Ice Age Floods

Study of Alternatives and Environmental Assessment

Following the Pathways of the Glacial Lake Missoula Floods—*February 2001*

United States Department of the Interior

NATIONAL PARK SERVICE
Pacific West Region
1111 Jackson Street, Suite 700
Oakland, California 94607

IN REPLY REFER TO:
(RD-PWR)

September 4, 2001

Dear Friends of the Ice Age Floods Project,

It is with great pleasure that we are enclosing a copy of the *Ice Age Floods Study of Alternatives and Environmental Assessment.* The release of the final report to the public coincides with the official release of the study report to Congress on August 24, 2001 by the United States Department of the Interior. The study report has been submitted under the requirements of Public Law 105-391, which among other provisions, outlines the procedure by which selected areas within the United States are objectively evaluated for their significance, suitability, and feasibility of becoming part of the National Park System.

The release of the final study report culminates a two-year effort involving a 70-member study team that was composed of both public and private sector representatives from throughout the northwestern United States.

The study presents four management options for consideration by Congress which offer various opportunities to enlighten, educate, and excite area residents and visitors alike about the intriguing story of the cataclysmic Ice Age Floods and Glacial Lake Missoula. The Floods ravaged much of the northwest United States at the end of the last ice age, some 12,000-14,000 years ago. They left a lasting imprint on the landscape of the region and have greatly affected our pattern of human settlement and development in parts of the Northwest.

I would like to acknowledge the 70-member interdisciplinary study team who produced this report. The team involved agency representatives and citizen volunteers who worked long hours to make the project a success. Their important efforts were critical in bringing this report to Congress and the American public. Secondly, I would like to thank President Dale Middleton, and the several hundred members of the non-profit Ice Age Floods Institute whose dedication and deep interest in the Floods story and Northwest geology had a lot to do with the public knowledge and support of the project.

Finally, but certainly not least, we want to recognize the broad citizen interest and support throughout the region that has been evident during the course of the study, including strong participation at a series of public meetings. It is clear that many people feel that this fascinating story about the Ice Age Floods and Glacial Lake Missoula is one that should be told to the American people. There was also broad public support that the story be told through a coordinated and collaborative approach that would involve the various local, state, tribal, and Federal governmental agencies and officials throughout the Northwest, along with area citizens

and private organizations. Certainly the future success of our mutual efforts rests with continuing the spirit of collaboration and partnership that has been a cornerstone of the Ice Age Floods study effort to date.

If you have further questions about the report, please contact our National Park Service planning project manager Keith Dunbar in our Seattle office at 206-220-4104. People may also choose to inquire about activities involving local chapters of the Ice Age Floods Institute, which are available for those persons who have further interest in the Floods story, programs and Floods features in their local area. General information about the Ice Age Floods can be obtained on the Web by accessing www.nps.gov/iceagefloods. The final report will be available at this website in the near future.

We appreciate your interest in the project, and look forward to future opportunities to share the story of the Ice Age Floods with the American people.

Sincerely,

William C. Walters

FOR John J. Reynolds
Regional Director

February 2001

ICE AGE FLOODS
Study of Alternatives and Environmental Assessment

Following the Pathways of the Glacial Lake Missoula Floods

Funded by the National Park Service through
its Special Resource Study Program

Produced by Jones & Jones
Architects and Landscape Architects
Seattle, Washington

Contents

section a

Executive Summary

This *Ice Age Floods Study of Alternatives and Environmental Assessment* examines various ways public and private sector entities throughout the northwestern United States can work collaboratively to tell the fascinating story of the cataclysmic floods of the region to the American people. The last Ice Age Floods (Floods) occurred some 12,000–17,000 years ago. Today, vivid reminders of their impact remain on the landscape of parts of western Montana, the Idaho panhandle, eastern and central Washington and northern Oregon. The powerful story of the Ice Age Floods is an important component of our Nation's natural history and geology, and presents a potentially very popular interpretive theme.

The *Ice Age Floods Study of Alternatives and Environmental Assessment* analyzes four distinct management options: two involving non-federal options and two that would require Congressional designation.

Common to three of the alternatives is the notion of developing a designated "Floods Pathways" tour route that would follow along the paths of the Floods. The Pathways would largely be an auto tour route along existing public highways and roads and would allow both visitors to the region and residents alike to follow the path of the Floods and view distinctive Floods features. In some places complementary land and water trails would lead to specific Floods features.

The funding for the *Study of Alternatives and Environmental Assessment* was secured from Congress through the National Park Service (NPS) Special Resource Study Program. The client of the study report is Congress, who in turn will consider whether or not some sort of designation or action may be appropriate on a national level.

The study format follows that required by Public Law 105-391, Title III. This program provides for an analysis of resources to determine if they are eligible

for inclusion into the National Park System or consideration for some other approach that also provides for the protection and public use of a specific resource. It is intended that the application of the study criteria will assist Congress in determining whether or not some sort of national designation for Ice Age Floods resources within the study region is appropriate.

The Story of the Floods

During the last Ice Age, a finger of the Cordilleran ice sheet crept southward into the Idaho Panhandle, blocking the Clark Fork River and creating Glacial Lake Missoula. As the waters rose behind this 2,000-foot ice dam, they flooded the valleys of western Montana. At its greatest extent, Glacial Lake Missoula stretched eastward a distance of some 200 miles, essentially creating an inland sea.

Periodically, the ice dam would fail. These failures were often catastrophic, resulting in a large flood of ice- and dirt-filled water that would rush down the Columbia River drainage, across northern Idaho and eastern and central Washington, through the Columbia River Gorge, back up into Oregon's Willamette Valley, and finally pour into the Pacific Ocean at the mouth of the Columbia River.

The glacial lake, at its maximum height and extent, contained more than 500 cubic miles of water. When Glacial Lake Missoula burst through the ice dam and exploded downstream, it did so at a rate 10 times the combined flow of all the rivers of the world. This towering mass of water and ice literally shook the ground as it thundered towards the Pacific Ocean, stripping away thick soils and cutting deep canyons in the underlying bedrock. With flood waters roaring across the landscape at speeds approaching 65 miles per hour, the lake would have drained in as little as 48 hours.

But the Cordilleran ice sheet continued moving south and blocking the Clark Fork River again and again, creating other Glacial Lake Missoulas. Over thousands of years, the lake filling, dam failure, and flooding were repeated dozens of times, leaving a lasting mark on the landscape of the Northwest. Many of the distinguishing features of the Ice Age Floods remain throughout the region today.

Together, these two interwoven stories of the catastrophic floods and the formation of Glacial Lake Missoula are referred to as the "Ice Age Floods." Therefore, in this *Study of Alternatives* the term Ice Age Floods is inclusive of both the formation of Glacial Lake Missoula and the subsequent floods.

While scientific research to date assists in telling this fascinating story, there is much inquiry and study that is still needed on the Ice Age events in the region. Conflicting theories on various aspects of the Floods remain to be debated and researched by future geological professionals, adding dimension to the educational aspect of the project.

Study Criteria

The *"Criteria for Parklands"* is an NPS publication that defines the process and criteria used to screen proposals for potential new park units. Criteria for the study are also provided by Public Law 105-391, Title III. Using the standards and requirements outlined in the *"Criteria,"* the objective of the *Study of Alternatives* was

threefold: first, to determine the significance of Ice Age Floods resources; second, to evaluate these resources for their suitability and feasibility as a potential new unit of the National Park System; and last, to examine a range of viable management approaches that identify various ways in which the coordinated interpretation of Ice Age Floods resources could be achieved. Highlights of the Study's findings are:

National Significance

By examining the NPS themes, which look at both natural and cultural resource themes, the Study found that the Floods region exceeds the basic requirements for consideration as a nationally significant resource. The Floods are the greatest scientifically documented floods known to have occurred, and the landscape of the Channeled Scablands in southeastern Washington was formed in a manner similar to that of channels on the planet Mars. Additionally, there are seven currently listed National Natural Landmarks within the study region that have Floods features as a principal component and resource value.

Threats to the Resource

Threats to the resources related to Floods features are generally considered minimal because of the size and number of Floods features in the four-state study region. While the protection of certain specific Floods features cannot be assured over the long-term, the scope and scale of the various Floods features across such a large landscape help to diminish most resource concerns.

Suitability

Based upon an evaluation of natural and cultural themes, various features of the Floods, along with the Floods pathways, are suitable for inclusion into the National Park System.

The Ice Age Floods are not presently represented in the National Park System. In addition many Floods features possess a high degree of integrity and are a good example of a collection of resources directly related to the theme.

Feasibility

The size, breadth, and multitude of ownerships throughout the study region make the area not feasible to consider for a traditional National Park, Monument or similar designation. However, it is feasible to interpret the Floods story along the Floods Pathways across parts of Montana, Idaho, Washington, and Oregon provided there is a high degree of cooperation among the various public and private entities within the four-state area.

Study Process

The Study process developed for the production of the *Ice Age Floods Study of Alternatives* was intended to provide an opportunity for interested individuals, organizations and communities throughout the Northwest to become actively involved. A study team composed of public and private sector representatives from throughout the four-state study region guided the conduct of the study. This included the interagency Ice Age Floods Task Force composed of local, tribal, state and federal public agency professionals in geology, interpretation, tourism and other fields. Also included on the study team were representatives from the nonprofit Ice Age Floods Institute, along with the study consultant, Jones & Jones of Seattle, Washington.

From the outset, given the size and complexity of the study region, four study zones were designated and zone chairpersons were identified. First, volunteers within each study zone took responsibility for inventorying Floods resources, building upon work already published by professional geologists from the U.S. Geological Survey, the Bureau of Land Management, area colleges and universities, and others. Next, various existing sites across the Nation, both within and outside the National Park System, were examined for their applicability to the project region. Finally, the study team advanced the concept of Floods Pathways for public viewing of Floods resources, and developed a range of four management alternatives, all with the common goal of providing a coordinated and collaborative interpretative approach to telling the story of the Ice Age Floods to the public.

Ice Age Floods Region and Floods Pathways Tour Route

Common to three of the alternatives developed by the study team for interpreting the Floods story is that the study area, which covers some 16,000 square miles across a four-state area, be defined as the Ice Age Floods Geologic Region. Within the Floods region, "Floods Pathways" could be identified as public tour routes, which follow the path of the Floods past various flood features. As designated, the Floods Pathways would extend from Missoula, Montana, to the Pacific Ocean. In most cases, the Floods Pathways would follow existing public highways and roads. A system of loops and spur routes would also be designated where some key Floods features were outside a linear auto route. Along the perimeter of the Floods Region are several communities that would serve as "gateways" to the Floods Region. In some cases, non-motorized hiking, bicycle, horse, kayaking, and canoeing trails could augment the driving route. Aerial and boat tours of Floods features could also be encouraged to gain a better understanding of the Floods epic story.

