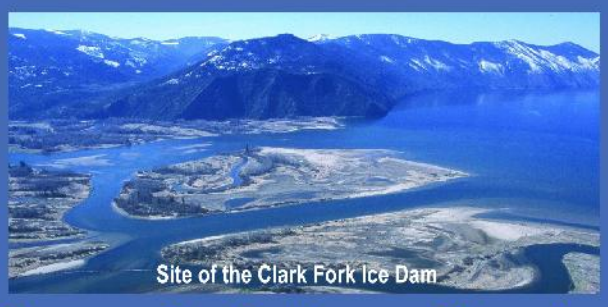

Coeur du Deluge Chapter

Sandpoint, Idaho

Coeur du Deluge is a chapter of the Ice Age Floods Institute (IAFI) whose 11 chapters are dedicated to the study and public education of the natural events that sculpted this region and the geological wonders that surround us through public displays, presentations and field trips.

Coeur du Deluge translates as "heart of the flood" and signifies the importance of the Ice Age Floods that reshaped and still impact the physical and cultural landscape of Montana, Idaho, Washington and Oregon.

Along with the many Ice Age Floods-related features found in North Idaho, the advance and retreat of the Continental Glacier from Canada scratched, scraped, filled, and eroded the area, leaving glacial, glacio-fluvial and lacustrine features.

The North Idaho area is also known for its extensive geologic history, with rocks dating back 2.6 billion years, tectonic folding, faulting and regional uplift, deep seated, slowly cooled granites and shallower, fast-cooling basalt flows.

The uniqueness of the Ice Age Floods and their impact on land use, transportation, vegetation, water resources and the overall regional economy has led to the establishment of the Ice Age Floods National Geologic Trail to highlight the flood features and to raise the public awareness of the genesis and richness of the region.

For more information on the Ice Age Floods, the Ice Age Floods Institute, and/or the Coeur du Deluge Chapter in Sandpoint, ID, please visit the IAFI website (www.iafi.org) or email us at cdd.iafi@gmail.com.

Key resources for understanding the impacts of the Ice Age Floods:

On the Trail of the Ice Age Floods

by Bruce Bjornstad and Eugene Kiver
Keokee Co. Publishing, Inc.

FOLLOWING THE PATHWAY

During the last glacial cycle of the Ice Age some 80,000 to 14,000 years ago, continental glaciers and repeated massive floods greatly transformed the landscape of the Inland Northwest.

North Idaho is an area where the impact of ice-age floods was first felt. Evidence abounds for these almost incomprehensibly gigantic floods, as it does for both erosional and depositional glacial activity.

This is your local guide to dramatic evidence of those ice-age floods and of the advances and retreats of the ice-age glaciers.

It is our hope that you will use this guide to explore this fascinating landscape, and that it entices you to learn more about the dramatic Ice Age Floods story.

OF THE GREAT FLOODS

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Learn MORE at IAFI.org or facebook.com/IceAgeFloods

A GUIDE TO THE INCREDIBLE ICE AGE FLOODS IN NORTHERN IDAHO

Our Cataclysmic Floodscape

DETAILED MAP INSIDE

Highlighting Day Trips to prominent ice-age flood features in the Idaho Panhandle area

A regional guide to geological evidence of the GREAT ICE AGE FLOODS that powerfully sculpted vast areas of the Inland Northwest's physical and cultural landscapes

Interesting Flood Facts!

The glacial ice dam that blocked the Clark Fork River was over 2,000 feet tall, several miles wide, well over 35 miles long and it impounded over 500 cubic miles of water in Glacial Lake Missoula – equal to lakes Erie and Ontario combined.

When the ice dam holding back Glacial Lake Missoula failed, the floodwaters raced out at a rate greater than 10 times the combined flow rate of all the rivers in the world today, travelling all the way to the Pacific Ocean in approximately two weeks.

Periodically this ice dam would advance and retreat resulting in another epic-sized Ice Age Flood. The number of times this cycle took place is still being investigated but it may have occurred up to 100 times.

