildfire risk is interpreted.

4.9.7. Probability of Future Events

The probability of future wildfire events can be interpreted from the Mean Fire Return Interval analysis and the Fire Prone Landscape numbers. The Mean Fire Return Interval assessment considers the historical return interval over a long period (10,000 years) of estimated fire occurrence. Current conditions are not directly integrated into this analysis for determining current probability of wildfire return.

Fire Prone Landscapes can be used to estimate the probability of future wildfire return. In order to put these numbers in terms of probability of occurrence, the FPL rating score can be modified to represent a probability of a wildfire event occurring during a given period of time. The lower the FPL rating score, the lower the probability of witnessing a wildfire event in that area. Directly, the FPL rating score can be converted to a probability by stating the relative score as a probability of occurrence within a 50-year period. Using the conversion defined by the Extreme Value Theory (Castillo 1988), the 50-year wildfire probability event would be stated as the FPL rating score converted to a percent. Thus, a FPL rating score of 25 would represent a 25% probability of witnessing a 50-year wildfire event. This conversion is intended for illustrative purposes only and the actual probability of occurrence may differ from these estimates.

Further extrapolation of these data can be made in order to better understand the probability of future wildfire events on the Coeur d’Alene Reservation. If the site is left undisturbed and unmitigated, the risk of future wildfire events for each area evaluated can be estimated by the risk rating score expressed as a percent (rating score of 15, expressed as 15%). This modified score can then be treated as an expression of the likelihood of that area experiencing a wildfire event within the next 50-year period. Of course, mitigation measures can be expected to decrease the likelihood of large-scale wildfire events.

The probability of wildfire events within the Coeur d’Alene Reservation is moderate to high and greatly dependant on topography, soils, lightning ignitions, and human ignited wildfires. This places specific areas within the Coeur d’Alene Reservation likely to experience damages due to wildfires.

Ordinarily, the Coeur d’Alene Reservation is expected to experience wildfire events to a high frequency (occurrence of multiple ignitions every year).

4.9.8. Resources at Risk

Using the approach implemented for assessing flood-risk exposure on the Coeur d'Alene Reservation, the value of resources at risk to wildfires has been completed. The FPL risk-rating score was assigned to each structure (private and non-private) on the Coeur d'Alene Reservation, then grouped in reference to the closest community location. The individual structure values were summed together in these groups to reveal structural values that are at risk to landslides (tracking the Fire Prone Landscape scores).

The modal score (value of the dataset mode – analogous to the mean) for these values was determined for each structure on the Coeur d'Alene Reservation. These "risk scores" for each structure were grouped into consolidated risk categories in units arranged for every tenth score. Thus, the consolidated risk score of 5 is the lowest-risk category (0-10), and is followed by consolidated-risk category 15 (10-20), then 25 (20-30), and so forth. The higher the consolidated risk category, the higher the comparative risk to structures.

Next, community closeness was determined for each structure (the closest community place), placing each in only one community area based on location. These structure risk values were summed by community area to record the value of assessed improvements linked with the FPL modal score. The resulting tabular summary provides insights to where risks are present in combination with improvement values (Table 43, Table 44, Figure LXV).

It is important to understand that the risk assessment is not considering the structure to be at-risk. The risk analysis is considering the risk on the land where the structure is located. Through reasoning, it can be extrapolated that the land's risk rating will translate directly to the risk of the structure or structures on the land.

The results of this analysis demonstrate that 28% of the privately owned structure value on the Coeur d'Alene Reservation is located within the FPL risk-rating score of 40-50 (the modal score for all private structures); 869 structures with a value of approximately $84.6 million (Table 43, Figure LXV). Approximately, 1,160 privately owned structures with a total appraised value of roughly $108.2 million are located on sites with higher FPL risk rating scores. Conversely, 1,550 privately owned structures, with an appraised value of $105.7 million, are located on sites with lower FPL scores (Table 43, Figure LXV).

The majority of non-privately owned structures on the Coeur d'Alene Reservation, are located on lower FPL risk-rated sites than the privately owned structures. Based on the location of the non-privately owned structures, approximately 59% of the value of these structures (56 structures) are located on the lowest FPL risk-rating score of 0-10 (Table 44, Figure LXV). Only 75 structures, with an estimated value of $37.0 million are located on sites scoring 40 and higher on the FPL risk-rating scale.

Both the privately owned and non-privately owned structures face the same challenges of being located on sites exhibiting increased FPL risk-rating scores (Table 43, Table 44). The highest priority for fuels mitigation in the short-term should be to assess the structures located on the highest-ranked FPL risk-score sites. There are approximately 62 privately owned structures with a value of roughly $4.9 million located on sites with a FPL risk-rating score above 70. Immediate assessment and determination of appropriate mitigation measures should be conducted and then acted on for WUI mitigation measures. The same principle should be applied to the sites with structures within the FPL risk-rating score of 60-70, where 463 privately owned structures with a value of $42.2 million, and 14 non-privately owned structures valued at $18.7 million are located. By progressing through this list for all structures as the FPL risk-rating scores decrease, the ability to prioritize WUI treatments will be most effective.