Floods Pathways would provide both visual and physical access to significant Floods features on public land, and would help link these features together as part of a coordinated effort among all levels of government, along with private sector support. Floods features on private lands could be viewed from public roads, and could be interpreted with the permission of the landowner. Final details concerning the locations of specific routes and interpretive facilities would be worked out as part of a future management planning process.

Regarding the lands upon which Floods features are located, the study team recommendation is to coordinate the interpretation of Floods resources on public lands. No Congressional authorization for acquisition of private land is either necessary or recommended.

Public Participation

There has been a high level of public interest and participation during the course of the study process. The public has attended meetings held throughout the four-state study region, including meetings in Missoula, Montana; Sandpoint, Idaho; Spokane, Seattle, and Richland, Washington; and Portland, Oregon. The local study zone groups have embarked on public outreach and

education programs have resulted in television and radio coverage and newspaper articles. A brochure was developed specifically for the project to acquaint the public with the purpose of the study. A webpage (www.nps.gov/iceagefloods) includes the Floods story, notice of public meetings, and information on the study report. Video tapes of the Floods story produced by the Washington State University Landscape Architecture Program in cooperation with the National Park Service, and another produced by Oregon Public Broadcasting, have been seen by thousands throughout the region and have stimulated interest in the project. The mailing list is made up of more than 1,100 interested citizens and organizations. Magazine articles, including a 1995 article in the *Smithsonian* magazine, have also stimulated interest in the Floods story.

Management Alternatives

The Study Team developed four distinct management alternatives to be considered by Congress. While each alternative varies in the approach it uses, common to each action alternative is a collaborative and coordinated approach for the interpretation of the Ice Age Floods story to the public. All management alternatives also place emphasis upon using Floods features on public lands to help convey the story, and three alternatives recommend the designation of a Floods Pathways auto tour route, with loops and spurs, throughout the four-state region.

The four management alternatives presented in the study include two alternatives that do not involve any federal designation, and two that would require authorization from Congress. They are described as follows:

Local/State Designation

Alternative 1—Existing Conditions: Under this alternative management would continue to be done at the local level. Flood resources on public lands would be managed individually without any coordinated effort.

Alternative 2—Quad-State Cooperation: Under this alternative, the State Legislatures of Montana, Idaho, Washington and Oregon would designate representatives to a quad-state commission that would promote the coordinated interpretation of the Floods story at the state and local level.

Federal Designation

Alternative 3—National Geologic Trail: Under this alternative, Congress would authorize the establishment of an Ice Age Floods National Geologic Trail. The Ice Age Floods National Geologic Trail would in essence be the national designation of the Floods Pathways concept. The trail would be managed by a National Park Service trail manager and small support staff. The NPS would be responsible for overall trail management and emphasis would be on coordination with various public and private entities. A trail advisory group would be formed to assist in coordination activities. It is further recommended that the NPS be given no new land ownership, acquisition, or regulatory authority in fulfilling this role.

Alternative 4—National Geologic Region: Under this alternative, Congress would designate the study area under a new designation as a National Geologic Region. As in Alternative 3, Congress

would also provide national designation for the Floods Pathways as the public tour route that links the Floods features throughout the National Geologic Region. The Floods Pathways would be managed by an Ice Age Floods Commission, appointed by the Secretary of the Interior, and composed of members nominated by the Governors of the four states, tribal governments and public agency officials. It is anticipated that the Commission would be composed of both public and private sector members and would have a paid executive director and small support staff. The role of the National Park Service in support of the Commission and staff would be largely in the area of interpretation and education assistance. In management of the National Geologic Region, the primary emphasis of the Commission would be on coordination with various public and private entities without any new land ownership, acquisition, or regulatory authority.

Common to Each Action Alternative

Common to each action management alternative would be the continued role of the nonprofit Ice Age Floods Institute in promoting education and public appreciation of the Floods story. Also common to each alternative would be the continued association with public agency geology, tourism, interpretive and education, and other professionals among local, tribal, state and federal agencies, and college and university officials. This association could be formalized through a written memorandum of agreement.

Most Effective and Efficient Management

Public Law 105-391 directs that the Secretary of the Interior "shall consider whether direct National Park Service management or alternative protection by other public agencies or the private sector is appropriate for the area . . ." and ". . . shall identify what alternative or combination of alternatives would in the professional judgment of the Director of the National Park Service be the most effective and efficient in protecting significant resources and providing for public enjoyment. . . ."

After careful consideration of the four management alternatives presented in the *Ice Age Floods Study of Alternatives and Environmental Assessment,* the National Park Service has determined that Management Alternative 3, which establishes the Ice Age Floods National Geologic Trail (Floods Pathways), is the most effective and efficient alternative.

Conclusion

Regardless of the future outcome, or designation provided, the study process has heightened public attention and awareness in the Ice Age Floods story and the role of the Floods in shaping this region of the United States. As the story of the Ice Age Floods continues to gain popularity, increasing numbers of people will want to view Floods features and learn more about the story. Representatives from all levels of government and private citizens and organizations have shown support for some kind of coordinated regional effort to help ensure the fascinating story of the Ice Age Floods is told to the American people in a coordinated manner.

F l o o d s

Ice Ages

For at least the last two million years, the earth's climate has fluctuated between ice ages. These cycles are largely driven by slight changes in the way the earth orbits around the sun—just small changes in the various wobbles of the earth's motion are sufficient to fundamentally shift the earth from an "ice-house" to a "hot-house."

F a c t s

s e c t i o n b

Introduction—How to Read this Study

This report is divided into thirteen sections. They are:

- Executive Summary
- Introduction—How to Read this Study
- Purpose and Need
- Background
- Examination of Similar Projects
- Criteria for Designation
- National Significance
- Suitability and Feasibility
- Study Process
- Interpretation
- Management Considerations
- Management Alternatives
- Most Effective and Efficient Management Alternative

The best way to obtain a thorough understanding of the Ice Age Floods Study of Alternatives is to read the report from start to finish. The first three sections—***Purpose and Need*** and ***Background*** and ***Examination of Similar Projects***—provide the background and context for the Study. The middle four sections—***Criteria for Designation, National Significance, Suitability and Feasibility,*** and ***Study Process***—

address the standards required for this type of project, how the standards were analyzed, and how the Floods region meets these standards. The final four sections—***Interpretation, Management Considerations, Management Alternatives, Most Effective and Efficient Management Alternative***—make recommendations on how to make the Ice Age Floods Geologic region successful.

For those readers who are in a hurry, the ***Executive Summary*** condenses the recommendations of this report into six concise pages.

At the beginning of each section is a brief summary that provides an overview of pertinent information and recommendations. When combined these summaries comprise much of the ***Executive Summary***.

Three types of information are provided in the margins of the report:

- Critical Information that has been pulled from the text and is being highlighted to make certain the reader does not miss it.

- Floods Facts that provide interesting pieces of information. For example: Glacial Lake Missoula contained more water than Lake Erie and Lake Ontario combined.

- Quotes from and about individuals involved with understanding the Ice Age Floods story.

When appropriate, graphic images are used to augment the text. These include maps, charts, photographs, and sketches, all of which are visual attempts to make information more accessible.

The Appendix includes supplemental information beneficial for readers seeking a more thorough understanding of the Floods region. This material includes:

- Reference List
- Glossary of Terms
- Study Team Participants
- Public Law 105-391
- Four State Resolutions
- Similar Projects

section c

Purpose and Need

Purpose

NPS Photo

Lower Moses Coulee, Washington

The Ice Age Floods Alternatives Study brings together professional geologists, public lands managers, representatives of the travel and tourism industry, academics, planners and the interested public to identify, discuss and recommend various approaches for managing and interpreting the great Ice Age Floods. The purpose of the *Study of Alternatives* is to identify a series of viable management options for the Director of the National Park Service. The NPS Director will submit to the Secretary of the Interior a recommendation for management and interpretation of the Ice Age Floods story based on the *Study of Alternatives*. In turn, the Secretary of the Interior will forward the Study to the Congress for consideration.

Need

The region lacks a coordinated interpretive approach to the Ice Age Floods story. The understanding and appreciation of the Ice Age Floods is a relatively recent phenomenon. As recently as the 1960s, not all geologists accepted the hypothesis of catastrophic Ice Age flooding in the Pacific Northwest. It took decades for the geologic community to accept the hypothesis of J Harlen Bretz, who was instrumental in proposing the idea of catastrophic flooding. In 1979 the Geological Society of America awarded Bretz the Penrose Medal, the nation's highest geological award. In 1986, John Allen and Marjorie Burns published *Cataclysms on the Columbia*, which sparked a wave of public interest in the Floods. In 1994 a video of the Floods was developed by the Washington State University Landscape Architecture program in cooperation with the National Park Service, and a year later

the *Smithsonian* magazine featured an article by Michael Parfit on the Floods. In 1998 Oregon Public Broadcasting produced a video program on the Floods, and public awareness of the Floods increased dramatically.

During this same period, tourism—especially "cultural tourism"—was growing at a rapid rate in the Pacific Northwest. The income from increasing tourism helped offset economic losses that were occurring in some parts of the region from reduced timber and mining activities. The visible remnants of the Floods are on such a large scale and found at so many different sites that change has not dramatically affected them, but as the area continues to develop the region will experience accelerated changes. These changes may affect floods features. At the present time, there is an opportunity to develop a cooperative effort to educate the public about the Ice Age Floods, to contribute to existing cultural tourism programs in Montana, Idaho, Washington and Oregon, and to develop a better understanding and appreciation of the remaining resources from the greatest documented floods on earth.

NPS Photo

Today's travelers to the Northwest are witnesses to a story that puzzled geologists for years.

s e c t i o n d

BACKGROUND

s u m m a r y

This section presents a brief overview of the Glacial Lake Missoula Floods story, two of the key people involved with discovering the Floods and the glacial lake from which the Floods originated, and events that led up to the initiation of the Ice Age Floods Alternatives Study.

1. Geologic Background

In recent geological history, portions of the United States have been the site of several massive flooding events caused by the abrupt drainage of glacial lakes. The most dramatic of these events are the Ice Age Floods that covered parts of Montana, Idaho, Washington, and Oregon. For a better understanding of the Floods, perhaps a good place to start is to first look at the geological and climatic changes that led up to these cataclysmic floods.

Generally accepted scientific evidence indicates that the earth is around 4.5 to 4.6 billion years old. Glaciation can be traced all the way back to the Proterozoic Era, approximately 2.3 billion years ago, when the earth was covered with ice. Near the end of the Proterozoic Era, between 850 and 600 million years ago, rock records indicate another global glaciation period.

About 200 million years ago the Atlantic Ocean began to open up and the continents drifted into their current configuration. The dinosaurs became extinct 65 million years ago, and about 20 million years ago, in late Cenozoic Era, the Pacific Northwest started to look much as it does today, with its mountains, valleys, and shorelines.