Regional-sized ancestral glacial lakes were formed, drained, and reformed multiple times.

Icebergs with huge embedded boulders floated hundreds of miles on the floodwaters before they ran aground, melted and left erratics scattered across our landscape where they are still visible today throughout the flood path.

These Ice Age floodwaters scoured, transported and deposited gigantic amounts of flood debris across the Pacific/Inland Northwest, creating Giant Current Dunes, the Spokane Valley/Rathdrum Prairie Aquifer, the Cheney-Palouse Scabland, Palouse Falls, Grand Coulee, Dry Falls, the soil that fills the Willamette Valley, a large underwater delta deposit in the Pacific Ocean and many other individual and regional features that are not only interesting, but made major impacts on the physical, cultural and economic landscape in which we live.

Thousands of square miles of fertile Palouse soil, in places over 200 feet deep, were stripped off and deposited as far away as Oregon's Willamette Valley and the ocean floor off Oregon and northern California.

The Story of the Great Ice Age Floods

During the peak of the last Ice Age, a vast Cordilleran continental ice sheet covered southwestern Canada and the northern parts of Washington, Idaho and Montana. The eastern Purcell lobe of the ice sheet descended into the Idaho panhandle, blocking the Clark Fork River with an ice dam thousands of feet thick.

Water rising behind the dam flooded the valleys of Montana creating Glacial Lake Missoula – a great inland lake stretching over 200 miles to the east with a volume of water greater than Lake Erie and Lake Ontario combined.

Ice decay and rising lake levels periodically caused the ice dam to fail, resulting in sudden, cataclysmic floods that rushed across northern Idaho and the Channeled Scablands of eastern and central Washington, through the Columbia River Gorge, and into Oregon's Willamette Valley, before emptying into the Pacifc Ocean at the ancient mouth of the Columbia River. Glacial Lake Missoula would have drained in just a few days as a volume of floodwaters greater than all the rivers of the world combined roared across the landscape at up to 60+ mph.

Now imagine this happening not once but dozens, perhaps even hundreds of times as the advancing continental glacier built a new ice dam!

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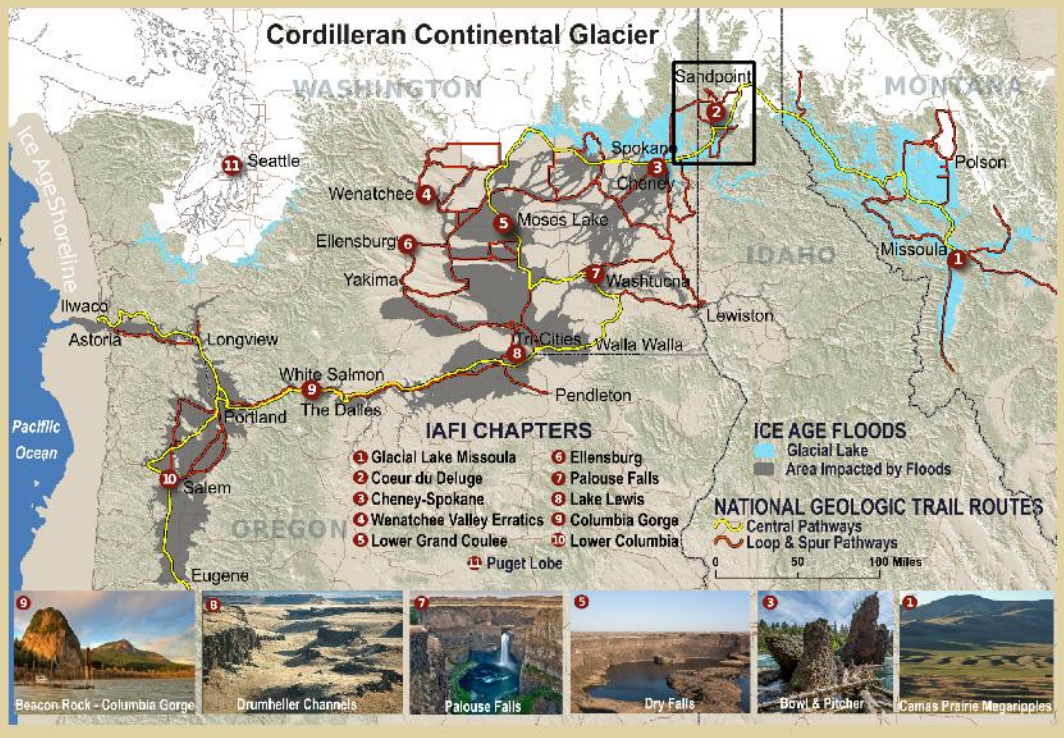
ICE AGE FLOODS NATIONAL GEOLOGIC TRAIL