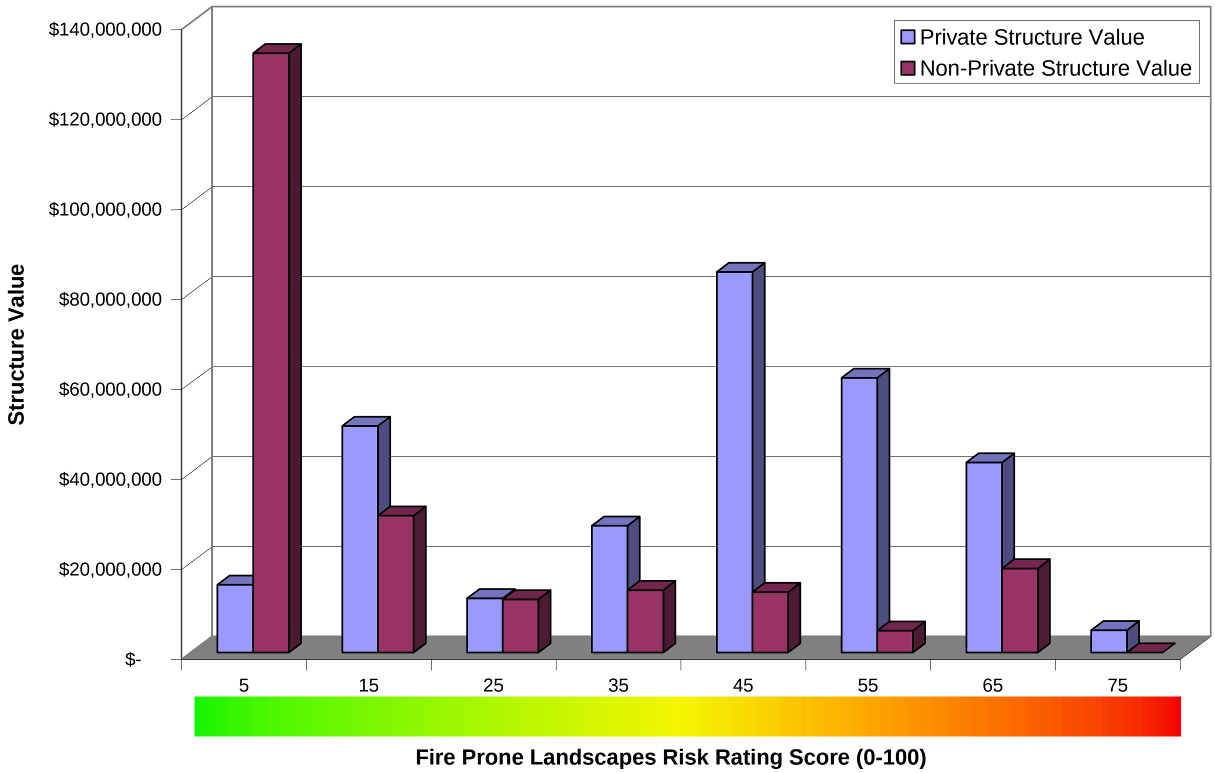
Table 43. Fire Prone Landscapes Risk Rating (0-100) for private structures, arranged by Community.