Ice Ages have occurred sporadically throughout the earth's history, although they represent a relatively small part of geologic time. Many of the still visible effects of the great ice sheets that periodically covered parts of North America were produced during the last Ice Age, in the Pleistocene Epoch. These ice sheets left a distinctive geologic

NPS Photo

Floods of molten lava poured across western Idaho, eastern Washington, and northern Oregon.

record in the land forms of the Northwest.

From 17 to 13 million years ago, lava flows emanating from a series of volcanic extrusions spread across the Columbia River Basin, constructing a broad lava platform across northeast Oregon, eastern Washington, and central Idaho. These extrusions were among the largest and most spectacular lava flows of their kind. The Columbia River basalts that flooded across the Pacific Northwest consisted of more than 42,000 cubic miles of lava. In places, the basalt is more than two miles thick. In the Columbia Basin, the lava basalts were covered with windblown glacial dust and silt, called loess, that is up to 250 feet thick. The Cascade Mountains were formed during the later part of these basalt extrusions.

During the Pleistocene Epoch Ice Age, beginning about 2.5 million years ago, virtually all of southwestern Canada was repeatedly glaciated by ice sheets that also covered much of Alaska, northern Washington, Idaho, Montana, and the rest of northern United States. In North America, the most recent glacial event is the Wisconsin glaciation, which began about 80,000 years ago and ended around 10,000 years ago. Floods events from this last glacial period are the subject of this report.

2. *Story of the Floods*

At the end of the last Ice Age, a finger of the Cordilleran ice sheet crept southward into the Idaho panhandle, forming a large ice dam that blocked the mouth of the Clark Fork River, creating a massive lake 2000 feet deep and containing more than 500 cubic miles of water. Glacial Lake Missoula stretched eastward for some 200 miles and contained more water than Lake Erie and Lake Ontario combined. When the highest of these ice dams failed, lake water burst through, shooting out at a rate 10 times the combined flow of all the rivers of the world.

This towering mass of water and ice literally shook the ground as it thundered toward the Pacific Ocean, stripping away hundreds of feet of soil and cutting deep canyons—"coulees"—into the underlying bedrock. With flood speeds approaching 65 miles per hour, the lake would have drained in as little as 48 hours.

Over time the Cordilleran ice sheet continued moving south and blocked the Clark Fork River again and again, recreating Glacial Lake Missoula. Over approximately 2,500 years, the lake, ice dam and flooding sequence was repeated dozens of times, leaving a lasting mark on the landscape.

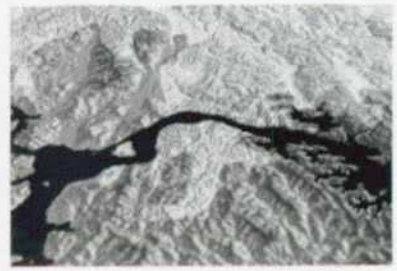
Today we can see how the floods impacted the landscape. They carved out more than 50 cubic miles of earth, piled mountains of gravel 30 stories high, created giant ripple marks the height of three-story buildings, and scattered 200-ton boulders from the Rockies to the Willamette Valley. Grand Coulee, Dry Falls, Palouse Falls—all were created by these flood waters, as were the Missoula and Spokane ground-water resources, numerous wetlands and the fertile Willamette Valley and Quincy Basin.

J. Tindall, B. Pettus, J. Sipes

Glacial Lake Missoula contained more than 500 cubic miles of water.


During the last Ice Age, a finger of the Cordilleran ice sheet crept southward into the Idaho Panhandle, damming the Clark Fork River and creating Glacial Lake Missoula. At its maximum, Glacial Lake Missoula contained more than 500 cubic miles of water and was 2,000 feet deep behind the ice dam.



About 17,000 years ago the ice dam broke numerous times, with the initial outburst releasing a torrent of water that flowed toward the Pacific Ocean at a rate of 10 times the combined flow of all the rivers of the world.

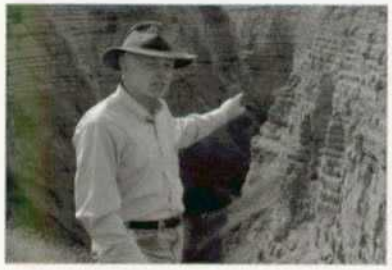



As the flood waters thundered toward the ocean, they stripped away thick soils, cut deep canyons in the underlying bedrock, and scattered house-sized boulders across four states.




Unable to pass through a narrow gap near Kalama, Washington, the flood water backed up and flooded the Willamette Valley, Oregon.

More than 16,000 square miles of land were flooded in the first-of-many Glacial Lake Missoula floods.




Today, geologists and visitors to the region can see first hand the varied flood features created by the Ice Age Floods.

Art and photography courtesy OPB (J. Tindall, B. Pettus, J. Sipes) and NPS

3. J Harlen Bretz—Hypothesis of Catastrophic Floods

In many ways, the story of the Floods is also the story of J Harlen Bretz (1882-1981), who proposed the theory that the Channeled Scablands of eastern Washington, and much of the Northwest as we know it today, were formed by catastrophic flooding.

J Harlen Bretz (1882–1981)
1949 photo by Dr. Julian Goldsmith

J Harlen Bretz spent more than four decades defending his theories on the Spokane Floods before they were generally accepted by the scientific community.

—John Allen and Marjorie Burns,

Cataclysms of the Columbia

Bretz became a high-school biology teacher in Seattle. He had earlier developed a keen interest in the glacial geology of the Puget Sound and had studied the area extensively. This interest in geology led him to the University of Chicago, where he was awarded a Ph.D. in Geology in 1913. Then, Bretz accepted a position as an assistant professor of geology at the University of Washington and later at the University of Chicago. His thesis was on the glacial history of the Puget Sound, and he quickly became recognized as an expert in the features of stream and glacial erosion.

Bretz began his field research in the Channeled Scablands of central Washington during the summer of 1922, and it quickly became clear to him that neither glaciation nor ordinary stream erosion explained the Scablands. The following year Bretz made his two presentations to the Geological Society of America on the Scablands. The first paper provided a detailed physiographic description of the Scablands; the second suggested that it would have taken a massive volume of water to create the degree of channel erosion that had occurred.

Bretz's second paper on the Scablands also discussed the mounded gravel deposits that were scattered throughout the area. He proposed the idea of a catastrophic flood and included the first detailed geological map that included all of the Scablands and showed the extent of the floods. Bretz used the name "Spokane Flood" because he assumed the source of the water for this flood was somewhere near Spokane, Washington.

Bretz was confident that a flood had occurred, but was unable to figure out where the water had come from. Originally, he proposed that the water was the result of increased runoff from melting glaciers. But even Bretz had a

NPS Photo

Columnar basalt at Frenchman Coulee in eastern Washington

tough time imagining any significant volume of water melting rapidly enough to have such devastating impact. Not until 1930 did Bretz consider Glacial Lake Missoula as the possible source of water he was searching for. But the geologic evidence was elusive, and he did not fully embrace the idea until 1956. Unable to provide a clear, scientific argument for the source of flood water, Bretz went on to other activities.

Bretz lived to the age of 98 and late in life had the satisfaction of seeing his theories validated. Perhaps it is poetic justice that in 1979, Bretz, at the age of 96, received the Penrose Medal, the Geological Society of America's (GSA) highest award.

Bretz knew that the very idea of catastrophic flooding would threaten and anger the geological community.

—Andrew Macrae, University of Calgary, Department of Geology & Geophysics

NPS Photo

Aerial view of Dry Falls cataract, Grand Coulee, Washington, looking north.

In his numerous reports, Bretz rarely asked about a water source, and then only in a brief sentence or two devoid of analysis.

—Richard Waitt, USGS

"I know where Bretz's Flood came from."

—J. T. Pardee, at a 1927 meeting of the Geologic Society in Washington DC.

NPS Photo

Giant ripple marks can still be seen clearly in Camas Prairie, Montana.

4. *Joseph T. Pardee—Glacial Lake Missoula*

Joseph Thomas Pardee (1871–1960) also played a key role in understanding the story of the Floods. It was Pardee who proposed that the floods Bretz talked about occurred when the ice dam that had formed Glacial Lake Missoula was breached.

Pardee, a geologist with the U.S. Geological Survey, began studying the Scabland region near Spokane, Washington, and the intermountain basins of Montana in 1910. Pardee found geomorphic evidence of a large glacial lake in western Montana; strandlines (high water marks) indicating the maximum height of the lake are clearly visible today in the area around the city of Missoula, Montana.

Pardee spent years collecting, analyzing, and documenting other geomorphic evidence, and eventually the scientific community was convinced that Glacial Lake Missoula had indeed existed.

Apparently Pardee and Bretz did communicate over the years, and Pardee suggested that Bretz consider the draining of Glacial Lake Missoula as a possible source of the Floods. But neither Pardee nor Bretz had the scientific evidence to back up such an idea.

Later, in the late 1930s at Camas Prairie in northwestern Montana, Pardee discovered a series of ripple marks left on the lake bottom sediments of Glacial Lake Missoula that could only have been formed by powerful currents that flowed over the bottom, shaping the sediments into smooth, parallel ridge-rows. The marks were evidence that the ice dam holding back the water had failed suddenly, and Glacial Lake Missoula had drained rapidly. The ripple marks are up to 50 feet high and 500 feet apart. Because the ripples are so large, it was only when Pardee was able to view these unique features from the air that he recognized them as being formed by water. Once they had been identified and people knew what to look for, similar examples of giant ripple marks were found throughout the path of the floods.

In addition to the ripple marks, Pardee found other evidence of the ice dam failure, including severely scoured

constrictions in the lake basin and huge bars of current-transported debris.

Pardee first presented this evidence in 1940 at a meeting of the American Association for the Advancement of Science in Seattle, Washington. His conclusions were later published in the 1942 *GSA Bulletin* paper titled "Unusual Currents in Glacial Lake Missoula." Collectively, these papers played a pivotal role in the scientific community's eventual acceptance of the cataclysmic flooding hypothesis. His work provided, for the first time, a logical source of water needed to support Bretz's hypothesis. The ripple marks were a key piece of evidence that eventually helped convince skeptics of the cataclysmic-flood hypothesis.

Even after Pardee's work was made public, acceptance of Bretz's theories was slow in coming. It took another 20 to 30 years before Bretz's theory of catastrophic flooding became generally accepted among geologists.

NPS Photo

Wave-cut strandlines cut into the slope at left in photo. These cuts record former high-water lines, or shorelines of Glacial Lake Missoula near Missoula, Montana. Gullies above the highway are the result of modern-day erosion.

Pardee and Bretz were certainly not the only ones involved in solving the mysteries of the Glacial Lake Missoula Floods. For example, in 1871, geologist Thomas Condon proposed the idea that Oregon's Willamette Valley was flooded sometime during the Ice Ages.

5. *Scientific Debates—Uniformitarianism vs. Catastrophism*

"They were all loaded for me and after letting me talk for two hours they opened fire."