Ice Age Floods National Geologic Trail

Since the 1990's the Ice Age Floods Institute (IAFI) has worked to create and to build support for the Ice Age Floods National Geologic Trail.

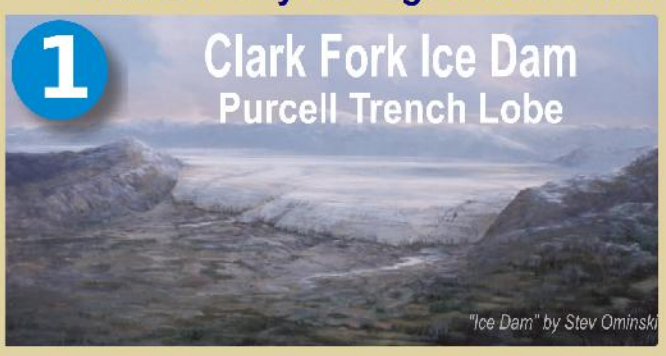
The Ice Age Floods National Geologic Trail is essentially a network of marked touring routes extending across parts of Montana, Idaho, Washington, and Oregon, with several special interpretive centers located throughout the region. Many interested parties are being brought together in a collaborative and effective interpretive program at a remarkably low cost, despite the extraordinary size of the region.

The Trail is being developed under the National Park Service on existing public lands, with no changes in jurisdiction and no threats to private property rights. The role of the National Park Service is to coordinate and manage the planning of the project and the telling of the story, without taking custodianship of public and private lands.



Explore Prominent Ice Age Flood Features in North Idaho

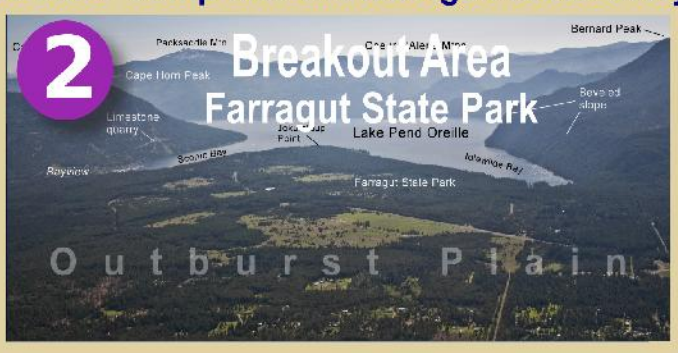
Discover why our region is like nowhere else. Jump into the Ice Age Floods story with a DRIVE/HIKE/LEARN day tour



THIS IS WHERE IT ALL BEGAN! The Purcell Trench Ice Lobe originated in Canada and flowed south into Idaho guided by the structural control of the Purcell Trench. Following the path of least resistance into the basin now occupied by Lake Pend Oreille, it was impeded by the Green Monarch Ridge located approximately 10 miles south of the Geologic Viewpoint on Idaho State Highway 200 one mile west of Hope, ID. Grinding and scraping, the Purcell Trench Ice Lobe backed up behind the Green Monarch Ridge, eventually building an ice plug up to 4,000 feet thick that scoured, deepened and filled what is now Lake Pend Oreille.