Community Name	0-10 (5)	10-20 (15)	20-30 (25)	30-40 (35)	40-50 (45)	50-60 (55)	60-70 (65)	70+	Number of Structures
	Fire Prone Landscape Risk Rating (0-100)								
BELLGROVE	$-	$-	$-	$157,503	$357,209	$335,910	$2,020	$-	28
BENEWAH	$219,805	$5,480,523	$2,937,542	$1,638,128	$5,600,654	$3,918,821	$1,963,020	$-	179
CHATCOLET	$595,480	$6,396,732	$2,512,279	$3,751,419	$5,977,489	$2,465,782	$1,070,032	$-	183
CONKLING PARK	$543,670	$6,030,560	$1,283,954	$3,201,640	$11,427,267	$2,216,035	$1,235,059	$162,990	233
DE SMET	$33,630	$541,892	$41,250	$528,069	$862,118	$102,750	$-	$-	47
HARRISON	$53,160	$5,632,432	$1,463,352	$3,614,857	$4,598,170	$4,587,124	$1,093,025	$-	171
LACON	$-	$-	$157,070	$1,114,330	$3,683,080	$3,036,697	$712,379	$80,450	108
MEDIMONT	$1,228,710	$6,107,954	$237,889	$3,718,469	$4,570,073	$958,191	$243,930	$-	145
MOWRY	$1,056,633	$1,503,730	$212,320	$88,090	$80,450	$95,220	$-	$-	65
PLUMMER	$7,119,760	$20,867,334	$3,130,837	$2,435,095	$8,304,814	$4,236,772	$1,829,960	$-	494
ROCKFORD BAY	$5,149,870	$12,113,994	$704,952	$4,803,880	$13,658,915	$13,301,877	$15,473,487	$2,008,009	703
SANDERS	$231,930	$172,279	$473,260	$33,440	$1,131,465	$3,179,172	$1,543,222	$318,510	97
SETTERS	$1,479,330	$70,700	$-	$-	$710,821	$2,214,196	$1,444,632	$58,090	89
ST. MARIES	$2,950,760	$8,221,043	$2,233,016	$9,108,069	$21,328,254	$10,129,247	$12,954,560	$3,565,710	719
TENSED	$132,380	$1,460,368	$1,287,990	$3,836,399	$2,502,346	$1,327,419	$1,415,794	$149,470	127
WORLEY	$3,976,326	$14,855,203	$1,401,514	$29,969	$316,976	$1,843,457	$564,442	$125,610	190
Count	**215**	**800**	**170**	**365**	**869**	**634**	**463**	**62**	**3,578**
Value	**$15,064,119**	**$50,368,865**	**$12,037,597**	**$28,195,198**	**$84,589,001**	**$61,053,177**	**$42,229,433**	**$4,944,377**	**$298,481,767**

Table 44. Fire Prone Landscapes Risk Rating (0-100) for non-private structures, arranged by Community.

Community Name	0-10 (5)	10-20 (15)	20-30 (25)	30-40 (35)	40-50 (45)	50-60 (55)	60-70 (65)	70+	Number of Structures
	Fire Prone Landscape Risk Rating (0-100)								
AGENCY	$9,531	$209,000	$-	$753,572	$2,000	$4,000	$12,000,000	$-	7
CHATCOLET	$-	$-	$-	$-	$-	$6,000	$2,000	$-	4
CONKLING PARK	$1,734,500	$45,000	$-	$-	$2,000	$-	$-	$-	5
DESMET	$110,527,454	$6,107,699	$626,100	$588,896	$541,654	$690,700	$285,970	$-	42
HARRISON	$-	$344,754	$-	$-	$23,328	$-	$-	$-	5
HEYBURN STATE PARK	$924,000	$1,133,340	$-	$41,990	$-	$95,025	$-	$-	13
LACON	$3,246,000	$1,265,000	$-	$-	$-	$-	$-	$-	2
MOWRY	$3,987,740	$-	$-	$-	$-	$-	$-	$-	2
PLUMMER	$9,608,758	$5,956,153	$9,513,617	$9,894,004	$11,033,807	$3,156,000	$6,300,000	$-	96
ROCKFORD BAY	$-	$5,686,425	$-	$304,000	$304,000	$-	$90,000	$-	9
SANDERS	$-	$-	$-	$152,000	$152,000	$-	$-	$-	2
SETTERS	$-	$152,000	$-	$-	$-	$-	$-	$-	1
ST. MARIES	$152,000	$1,976,000	$152,000	$1,368,000	$760,000	$152,000	$-	$-	30
TENSED	$304,000	$543,300	$-	$-	$456,000	$456,000	$-	$-	13
WORLEY	$2,736,000	$6,992,000	$1,520,000	$760,000	$152,000	$304,000	$-	$-	82
Count	**56**	**116**	**26**	**40**	**35**	**26**	**14**	**0**	**313**
Value	**$133,229,983**	**$30,410,671**	**$11,811,717**	**$13,862,462**	**$13,426,789**	**$4,863,725**	**$18,677,970**	**$-**	

Figure LXV. Fire Prone Landscapes Risk Rating (0-100) arranged by group scores and ownership category.



4.9.9. Potential Mitigation Activities

For many decades in the 20th century the policy of the BIA, USFS, and other agencies, was to suppress all wildfires. This policy was epitomized by the mascot Smokey Bear and was also the basis of parts of the Disney produced Bambi movie. The previous policy of absolute fire suppression in the United States has resulted in the higher-than-historical buildup of fuel in some ecosystems such as dry ponderosa pine forests. In acute cases, forest species composition has transitioned from a fire tolerant species mix of ponderosa pine, lodgepole pine, Douglas-fir, and western larch, to a mixture of these species plus a substantial component of grand fir. When fire is suppressed long enough, grand fir forests can dominate these sites. Grand fir has a significantly different fire-response profile than the species it replaces and also provides substantially altered ecosystem mechanisms for wildlife, watersheds, fisheries, and biodiversity. This example provides only a small insight to the forest ecosystem changes across the Upper Columbia Plateau brought about by 20th century fire management policies.