—Bretz, after a 1927 meeting of the Geologic Society in Washington DC.

The debate over the origin of the Channeled Scabland region of eastern Washington was one of the great controversies in the history of geology. One reason Bretz encountered such vehement opposition to his hypothesis of catastrophic flooding was that there were no records of such floods in modern-day experience and the magnitude of the floods was at a scale that was difficult to imagine. The biggest difficulty, however, was that a catastrophic flood at the scale Bretz was describing was almost biblical in proportion, and this notion was directly at odds with the idea of Uniformitarianism.

James Hutton, a Scottish geologist, was the first to articulate the principle of Uniformitarianism, the accepted model in geology during the early 1920s when Bretz proposed his idea of catastrophic floods. According to Hutton, in his 1788 book *Theory of the Earth*, geological process is steady, slow, repetitious, and "uniform." In essence, Uniformitarianism says that geological processes that can be observed in the present are likely to be the same as those that operated in the past. This model has served the geologic community well because, in general, geological changes averaged over eons do occur slowly.

Among geologists in the 1920s, the only acceptable large-scale catastrophic events were volcanoes and earthquakes. Beyond these events, catastrophism was considered to be "bad science" and virtually vanished from geologic thinking. Geologists from that era attributed the creation of the Channeled Scablands to glacial erosion, which was much more in keeping with theories of Uniformitarianism. It is perhaps understandable, then, that acceptance of Bretz's theories of huge, sudden catastrophic floods took as long as it did.

It is usually interpreted as a contest of ideas between neocatastrophist Bretz and a platoon of diehard gradualists, an image Bretz himself promoted. . . .

—Richard Waitt, USGS

With the eventual availability of more evidence, a plausible mechanism, and evidence for that specific mechanism, most geologists quickly accepted Bretz's hypothesis. . . .

—Andrew Macrae, University of Calgary, Department of Geology and Geophysics

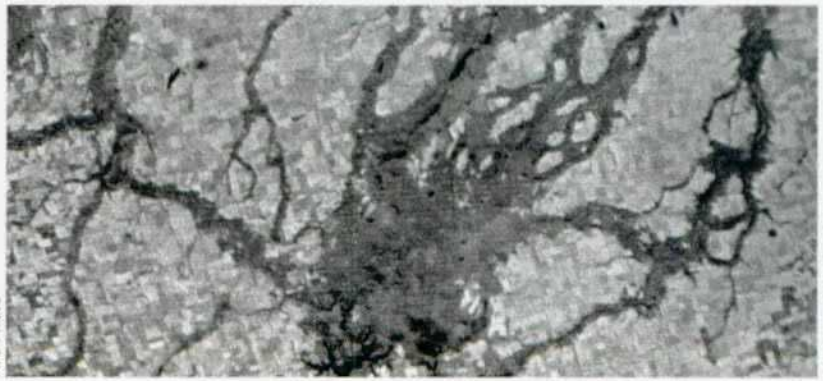
Bretz's scablands "evidence" was astonishing, and most of his descriptions remain today as fresh and accurate as when written. . . .

—Richard Waitt, USGS

6. *Science's Modern-Day Evidence and Acceptance*

J Harlen Bretz spent more than four decades defending his theories on the Floods before the scientific community generally accepted them. Before this acceptance would occur, all of the pieces of the puzzle had to come together. And it certainly didn't hurt when scientists were finally able to study glacial floods in action.

In the 1960s and 1970s, glacial geologists began to develop a better understanding of how floods in glaciated lands could occur by studying *jökulhlaups*, outburst floods that occur from the tunneling by water through a glacier. Although the reason the flooding occurs is very different between jökulhlaups and the Ice Age Floods, many of the dynamics are the same. Most of these studies have occurred in Iceland, which has a unique environment, because it has active volcanoes that create hot crustal conditions yet is a glaciated region. Basically, scientists discovered that in Iceland subglacial lakes formed when the lower surface of a glacier starts to melt. The water is typically trapped in a subglacial cavity until enough pressure builds up and the water escapes out from under the glacier, creating a glacial flood. In Iceland, this type of glacial flooding occurs regularly; the cycle repeats itself every 20 years or so.



NPS Photo

Modern tools, such as satellite imagery, help scientists to comprehend the scale of the Ice Age Floods.

7. *Increased Public Interest*

After the scientific community finally embraced the story of the Floods, research in the Channeled Scablands and other areas impacted by the Floods increased. The result of this research was a more thorough understanding of events that led up to the Floods and the impacts that they had on the landscape. This research, which has resulted in dozens of scientific papers (see the Reference List in the Appendices), also has helped create a greater public awareness of the Ice Age Floods. It is only within the past decade or so that the story of the Floods has become widely publicized via magazine and newspaper articles, books, brochures and pamphlets, and television documentaries.

It became evident that what was needed was the development of a coordinated interpretive and educational approach to tell the Floods story throughout Montana, Idaho, Washington, and Oregon.

Over the past decade or so, the public has shown an increasing interest in the Ice Age Floods. In 1995, Smithsonian magazine published a feature article about the floods; several popular books have included Floods material; several newspapers have published stories; a number of videos have been produced; and Oregon Public Broadcasting televised a half-hour special on the subject.

The more the public learns about the Ice Age Floods story, the more fascinated they become. After all, this is a story that seems to belong more to the realm of science fiction than to reality. The scale and immensity of the Floods are hard to imagine; standing in central Washington it is almost impossible to comprehend that everything visible in all directions was covered by hundreds of feet of water during the height of the Floods.

People are asking that the Floods story be told in an exciting and accessible way. It is evident that what is needed is the development of a coordinated interpretive and educational approach to tell the Floods story throughout the four-state area and beyond.

8. *Formation of Ice Age Floods Task Force—The Early Days*

While there has been more than a casual interest in the Ice Age Floods story on the local and state levels, very little appreciation for the national significance of the Flood events has been noted, except from within the scientific and professional geologic community. The Ice Age Floods story was publicized during the 1974 World's Fair in Spokane, Washington, with occasional articles featured in local and regional newspapers since that time. In addition, a descriptive and interpretive booklet, "The Channeled Scablands of Eastern Washington: The Geologic Story of the Spokane Flood," was published by the U.S. Geological Survey. The booklet, which is in its third edition, is available through the Eastern Washington University Press. To date, more than 125,000 copies have been printed.

In June of 1987, in response to a request from the National Park Service (NPS) Regional Office to document the status of the National Natural Landmark (NNL) sites, NPS representatives from (then) Coulee Dam National Recreation Area organized a field trip to those sites within a one-day drive of Coulee Dam, Washington.

Dan Hand, Interpretation Specialist at Coulee Dam (now Lake Roosevelt) National Recreation Area, laid out a route of travel to include the upper and lower Grand Coulee, Withrow Moraine, Haystack Rocks, a great gravel bar in Moses Coulee and some eskers and kames near Sims Corner. Others making the trip were Superintendent Gary Kuiper, NPS, Craig Sprankle, Public Affairs Officer of the U.S. Bureau of Reclamation (USBOR), Judy Sprankle, Editor of the Star newspaper in Coulee Dam, and Phil Hansen, USBOR Geologist.

From this initial field trip, it soon became evident that here was a story that needed to be told. Other than what Washington State Parks featured within their system, there was not a single interpretive display or roadside exhibit along the entire length of the upper Grand Coulee or at the other sites that were visited. Hansen's interpretation of the geologic history leading up to the

series of flood events left the tour group wanting to know more. And indeed, there was more to the story than could be covered in one day.

Judy Sprankle's article about the Floods in the *Grand Coulee Star Newspaper* had the desired effect. Local interest developed and another tour was organized for the local Chamber of Commerce and others interested in learning about the Floods story.

About this time, Dan Brown replaced Dan Hand as the park interpreter at Coulee Dam National Recreation Area. Brown hired an experienced photographer to develop a slide file. It would enable National Park Service interpreters to present the story of the Ice Age Floods to the public. Ed Soldo built a slide file with more than 3,000 slides, including aerial shots. His next season was dedicated to labeling and organizing the slides.

Brown also prepared the script for an Ice Age Floods slide program that was based in no small part in *Cataclysms on the Columbia* by John Allen, Marjorie Burns and Samuel Sargent, which was published in 1985.

While local NPS representatives realized that the Floods events were of national significance, selling the idea to cooperating agencies and eventually the public was an important first step. Officially, the NPS Regional Director was notified by memo in August 1987 that, at least in the opinion of interested individuals, the Ice Age Floods events met the criteria for identification as being nationally significant. NPS Regional Director Chuck Odegaard was a former Washington State Parks Director and was familiar with the state park interpretive program at Dry Falls. He gave the go ahead to pursue an initiative to inform agencies and the public of the value of the Floods resources.

NPS Photo

During the Ice Age Floods, Dry Falls was under 300 feet of water approaching at a speed of 65 miles per hour.

Realizing that elected officials would eventually play an important role, efforts were made to work with county commissioners and Congressional delegations and inform them of the Floods resources in their back yards. Moreover, project organizers took great pains to

assure everyone that the NPS was not interested in acquiring more land.

Project organizers contacted geologists at each of the state universities and soon were networking with counterparts in Montana, Idaho, Washington, and Oregon.

In early 1993, the team of Dan Brown and Gary Kuiper hit the road, showing the program to more than 70 audiences, including the Audubon Club, Grange, and Chamber groups, Tribal officials and county commissioners, other federal officials, anyone, for that matter, who showed an interest. Each of the four states was covered, and long days and nights were the rule. In addition, an article in the *Spokesman Review* written by Becky Napi generated a great deal of interest.

Kathleen Johnson of the USGS, Spokane Office, provided the necessary maps and connected project organizers with Richard Waitt, USGS, and others in her agency. The BLM Spokane District Office staff added to the concept by suggesting that the Floods story be aimed at a wider regional audience. This expanded target was critical because the BLM had a majority of the Floods landscape under its jurisdiction in eastern Washington. Soon there were solid contacts in Montana with USFS geologists Norm Smyers and Jim Shelden, and Karen Porter of the Montana Bureau of Mines and Geology. In Idaho, the project had the support of Roy Breckenridge of the Idaho Geological Survey. Others lending support were Dale Stradling and Gene Kiver of Eastern Washington University and Paul Weis, retired USGS, whose publication on the Scablands of Eastern Washington is still a popular item.

These early conversations and meetings led to a more formal approach, and on February 17, 1993, the first of seven Ice Age Floods Task Force meetings was held. Such items as an organizational structure, purpose, action plan, strategy paper, inventory of flood features and existing interpretive waysides were identified. Most importantly, the membership of the Task Force was meant to include the interested general public and legal entities such as county commissioners, Tribes, Chambers of Commerce, tourism industry and political staffers. Although having all of these groups serving as active members of the Task Force was not the point, it was essential that they be kept informed and be invited to participate in the process.