The Purcell Trench Ice Lobe divided into four sub-lobes: one went approximately west (US Highway 2), two went south (US Highway 95 and Lake Pend Oreille basin) and one went east (Idaho State Highway 200). This damming effect resulted in the formation of Glacial Lake Missoula, the source of the waters for the Ice Age Floods. All four sub-lobes contributed to blocking the Clark Fork River drainage and controlled the number, the magnitude and initial paths of these humongous floods.

Other features in the vicinity include: glacial scour marks along SH-200; glacial scour marks and current dunes along River Road (approx. 3.5 miles west of Clark Fork); rhythmites (approx. 8 miles north of Clark Fork); the Purcell Trench extending north from Sandpoint through Bonners Ferry to Canada (also the main route of US-95); and great views from Schweitzer Mountain (approx. 8 miles outside of Sandpoint, ID) of the Purcell Trench, Lake Pend Oreille, glacially formed lake fjords on Sagle Peninsula, the Cabinet Mountains, the Green Monarch Ridge, and the mouth of the Clark Fork River.



Farragut State Park is located at the "breakout" area of Glacial Lake Missoula Ice Age floods. Failure of the ice dam (an over 2,000-foot-thick tongue of ice extending over 10 miles up the Clark Fork River drainage and over 25 miles south occupying the Lake Pend Oreille basin) released 530 cubic miles of water from Glacial Lake Missoula in approximately three days. Churning flood waters flowed across Farragut State Park. Nearly all the water escaping from Glacial Lake Missoula passed through this breakout area. A slurry of water, ice, trees, boulders and other debris probably over 2,000 feet high erupted from the south end of the present-day Lake Pend Oreille. An extensive, heterogeneous mixture of flood-debris transporting sand, giant boulders, icebergs, Pleistocene flora and fauna, etc. flushed through the breakout area and was rapidly deposited, forming the Rathdrum Prairie Outburst Plain. Discharge estimates range from 500 to 750 million cubic feet per second.

In addition to the Flood Breakout Area and Lake Pend Oreille, other local geologic features left by glaciation and the mega floods include: lateral moraines, Jökulhlaup Point, kettles, Hoodoo Channel, Athol flood bar, upper portions of the Rathdrum Prairie–Spokane Valley Aquifer, pendant bars, erratics, car sized flood boulders, and Round Mountain.

Hoodoo Channel is an abandoned outlet of Lake Pend Oreille that provided a pathway for late-glacial meltwater and for the last outbursts from Glacial Lake Missoula. The channel is marked with classic river terraces and several closed depressions resulting from burial and subsequent melting of icebergs (kettles) or turbulent flood flow.