In addition to the loss of human life from direct firefighting activities, homes designed without consideration of the fire prone environment in which they are built have been a significant reason for the catastrophic losses of property and life experienced in wildfires.

The risk of major wildfires can be reduced partly by a reduction or alteration of fuels present. In wildland areas, reduction can be accomplished by various methods: first, conducting controlled burns (prescribed burning); second, the alteration of fuel mechanics, which involves reducing the structure of fuel ladders. Fuel alteration can be accomplished by hand crews with chainsaws or by large mastication equipment that shreds trees and vegetation to a mulch. Another method is changing the vegetative component by replacing vegetation with less fire-susceptible species. Such techniques are effective within the WUI.

People living in fire prone areas can take a variety of precautions, including building their homes out of flame-resistant materials, reducing the amount of combustible fuel near the home or property (including firebreaks, effectively their own miniature control lines), and investing in their own firefighting tools (hand tools, water tanks, pumps, and fire-hose). Rural farming communities are also often threatened directly by wildfire. Expanding urban fringes have spread into forested areas, and communities have literally built themselves in the middle of highly flammable forests.

In 2004, the Coeur d'Alene Tribe developed and in 2005 adopted a Coeur d'Alene Reservation Fire Management Plan. This plan was developed to provide direction and continuity and to establish operational procedures to guide all wildland fire program activities to ensure that fire is properly used as a means of resource management. The Fire Management Plan presents actions that will integrate fire management with resource management goals. This plan will be evaluated and updated in future years as required by changes in policy, management actions, and priorities.

Planning objectives for Fire Management during 1995-2005 planning period included:

A. Continue to maintain adequate wildfire suppression capabilities,
B. Utilize prescribed fire at a level consistent with goals of the Tribe,
C. Enhance interagency fire cooperation on a regional and national level,
D. Provide employment opportunities,
E. Integrate fire and fuels management into all timber-sale activities,
F. Implement the National Fire Management Analysis System (NFMAS), to help minimize loss and cost in wildland fire program.

That plan identified several potential mitigation activities to reduce the risk of loss of life, destruction of homes and other structures, and the disruption of the local economy, and to facilitate the maintenance of a healthy forestland environment.

A major emphasis in that plan was the creation of defensible spaces around homes and neighborhoods to increase the success potential of fire fighters in the case of wildfire emergency. This reduction of the "resistance to control" focused primarily on removing vegetation immediately adjacent to homes, improving ingress and egress, and replacing flammable structure materials with fire-resistant materials (e.g., decks and roofing).

Since that plan's adoption, implementation has been targeted and effective. Homes have been "protected".

4.9.10. Protection

A key component in meeting the underlying wildfire control need is the protection and treatment of fire hazard in the WUI. These WUI areas encompass not only the interface (areas immediately adjacent to urban development), but also the continuous slopes and fuels that lead directly to a risk to urban developments. Reducing the fire hazard in the WUI requires the efforts of federal, state, and local agencies and private individuals (Norton 2002). "The role of [most] federal agencies in the WUI includes wildland fire fighting, hazard fuels reduction, cooperative prevention and education, and technical experience. Structural fire protection [during a wildfire] in the WUI is [largely] the responsibility of tribal, state, and local governments" (Norton 2002). Property owners share a responsibility to protect their residences and businesses and minimize fire danger by creating defensible areas around them and taking other measures to minimize the fire risks to their structures. With treatment, a WUI area can provide firefighters a defensible area from which to suppress wildland fires or defend communities. In addition, a WUI that is properly thinned will be less likely to sustain a crown fire that enters or originates within it (Norton 2002).

Tools are available to emergency service responders and managers to assess wildfire fuels, structural risks, and infrastructure components. Computer programs such as RedZone® Software are written to assist fire departments and emergency services efforts to assess individual structures, communities, and regions to understand relative risk components of wildfire exposure and delineate these components of risk in a GIS map. RedZone Software's suite of products provides agencies a comprehensive solution to data collection, visualization, and map production (Red Zone Software 2009).

By reducing hazardous fuel loads, ladder fuels, and tree densities, creating new defensible space, and reinforcing existing defensible space, landowners would protect the WUI, the biological resources of the management area, and adjacent property owners by:

- Minimizing the potential of high-severity surface, ladder, and crown fires entering or leaving the area around homes.
- Reducing the potential for firebrands (embers carried by the wind in front of the wildfire) impacting the WUI. Research indicates that flying sparks and embers (firebrands) from a crown fire can ignite additional wildfires as far as 1¼ miles away during periods of extreme fire weather and fire behavior (Norton 2002).
- Improving defensible space in the immediate areas for suppression efforts in the event of wildland fire.

Figure LXVI. Beaver dam pond and den upstream of the Plummer Forest Products facility.