Gary Kuiper served as the first chair of the Task Force and remained in that position into 1993–1994. His tenure was followed by Coulee Dam NRA Superintendent Gerry Tays, who was elected by the Task Force to serve as chair. Superintendent Tays served for the next three and a half years and continued to promote the merits of a coordinated interagency approach.

One of the most influential events in carrying the story of the Floods to a wider audience was the production of a video of the Floods. Initially Ann Herdrick of the Odessa (Washington) Economic Development Committee (OEDC) approached Jim Sipes, Washington State University Professor of Landscape Architecture, about using the Floods story to help increase tourism in the Odessa area. They started work on a video that would tell the story of the Floods and guide people to significant Floods features, specifically around Odessa. Around the same time both Superintendent Kuiper and Interpretive Specialist Brown realized they could not

continue indefinitely to take their "road show" to every group that requested it. The decision was made to combine forces, and the result was the production of the 13-minute video, "The Great Floods: Cataclysms of the Ice Age." (A video called "Floods of Fire and Water" was subsequently developed for OEDC in June 1994.) The video combined the narrative and some photos of the slide show with video and computer animation sequences developed by WSU that showed the Floods roaring across the landscape of northwestern Montana, Idaho, Washington, and Oregon, and finally out to the Pacific Ocean. Three WSU students, Bruce Morrow, Mike Spencer, and Andrea Blake, assisted Professor Sipes in the effort. The product was an instant success, having been aired on PBS, shown at visitor centers and schools, and receiving several national awards.

While the notion of a coordinated interpretive approach remained a primary goal, the Task Force became inactive pending the availability of study funds.

9. *Formation of the Ice Age Floods Institute*

Toward the end of 1993, members of the Task Force discussed the need for a private, nonprofit organization that would complement the interagency Task Force. The consensus was that the private sector could more readily support and participate in the development of a coordinated interpretive program. A number of individual citizens and representatives of business groups had already been attending Task Force meetings.

NPS Photo

The gorge below Palouse Falls, Washington, with talus slope.

NPS Photo

Park Lake, Sun Lakes–Dry Falls State Park, within the lower Grand Coulee.

With assistance from some members of the Task Force, the Ice Age Floods Institute was organized early in 1994. Officers and a board were elected, bylaws and articles of incorporation were adopted, and the process to qualify as a Washington nonprofit corporation and to be granted 501(c)(3) status with the IRS was initiated. Mikki Kison, a Ritzville, Washington, resident, served as its first president. Dale Middleton currently serves in that role and has been instrumental in the development of this *Study of Alternatives*. The first Institute newsletter was published and sent to individuals from the Task Force's mailing list. Institute members adopted a logo, and Task Force members helped design and produce a brochure that is still being used. The purpose of the brochure was both to promote interest in the Floods and to recruit members for the Institute. The Spokane Chamber of Commerce provided a home base for the Institute in this formative period.

Over the course of the year (1994), the Institute became active and visible in promoting the concept of a comprehensive interpretive program. Presentations were made to tourism and business groups, and statements of support were received from several Chamber of Commerce groups. One Institute member in particular, Karen Wagner of Moses Lake, Washington, Chamber of Commerce, became a leading advocate for the Floods initiative. The Institute and its objectives were featured in a number of newspaper articles.

As a functioning group, the Task Force became less active, and then went on standby, intentionally awaiting funding for a study. The Institute continued the

effort, relying on interest and support from the private sector. The Institute benefited from the continuing interest and participation of some agency and university personnel and retired staff who were members of the Task Force. In addition, the BLM Spokane office provided meeting space to the Institute for a number of years.

An important legacy of the Task Force period is the "Great Floods" video, which became available in 1994 and has been selling steadily ever since. The video has proved to be very useful in making presentations to a wide variety of audiences.

In 1995 an important item appeared—Michael Parfit's excellent article, "The Floods That Carved the West," in *Smithsonian* magazine (April 1995). The article immediately became one of the prime informational pieces about the Floods; the Institute was included in the list of "additional sources."

One of the remarkable events in the history of the Institute was its collaboration with NASA, Arizona State University and the Jet Propulsion Laboratory (JPL) in the fall of 1995. In preparing for the Mars Pathfinder mission, NASA, ASU and JPL sent a team to the Channeled Scablands to examine Floods features that apparently are analogous to features on the surface of Mars. The Institute helped with arrangements for the visit, and in the exploration of the Scablands. The project was very well publicized.

At the time, the publication of the *Smithsonian* article and the visit by NASA were encouraging, but overall the Institute was facing a rather difficult period. Substantial commercial support had not materialized, and there was little apparent progress toward the goal of a comprehensive interpretive program. The Institute moved its base of operations from Spokane to the Ritzville Chamber of Commerce, then to the Odessa Economic Development Committee, and finally to the Moses Lake Chamber of Commerce, where it currently has its headquarters.

Some individuals who had been involved in the Task Force and the Institute dropped out. A small group remained to hold the Institute together and to keep the idea of a coordinated interpretive program alive, and they succeeded. No one could know that within about three years, a ground swell of media and public interest would emerge.

This small, yet growing group of dedicated individuals persevered for several years, sharing their enthusiasm amongst themselves and with others. In October 1996 the Institute offered its first field trip, led by a retired USGS geologist and Task Force member. It included sites in the Spokane and Idaho Panhandle area. It was originally hoped that field trips would be an annual activity, but none was offered in 1997.

A new guidebook appeared in 1997: *Fire, Faults & Floods: A Road & Travel Guide Exploring the Origins of the Columbia River Basin,* by Marge and Ted Mueller (University of Idaho Press). The book covers the Columbia River Basalt flows, as well as the Ice Age Floods.

After years of effort, a dramatic turning point came in 1998. From the following events, it is clear that interest in the Floods had reached a remarkable level:

- Grant County Commissioners (WA) voted to assist financially in the operation of Dry Falls Interpretive Center, in order to keep the center open seven days a week in the summer season.

- The governing boards for Washington State Parks and the Idaho Department of Parks and Recreation passed resolutions of support for the proposed NPS Study.

- KSPS (Spokane) began production of a one-hour TV show on the Floods, to be shown in the spring of 2001.

- Oregon Public Broadcasting (Portland) aired a new half-hour show on the Floods.

- Discovery Channel included a segment about the Floods in a two-hour show titled "Amazing Earth."

A particularly significant event in 1998 was the publication of the large map, by the Northern Region (Region 1) of the U.S. Forest Service (USFS) in Missoula, Montana, "Glacial Lake Missoula and the Channeled Scabland." The map, which shows the whole region affected by the Ice Age Floods, went on sale late in the year and quickly became a best-seller. By February 2000 the map had gone through three printings and 15,000 copies had been sold. As a gauge of public interest in the Floods, these figures are hard to ignore.

None of the projects listed above were a direct result of Institute initiatives, but the Institute was active in encouraging and/or publicizing these projects.

In the Institute's own program, three developments were noteworthy in 1998:

- The Institute's website was established and continues to be hosted by the Idaho Geological Survey, at the University of Idaho. The site has attracted new members to the Institute, some from outside the region.

- A major field trip was conducted to explore the Glacial Lake Missoula area in Montana, and it received an enthusiastic response in print and broadcast media. The tour was organized and led by a USFS member of the Task Force.

- The Institute, largely through its newsletter, became established as an effective source of information about Floods activities and resources.

The Institute and the Study

After years of effort to have the Floods formally recognized for their significance, the first procedural "giant step" came early in 1999, with the announcement by the National Park Service that funding for the *Study of Alternatives* had been secured through the Congressional appropriations process. The Institute has taken an active part in the conduct of the Study and wholeheartedly supported its objectives. Participation in the Study was the most important activity of the Institute membership in 1999 and 2000, and interest in the Study can be credited for a substantial increase in Institute membership. The prospect of successfully launching an interpretive program has proven to be very effective in generating even greater interest and involvement. Institute members have

made presentations on the Floods and the Study to local groups, and have been working with these groups in order to encourage their participation and input.

Over the course of this Study, Institute meetings were held in conjunction with Study Team and Study Zone meetings. Following several of these meetings, one-day field trips provided opportunities to explore important and distinctive Floods features in five different areas of the region. The field trips were co-sponsored by the Institute and the National Park Service. Though primarily intended for members of the Study Team and the Institute, the tours also were open to schoolteachers and the general public. Staff at local museums and Chambers of Commerce helped with arrangements, and the trips were well reported in the local media.

Each of the field trips was subscribed to full or near capacity, and all were well received. Credit for their success goes to the tour guides' expertise, preparation, planning, and presentation skills. The guides were highly qualified volunteers from the USGS, BLM, USFS, Pacific Northwest National Laboratory, Foundation for Glacial and Environmental Research, Idaho Geological Survey, and the Idaho Department of Parks and Recreation. Six of the guides were members of the original Ice Age Floods Task Force.

The first of the series, held in October 1999, visited dramatic sites near Moses Lake, Washington, including lower Grand Coulee, Dry Falls, and the Drumheller Channels. In February 2000 a tour starting in Vancouver, Washington, explored the pervasive evidence of the volume, force, and load-carrying capacity of the Floods in the Portland-Vancouver basin. In May, a trip from Missoula, Montana, focused on the filling and sudden drainage of Glacial Lake Missoula, and included stops in Missoula, the Clark Fork River Valley, Camas Prairie, and Mission Valley. In September a trip from Richland, Washington, included stops at Wallula Gap, Palouse Falls, and at significant rhythmite beds in the Walla Walla Valley. Also in September a tour was conducted from Sandpoint, Idaho, to the location of the ice dam and to features located in the immediate path of the catastrophic outbursts that occurred when the dam repeatedly failed. Tour stops included Cabinet Gorge, Lake Pend Oreille, and Spirit Lake.

The field trips proved to be very effective in presenting physical evidence of the Floods and in responding to the interest and questions that the Floods story evokes. The Institute and other groups will be expanding opportunities for expert-guided tours to explore the Floods regions.

At the October 1999 meeting, the Institute voted to form an expert Scientific Advisory Panel because of concern about the reliability of Floods information being presented to the public. The Panel reviews technical information developed for Institute projects and materials as well as drafts submitted by reporters and other writers who turn to the Institute for advice. The Panel also prepared a basic fact sheet about the Floods, which serves as a guide for writers and interpreters, and also as a source of general information.

The Institute was also active during 1999 and 2000 in a number of collaborative activities:

- Working with the American Automobile Association (AAA) to include more information about the Floods in forthcoming AAA regional TourBooks.
- Providing referrals to help the Port of Walla Walla (WA) develop an interpretive installation at Wallula Gap, a major site in the Floods story as well as in the cultural and overall natural history of the region.
- Assisting consultants working with Avista Corporation and local Chambers of Commerce in their development of interpretive facilities and a scenic byway in the Cabinet Gorge Dam area and along the lower Clark Fork River.
- Working with charter flight companies to promote aerial sightseeing services over the landscape created by the Floods.
- Beginning discussions with CarTours, an organization that produces cassette and CD touring guides and is affiliated with the Northwest Interpretive Association.