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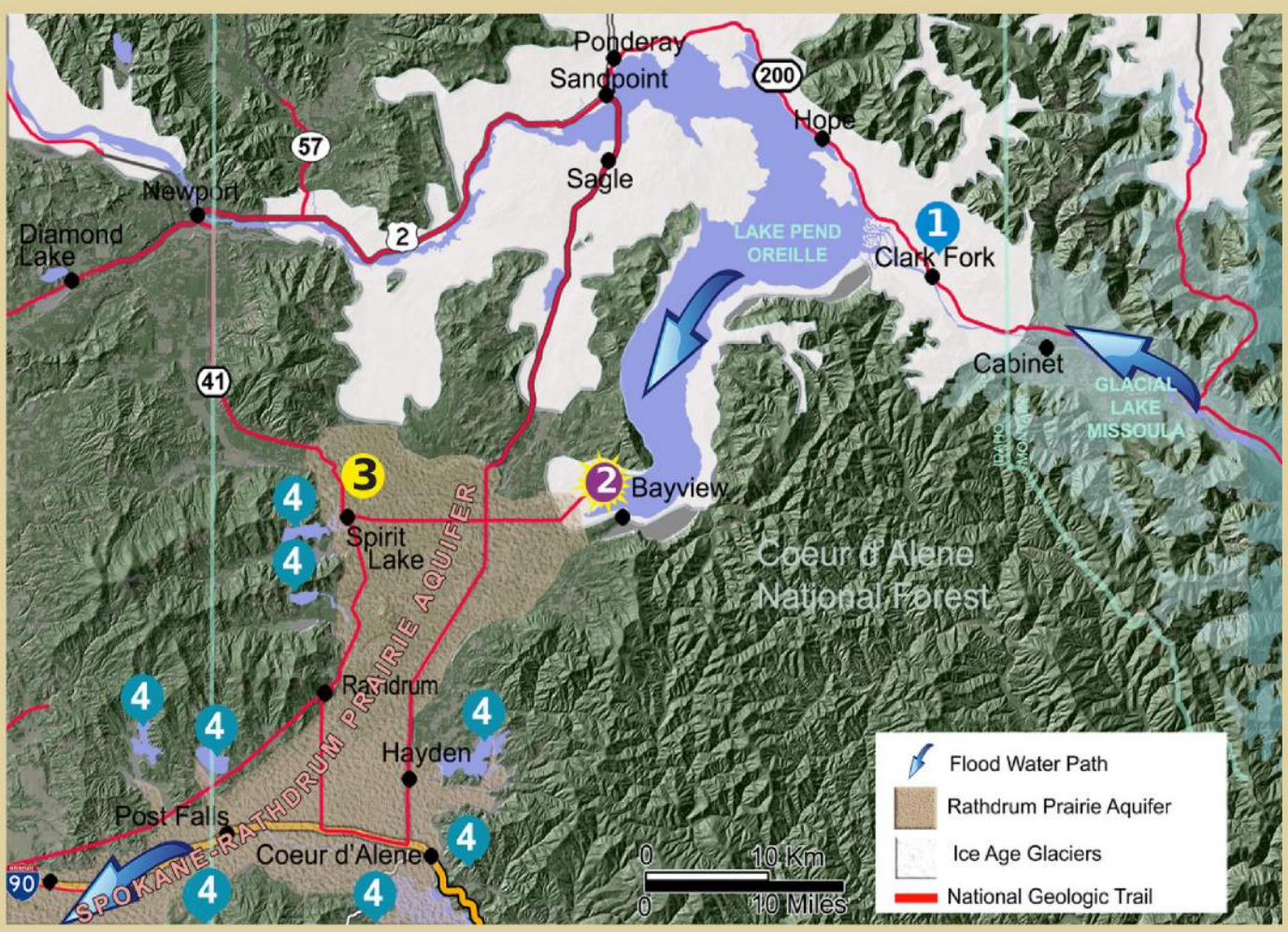
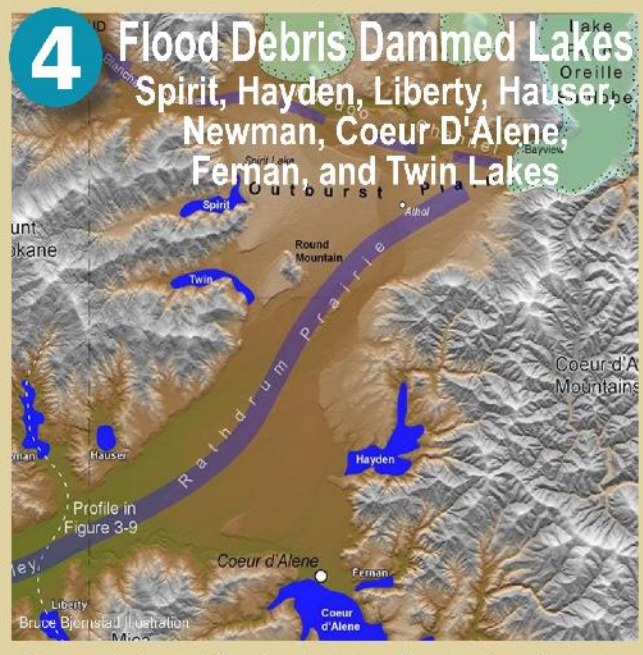
One of Bretz's most important pieces of evidence for catastrophic flooding was the "**giant current dunes**". These large-scale fluvial bedforms appeared as patterns of parallel ridges and swales on many aerial photographs in the flood channels throughout the area impacted by the Ice Age Floods. These current dunes had escaped recognition from the ground because of their large size.