These connections are indications of the interest of the general community in the Floods story and of the ways the Institute can bring people together and make efficient use of resources and talents.

10. Partnerships

From the beginning, interest in the Ice Age Floods in the late 1980s, partnerships have been an important ingredient. The creation of the Ice Age Floods Task Force brought federal and state agencies together with tribal governments, academia, and private enterprise to examine the potential for creating a structure to interpret the Ice Age Floods story.

Throughout this Study, the need for forming partnerships becomes evident. These future partnerships will have to be formalized by written agreements defining the roles and responsibilities of each partner. These partnerships will have to cover a broad spectrum and not be limited to land management agencies. Examples of the broad extent of partnerships include:

- Chambers of commerce
- Tourism councils and commissions
- County governments
- State agencies
- Tribal governments
- Conservation and environmental groups
- Historical societies
- Geological societies
- City governments
- Visitor and convention bureaus
- Tour companies (automobile, aviation, and marine)
- Federal agencies
- Colleges and universities
- Museums
- Publishing companies
- Economic development councils
- School districts
- Energy corporations
- Private landowners whose land contains Floods resources

A start in developing partnerships has already begun. There were nine federal agencies, six tribal governments, 17 state agencies, and seven colleges and universities involved in some degree during the early planning. Numerous chambers of commerce and visitor and convention bureaus are active in support of the concept. The private sector has been closely involved: it

includes representatives from the hospitality and tourism industry to large power companies such as Avista.

Additional informal partnerships have been developed over the past year. The Seattle (WA) Public School District is working with the study consultant to develop an inquiry-based earth sciences program using the Ice Age Floods story. Various computer and video techniques will be used to develop a teacher's guide and resource section to accompany the student version. Oregon Public Broadcasting (OPB) from Portland, Oregon—the producers of the 28-minute video *Ice Age Flood: Catastrophic Transformation of the West*—and study consultant project manager Jim Sipes are working with the Seattle Public School District to produce an educational poster using the Ice Age Floods story to stimulate the students to learn more about earth science by using the Floods story.

The study consultant, Jones & Jones, has also assisted the Northern Rockies Heritage Center in Missoula, Montana, by producing computer graphics. On a Study Group level, Bruce Bjornstad, Study Zone Chair for the Mid-Columbia Zone, has been working closely with the Columbia River Exhibition of History Science and Technology in Richland, Washington.

As more information becomes available to the public, the public responds by offering to help, and the network of potential partners and partnerships will rapidly grow.

11. Commencement of the Ice Age Floods Alternatives Study

In an effort to develop a coordinated interpretive and educational approach to telling the Floods story across four states, the National Park Service funded the *Ice Age Floods Study of Alternatives and Environmental Assessment* through their Special Resource Study Program. There was consensus within the region among public agencies and private sector partners within the region that such a study was needed. Analyzing Flood features through an inventory system, the study addresses the suitability and feasibility of federal designation and assistance, as well as various options for forming partnerships and developing cooperative strategies. The *Study of Alternatives* will culminate in a final report, to be presented to the Secretary of the Interior for transmittal to Congress.

The work of coordinating the study and completing its reports was contracted to consultant Jones & Jones, a Seattle firm noted for its planning and design expertise. To assist in the project a Study Team was formed. The Study Team consists of members of the original Ice Age Floods Task Force, members of the Ice Age Floods Institute, the project consultants, and the National Park Service.

The study process relied heavily on a partnership between public and private participants. Across the Floods region many local workshops were held to answer questions and invite the participation of residents throughout the region.

The Ice Age Floods Study Team consists of members of the original Ice Age Floods Task Force, members of the Ice Age Floods Institute, the project consultants (Jones & Jones), and the National Park Service.

section e

Examination of Similar Projects

Introduction

A comparison and analysis of projects that have characteristics similar to those of the Ice Age Floods region provided an opportunity to learn from the experiences of others. The objective was to analyze funding, management, interpretation and maintenance of these projects in order to determine the best approach for this study. The Ice Age Floods region is unique, but there are other projects with characteristics that are somewhat similar to the Floods region. These projects are described in greater detail in Appendix F of this report. Many of the projects fall under the NPS Long Distance Trails Program, which consists of 14 National Scenic and Historic Trails totaling 26,000 miles. Each trail is managed through strong partnerships between nonprofit partners and federal and state agencies. The NPS provides administration, technical assistance, and coordination to ensure appropriate protection and interpretation of the trails.

Each project was analyzed by examining such variables as size, uses and activities, management, cooperating partners, visits, features, interpretive elements, staffing, budget and funding, and jurisdiction.

The various projects fall under seven basic headings currently used by the National Park Service. Examples of these area/ projects include:

- National Historic Trails—Oregon NHT, Lewis & Clark NHT
- National Scenic Trails—Ice Age NST, Natchez Trace NST, Potomac NST
- National Heritage Corridors—Illinois & Michigan Canal NHC, Blackstone River Valley NHC, Delaware and Lehigh NHC, Quinebaug and Shetucket Rivers Valley NHC

summary

Examining similar projects, several of which are part of NPS Long Distance Trails Program, provides the opportunity to understand better the options for funding, management, interpretation, and maintenance. Fifteen projects from around the country were reviewed. Many of these projects are considered to be "non-traditional" in their concept, and the Floods region is expected to require a similar approach.

F l o o d s

Bonneville Flood Down the Snake River

The "Bonneville Flood" occurred about 15,000 years ago when the great Lake Bonneville, which covered much of Utah (Great Salt Lake is the minuscule remnant), overtopped Red Rock Pass causing the lake surface to drop 300 feet to the Provo shoreline. The Bonneville flood released 1,000 cubic miles of water The volume of this flood was twice as large as the biggest Missoula flood. However, unlike the Ice Age Floods, the Bonneville Flood occurred over a period of a couple of weeks.

F a c t s

- National Scenic Areas*—Columbia Gorge NSA (USFS)
- National Historic Parks*—Klondike Gold Rush NHP, Nez Perce NHP
- National Reserves—Ice Age National Scientific Reserve
- National Heritage Trail—New Jersey Coastal Heritage Trail

*Although the National Scenic Areas and National Historic Parks appear to be unlike the Ice Age Floods proposal, they were included as similar projects because of the extensive use of partnerships, both governmental and non-governmental, in a non-traditional setting.

See Appendix F for a more detailed description of the similar projects that were examined.

Section 1

Criteria for Designation

The National Park System has grown to include some 380 units since 1872, encompassing national parks, monuments, historic sites, trails, reserves, and other designations. Within this system, the National Park Service has a management mandate to provide for public enjoyment in a way that will leave resources "unimpaired for the enjoyment of future generations." To help achieve this objective, through both policy and law, NPS has a clearly defined process for screening proposals for new park units. This process assures that only the most outstanding natural, cultural, historic, and recreational resources are added to the National Park System by an act of Congress.

Proposals for new national park units may come from the public, state or local officials, Indian tribes, members of Congress, or the National Park Service. Studies are conducted in consultation with appropriate federal, state, and local agencies, and Indian tribes. In addition, public participation is critical. The public is to be invited to participate through informal contacts, workshops, meetings, tours, and opportunities to review draft documents.

To be eligible for favorable consideration as a unit of the National Park System, an area must meet the following criteria:

- Possess nationally significant natural, cultural, or recreational resources
- Be a suitable and feasible addition to the National Park System
- Require direct NPS management instead of protection by some other government agency or by the private sector.

If a unit under study meets these criteria, it can be added to the National Park System by an act of Congress. Congressional committees usually hold hearings on proposed additions to the

Summary

Criteria for Parklands is a National Park Service (NPS) publication that defines the process and criteria used to screen proposals for potential new park units. Since the *Study of Alternatives* is funded by NPS, it must address these standards. Studies must also meet the legislative requirements of Public Law 105-391, the National Park Omnibus Management Act of 1998.

System and ask the Secretary of the Interior for recommendations. Legislation authorizing a new unit will explain the purpose of the unit and outline any specific directions for additional planning, (if necessary) land acquisition, management, and operations.

An addition to the National Park System is only one alternative. There may be other viable local, state, federal, nonprofit, or other management options to consider. The National Park Service also operates several programs that help others preserve natural, cultural, and recreational areas outside of the System.

The term "Affiliated Area" is frequently brought up in regard to the Ice Age Flood, and some clarification of the term is warranted. The *National Parks: Index 1997–1999* describes "Affiliated Areas" as follows:

> *In an Act of August 18, 1970, the National Park System was defined in law as any area of land or water now and hereafter administered by the Secretary of the Interior through the National Park Service for park, monument, historic, parkway, recreational, or other purposes.*

The same law specifically excludes "miscellaneous areas administered in connection therewith"; that is, those properties that are neither federally owned nor directly administered by the National Park Service but which utilize NPS assistance.

The Affiliated Areas include a variety of locations in the United States and Canada that preserve significant properties outside the National Park System. Some of these areas have been recognized by acts of Congress; others have been designated national historic sites by the Secretary of the Interior under the authority of the Historic Sites Act of 1935. All draw on technical or financial aid from the National Park Service. The Ice Age National Scientific Reserve in Wisconsin is an example of an Affiliated Area.

The criteria to be used for designating an Affiliated Area stipulate that the sites must:

- Possess resources that have national significance, and these resources must support interpretation of the story.
- Need some special recognition or technical assistance beyond what is available through existing NPS programs.
- Document that a cooperative arrangement with NPS and adequate contributions from other sources will assure long-term protection of the resource, and be able to establish and continue a standard of maintenance, operations, public service, and financial accountability consistent with requirements of NPS units.
- Be managed by an organization with which the NPS has a formal cooperative relationship.

section 3

National Significance

1. National Significance

An examination of resources for their national significance is the first step in the study process. The *Criteria for Parklands*, a National Park Service publication, lists the qualifications used for screening proposals for new park units to assure that only the most outstanding resources are added to the National Park System.

NPS applies ten specific standards to determine national significance. The Ice Age Floods study region meets four of these standards:

1. The Floods features are *an outstanding example of a particular type of resource.* Identified sites within the Ice Age Floods study area possess extraordinary features that exemplify catastrophic floods of the Ice Age.

2. The Floods region *possesses exceptional value or quality in illustrating or interpreting the natural or cultural themes of our nation's heritage.* Existing Floods resources offer an outstanding opportunity to illustrate and interpret an extraordinary natural phenomenon.

3. The region *offers superlative opportunities for recreation, public use and enjoyment, and/or scientific study.* The proposed Ice Age Floods region ties recreational and visitor use into a comprehensive and coordinated interpretive program across a four-state area. It also provides additional opportunities for scientific study by identifying significant Floods resource areas.

4. Many features in the Floods region *retain a high degree of integrity as true, accurate, and relatively unspoiled*

summary

The Floods region is reviewed to determine if it meets NPS requirements for "national significance," and if the resources within the area are threatened in any way. Level of National Significance is established in part by examining NPS "service themes," which look at both natural and historic themes. Based upon these criteria, the Floods region exceeds the basic requirements for consideration.

Awesome signs of its passage are still visible to this day.

Smithsonian Magazine, The Floods that Carved the West, April 1995.

NPS Photo

The floods carved out more than 50 cubic miles of earth from western Montana to the Pacific Ocean.

examples of the resource. Because of the immense size and extent of the Floods region, many features remain that have high degrees of integrity and are relatively unspoiled.

The *Criteria for Parklands* also includes examples of the types of characteristics that would help define an area or region as being truly unique and worthy of consideration. Four resource evaluations examples listed apply directly to the Ice Age Floods region:

- A landform or biotic area that has always been *extremely uncommon* in the region or the nation.
- A site that possesses *exceptional diversity* or ecological components (species, communities, or habitats) or *geological features* (landforms, observable manifestations of geological processes).
- An area that has outstanding scenic qualities such as *dramatic topographic features, unusual contrasts in landforms and vegetation, spectacular vistas, or other special landscape features.*
- A site that is an invaluable ecological or *geological benchmark* due to an extensive and long-term record of research and scientific discovery.

There are seven National Natural Landmarks (NNLs) located within the Ice Age Floods region. A National Natural Landmark is a nationally significant area that has been designated by the Secretary of the Interior. To be nationally significant, a site must be one of the best examples of a type of biotic community or geologic feature in its physiographic province. The Floods-related NNLs are:

- Wallula Gap, Washington—Glacial outburst waters that crossed the Channeled Scablands during the Spokane floods were channeled through Wallula Gap. For several weeks, as much as 200 cubic miles of water per day was delivered to a gap

that could discharge less than 50 cubic miles per day. Ponded water filled the Pasco Basin and Yakima and Touchet valleys to form temporary Lake Lewis.

- The Great Gravel Bar of Moses Coulee, Washington—This bar is perhaps the largest example of bars created by outburst floods on the Channeled Scabland. The bars are well-preserved and have only sparse vegetation.

- Drumheller Channels, Washington—The site is a spectacular tract of butte-and-basin scabland and provides excellent geomorphic evidence for late Pleistocene catastrophic floods on the Columbia Plateau.

- Grand Coulee, Washington—Grand Coulee is the largest coulee in the Columbia Plateau and is probably the world's finest example of a recessional cataract gorge.

- Crown Point, Oregon—The Crown Point section of the Columbia Gorge illustrates more gradual stream valley formation as downcutting kept pace with the rise of the Cascade Range. The Columbia River Gorge at Crown Point passes from the steeper, more rugged terrain of the western slopes of the Cascade Range to rolling cultivated plains. The promontory provides a strategic vantage point for observing this classic illustration of riverine process.

- Willamette Flood Plain, Oregon—The site represents the largest remaining native and unplowed example of bottomland interior valley grasslands in the North Pacific Border natural region.

- Giant Flood Ripples, Montana—During is maximum stages, Glacial Lake Missoula had a surface area of 2,900 square miles and contained more than 500 cubic miles of water. With the failure of the ice dam near Cabinet Gorge, the lake drained in just a few days, releasing catastrophic floods of enormous magnitude across the Columbia Plateau. This catastrophic flood withdrawal was recognized by J. T. Pardee. He described various types of evidence such as scouring, high eddy deposits of flood debris, flood bars of boulders and coarse gravel, and a succession of giant arcurate ripples or ridges of gravel resting on bedrock surfaces.

The finest examples of these giant flood ripples are found 12 miles north of Perma, Montana. The giant ripples appear as ridges 15 to 50 feet high, 100 to 250 feet wide and from 100 yards to a half mile long. They generally traverse the direction of the current. The form, structure, and arrangement of these features are similar to those of ordinary current ripple marks, but the features are so large that the term "ripple mark" seems inappropriate. It is believed that the giant ripple marks could only have been formed by water at least 800 feet deep, moving over Markle Pass at velocities up to 55 miles per hour.

Floods

Highest Velocity of the Flood Waters

Along the entire flood route between Glacial Lake Missoula and the Pacific Ocean, the great floods spread out over wide areas and then funneled through constrictions. The narrowest constriction of all was near Crown Point in the Columbia River Gorge, where all 500 cubic miles of water were forced between tall cliffs only 1.5 miles apart. Like a jet of water exiting a nozzle, the flow accelerated from the narrow opening, probably reaching speeds of 80 miles an hour before slowing and spreading out over the Portland Basin.

Facts

The national significance of these seven NNLs has already been established, and with the addition of a multitude of other Floods-related resources, combine to make the Ice Age Floods region a spectacular assemblage of Floods resources that exceed the requirements for recognition of a nationally significant resource.

Conclusion

Based upon the requirements established in the NPS *Criteria for Parklands*, the Ice Age Floods region exceeds the basic requirements for consideration under the criteria for national significance. These Floods are the greatest scientifically documented floods known to have occurred in North America and are one of three documented geologic areas in the world that experienced catastrophic Ice Age floods of a similar magnitude. In addition, NASA intensely studied the Channeled Scablands for comparisons to similar catastrophic flooding that scientists believe occurred on the planet Mars.

NPS Photo

Palouse Falls State Park, Washington

NPS Photo

Moses Coulee gravel bar, Douglas County, Washington

2. *Integrity*

The term "integrity" has two definitions, both of which are closely related. The first refers to a state or quality of being complete, and the second addresses the quality of being unimpaired or unmarred. One interesting feature of the Ice Age Floods resources is the fact that many Flood resources are still visible and have not been damaged by human development or natural processes over more than 13,000 years. The existing Floods resources captured the interest of Pardee and Bretz, who were able to develop their theories from the things that they could see. The huge scale of the Ice Age Floods region helps in preserving the integrity of the resource; most changes seem minor when considering the enormity of the region and the sheer size of individual features. The immensity of the ripple marks in Camas Prairie, Montana, the width of Dry Falls, and depth of the plunge pools, and 800-foot flood strandlines that are still visible all contribute to exceptional integrity of the Ice Age Floods resources. A number of Floods resources are virtually untouched, and many are so resistant to change that even large-scale mining operations have not had much impact.

The fact that several Floods features are within protective management on public lands helps ensure the integrity of the resources. Some private landowners also protect Flood features on their property through voluntary stewardship. Some of these features are designated as National Natural Landmark sites.

Driving through the landscape, a motorist familiar with the story of the Floods and with a knowledge of specific types of Floods features can't help but notice the evidence left behind. This evidence is much the same as it was when Bretz and Pardee made their discoveries.

Conclusion

The Ice Age Floods resources, the majority of which have been largely unchanged for thousands of years, possess a very high degree of "integrity" and meet the requirements of PL 105-391.

Summary

The *Criteria for Parklands* requires that any proposed new National Park Service unit be both "suitable" and "feasible," and that other factors, such as "rarity and integrity of the resources" also be considered. Based upon an evaluation of natural history themes, and history/prehistory themes, the Ice Age Floods region is suitable for inclusion in the National Park System. It is feasible to interpret the Floods story across four states, especially if there is a high degree of cooperation among the states and federal agencies. The Floods region is considered to have a high degree of rarity because of the size and extent of the Floods, the uniqueness of Floods features, similarities with the Mars landscape, and the fact that there is no other area like this in the National Park System.

Section H

Suitability and Feasibility

Since the *Ice Age Floods Study of Alternatives* is being conducted under the *Criteria for Parklands*, one of the principal analyses required is an examination of both the suitability and feasibility of the resources of the Floods region to be part of the National Park System.

1. Suitability

The *Criteria for Parklands* defines suitability as follows:

> An area is considered suitable for addition to the National Park System if it represents a natural or cultural theme that is *not already adequately represented in the National Park System*, or is not comparably represented and protected for public enjoyment by other federal agencies; tribal, state, or local governments; or the private sector. Adequacy of representation is determined on a case-by-case basis by comparing the potential addition to other comparably managed areas representing the same theme or resource type, while considering differences or similarities in the *character, quality,* or *combination of resource values*. Other essential comparisons include: representation of one of the *most important examples of a particular resource type* in the country, *rarity* of the resources, and *interpretive and educational potential.* The comparison results in a determination of whether the proposed new area would expand, enhance, or duplicate resource-protection or visitor-use opportunities found in other comparably managed areas.

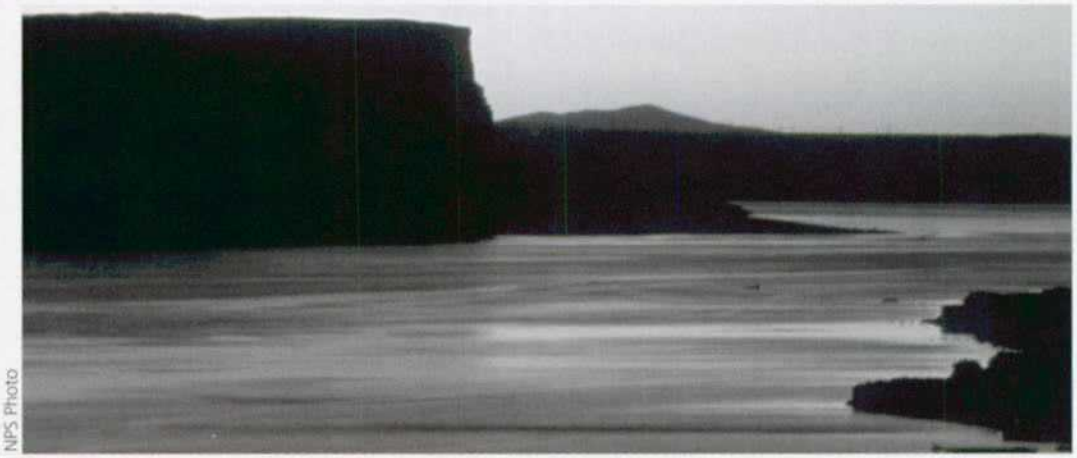
The National Park Service uses a series of natural and cultural themes to evaluate potential areas for inclusion in the National Park System (see Section G). The themes are evaluated by two criteria: 1) Significance and 2) Adequacy of representation within the National Park system.

National Park Service Themes

The National Park Service has developed a thematic framework for evaluating potential and existing units within the National Park System. These themes are found in a two-volume set covering the Natural History and History and Prehistory of the United States. In addition, there is a revised statement for cultural history, which was added June 28, 1994. The basic thematic framework was developed in the 1960s and the cultural history element has been updated to reflect current knowledge or appreciation of events or trends over the past 40 years. The NPS themes can be used to identify areas of national significance that are not currently reflected in the National Park System or to enhance existing interpretive programs.