The Giant Current Dunes formed transverse to the current direction with arms that pointed downstream and the size of the cusps increased as the velocity of the flood water increased. Giant Current Dunes exhibit an asymmetrical profile with the downstream (lee) slope steeper than the upstream slope indicating the direction of flow. Crests range from 20 to 200m apart and heights range from 1 to 15m and are among the larger current dunes found throughout the Ice Age Floods area. Internally these dunes consist of gravel and pebbles. The Spirit Lake current dunes can be easily recognized from the air by their characteristic pattern accentuated by vegetation. The wavelength (distance from crest to crest) of these dunes is easily measured along SH-54 as the crests are often the site of a telephone pole. This dune field is immediately in the path of the breakout from Lake Pend Oreille and experienced extremely high energy flows.

Other flood related features near Spirit Lake are a Pendant Bar and exceptionally large erratic boulders on the downstream side of Round Mountain. One of the largest glacial erratics in the area (estimated to be over 1,600 tons) is located on the eastside of SH-41 about 2.5 miles south of the town of Spirit Lake.





The explosion of the debris-laden flood waters from the south end of Lake Pend Oreille extended beyond the Flood Breakout Area mentioned previously. Flood water transported rocks, boulders, sand, gravel, trees, icebergs, and yes, possibly Pleistocene Flora and Fauna towards the south and southwest, filling the valley all the way to Spokane. These flood deposits eventually formed earthen dams that blocked the drainage basins along the two sides of the valley. Eight lakes formed behind these naturally created earthen dams and are presently known as Spirit, Twin, Hauser and Newman Lakes along the NW margin of the Ice Age flood deposits and Hayden, Fernan, Coeur d'Alene and Liberty Lakes along the SE margin of the Ice Age flood deposits. The discharge from most of these lakes is subsurface, with a few supporting short surface streams. The exception is Lake Coeur d'Alene which serves as the headwaters of the Spokane River.

All these Flood Debris Dammed Lakes provide outdoor recreation opportunities for many Idaho and Washington residents. They also help to replenish the Spokane Valley-Rathdrum Prairie Aquifer.

Part of the massive amount of Ice Age Flood sediments (sand, gravel and boulders) was deposited in the floodway extending from the south end of Lake Pend Oreille to several miles past Spokane, WA, forming what is collectively called the Spokane Valley-Rathdrum Prairie Aquifer (aka, SVRP Aquifer).

The surface of this dog-leg right shaped flood deposit covers over 370 square miles in two states (Idaho and Washington). Over 210 square miles of this aquifer is in Idaho and makes up the Rathdrum Prairie Aquifer. The coarseness of these flood deposits allows water to easily flow in the direction of gravity. The top of this underground aquifer is generally found 100 or more feet below the surface, and in selected areas it is over 800 feet thick.

The importance and location of these flood deposits as a hydrologic feature, an aquifer, cannot be overestimated. Discovered in 1894, the SVRP Aquifer is the primary source of water for most people (over 500,000) in towns and cities in Kootenai County, ID and Spokane County, WA. However, its importance goes further than providing residential, agricultural and industrial water for the area because without these Ice Age Flood deposits and the resultant SVRP Aquifer, Spokane would not exist. Nor would Coeur d'Alene, Sandpoint and many of the other towns in North Idaho and NE Washington..

Find an interactive map and additional details about these and other Ice Age features online at https://iafi.org/floodscapes/