By its very nature, an area the size of the Ice Age Floods Region will have more than one or two themes as would be typical of smaller NPS units. The themes used for the Ice Age Floods cover Natural History themes and sub-themes, as well as the History and Prehistory themes.

A mass of compressed air preceded the towering wall of flood water. The roar would have increased in intensity beginning a half hour before the onrushing flood struck. The winds reached hurricane strength, uprooted trees, created a blinding dust storm, and caused a shift in microclimate resulting in sudden and severe rainfall.



NPS Photo

The upper Grand Coulee is probably the world's finest example of a recessional waterfall gorge.

NPS Photo

As the floods escaped the channels, the water spread out, leaving boulder-strewn plains.

The themes and sub-themes for natural history that relate to the Floods region are:

Regional Themes	Sub-themes
Landforms of the Present	Mountain Systems Works of Volcanism Sculpture of the Land Eolian Landforms River Systems and Lakes Works of Glaciers
Geologic History	Oligocene to Present
Land Ecosystems	Tundra Boreal Forest Dry Coniferous Forest Grassland Desert
Aquatic Ecosystems	Marine Environments Estuaries Lakes and Ponds

Themes for History and Prehistory

NPS Photo

The J Harlen Bretz Interpretive Center at Sun Lakes–Dry Falls State Park, Washington, is a major Floods interpretive site on State Route 17.

Major Themes

Collectively, five of the nine NPS themes and the interrelationship among them, indicate that there is a remarkable opportunity to present visitors to the Floods region a broad picture of the Nation's natural and culture history from 36.6 million years ago (the Oligocene Epoch) to the present. Emphasis would be on the period of the Floods and subsequent human interaction with the Floods landscape.

I. Peopling Places—examines human population movement and change through prehistoric and historic times.

V. Developing the American Economy—reflects the ways Americans have worked.

VI. Expanding Science and Technology—focuses on science, which is modern civilization's way of organizing and conceptualizing knowledge about the world and the universe beyond.

VII. Transforming the Environment—examines the variable and changing relationships between people and their environment.

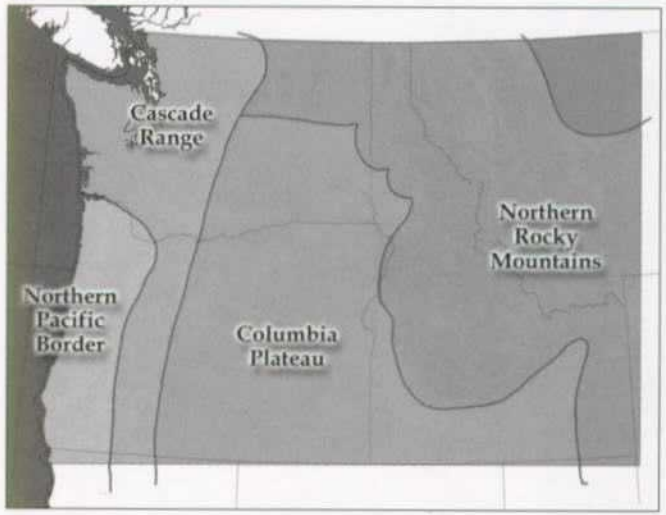
VIII. Changing Role of the United States in the World Community—explores diplomacy, trade, cultural exchange, security and defense, expansionism, and imperialism.

Physiographic Regions

The National Park Service, using Fenneman's *Physiographic Divisions of the United States (1929)* as a basis, divided the United States into 23 separate natural regions or provinces. Four of the regions fall within the scope of the Ice Age Floods proposal:

- **Northern Pacific Border**—the area along the Pacific Coast from San Francisco to the Olympic Peninsula.
- **Cascade Range**—the rugged mountainous area stretching from northern California to the Canadian border.
- **Columbia Plateau**—the vast high plateau between the northern Rocky Mountains and the Cascades and bordered on the south by the Great Basin.
- **Northern Rocky Mountains**—the area of eastern Idaho and western Montana.

The genesis of the Ice Age Floods began with a lobe of the Cordilleran Ice Sheet damming a large river flowing westward out of the Northern Rocky Mountains and impounding an immense lake in western Montana. The ice dam failed a number of times and waters tore across the landscape of the Columbia Plateau and through the breach in the Cascades now called the Columbia Gorge. The flood waters backed up and inundated the Willamette Valley before rushing down the lower Columbia River to the Pacific Ocean through the region now known as the North Pacific Border. Rarely has a study of alternatives covered such a vast area that it includes parts of four physiographic regions. Public understanding of the tremendous size and scope of the existing Floods remnants can only be achieved if the full geographic extent of the phenomena is included.



Physiographic Regions of the Floods region

Evaluation of the Natural History Themes

The following four charts address the Significance and Adequacy of Representation of the natural resources within the study area. It should be noted that the NPS's Natural History evaluations were completed in the 1960s, almost two full decades before J Harlen Bretz's and J. T. Pardee's hypotheses were widely accepted by the scientific community. Since the late 1970s, the academic and geologic communities have tested the catastrophic flood theory and found that Bretz's and Pardee's concepts could be supported and proven. The NPS Natural History evaluations, however, illustrate the awareness of a number of subthemes not represented within the National Park System.

North Pacific Border

NPS Representation	Adequate Representation in NPS		Little or No Representation in NPS	
Significant Levels	Significant	Prime Significance	Significant	Prime Significance
a. Mountain Systems	■			
b. Sculpture of the Land *(see note 1)*				
c. Eolian Landforms			■	
d. River Systems and Lakes			■	
e. Work of Glaciers			■	
f. Oligocene to Present *(see note 2)*				
g. Tundra	■			
h. Boreal Forest	■			
i. Pacific Forest	■	■		
j. Dry Coniferous Forest	■			
k. Chaparral	■			
l. Marine Environments			■	■
m.Estuaries			■	
n. Lakes and Ponds			■	

Cascade Range

NPS Representation	Adequate Representation in NPS		Little or No Representation in NPS	
Significant Levels	Significant	Prime Significance	Significant	Prime Significance
a. Mountain Systems	■	■		
b. Works of Volcanism	■	■		
c. Hot Water Phenomena	■			
d. Sculpture of the Land *(see note 3)*				
e. River Systems and Lakes	■	■		
f. Work of Glaciers	■	■		
g. Caves and Springs			■	
h. Oligocene to Present			■	
i. Tundra	■			
j. Boreal Forest	■			
k. Pacific Forest	■	■		
l. Dry Coniferous Forest	■			
m. Lakes and Ponds	■			

Note 1. Numerous streams and rivers have shaped the landforms within the North Pacific Border prior to, during, and after the Ice Age Floods. During that time period sea level was 500 feet lower, creating the Astoria Canyon, which was steepened by the Floods.

Note 2. The Geologic History sub-theme was added because during the Miocene Epoch (23.7 to 5.3 million years ago), the Columbia Plateau Back Arc spread volcanism throughout the study area. During the Pleistocene Epoch (1.8 to 0.1 million years ago), the Continental Glaciers descended on the Northwest and multiple Ice Age Floods from Glacial Lake Missoula impacted the study area.

Note 3. Numerous streams and rivers cut deep gorges into the rocks and landforms of the Cascades prior to, during, and after the Ice Age Floods.

Columbia Plateau

NPS Representation	Adequate Representation in NPS		Little or No Representation in NPS	
Significant Levels	Significant	Prime Significance	Significant	Prime Significance
a. Plains, Plateaus, Mesas				
b. Mountain Systems				
c. Works of Volcanism				
d. Sculpture of the Land				
e. Eolian Landforms *(see note 4)*				
f. River Systems and Lakes				
g. Work of Glaciers				
h. Oligocene to Present				
i. Tundra				
j. Boreal Forest				
k. Dry Coniferous Forest				
l. Grassland				
m. Desert				
n. Lakes and Ponds				

Note 4. Windblown silt was a significant source of soil deposition within the Columbia Plateau.

Northern Rocky Mountains

NPS Representation	Adequate Representation in NPS		Little or No Representation in NPS	
Significant Levels	Significant	Prime Significance	Significant	Prime Significance
a. Mountain Systems			■	■
b. Sculpture of the Land *(see note 5)*				
c. River Systems and Lakes			■	
d. Work of Glaciers			■	
e. Oligocene to Present *(see note 6)*				
f. Tundra	■	■		
g. Boreal Forest	■	■		
h. Pacific Forest	■	■		
i. Dry Coniferous Forest			■	
j. Lakes and Ponds	■	■		

Note 5. Numerous streams and rivers have shaped the landforms within the Northern Rocky Mountains prior to, during, and after the Ice Age Floods.

Note 6. The Geologic History sub-theme was added because during the Miocene Epoch (23.7 to 5.3 million years ago), the Columbia Plateau Back Arc spread volcanism throughout the study area. During the Pleistocene Epoch (1.8 to 0.1 million years ago), the Continental Glaciers descended on the Northwest and multiple Ice Age Floods from Glacial Lake Missoula impacted the study area.

Conclusion

Within the four physiographic regions of the Ice Age Floods region, there are *four* sub-themes with "Prime Significance and no representation," and *seventeen* sub-themes with "Significant and no representation." This analysis supports the contention that there is a *substantial gap in the adequacy of natural history representation of the Columbia Plateau* within the National Park System. There are also areas of significance in the North Pacific Border and the Northern Rocky Mountains.

F l o o d s

The Route of the Oregon Trail and the Ice Age Floods.

In 1841 the first of the great wagon trains descended the steep Blue Mountains, passed the site of present-day Pendleton, Oregon, and entered onto the sandy and gravel-strewn bottom of an Ice Age floodlake. The emigrants' wagons had narrow metal wheel rims that cut into the sand and gravel and mired the wagons. To avoid the terrible conditions and find firm ground, later the settlers stayed 5 to 7 miles south and parallel to the Columbia River until they crossed John Day River. It wasn't until the wagons reached the present location of Biggs, Oregon, that they saw the Columbia River. The emigrants' goal was the rich soil of the Willamette Valley—deposited there by the Ice Age Floods.

F a c t s

Evaluation of the Cultural History Themes

Cultural History themes overlie the regional landscapes included in the Ice Age Floods study area and complement the Natural History themes. These themes are integral to the interpretive story of the Ice Age Floods. Through analysis, it was determined that five of eight Cultural History themes were applicable to the study region. While the evaluation of Cultural History themes is independent of the geologic story of the Floods, they do "round out" the interpretive story for the Ice Age Floods region.

Peopling Places, Theme I

Nez Perce National Historical Park, Whitman Mission National Historic Site, and Lake Roosevelt National Recreation Area all interpret the culture of the local Native American People, but there is no comprehensive overview of the Plateau people in the National Park System or any other federal, state, or local agency. Interpretive signing throughout the Floods region would expose visitors to the rich culture of the diverse tribes and bands at appropriate sites along the Columbia Plateau and River.

Early British explorers and fur traders and Lewis and Clark's "Corps of Discovery" traversed the heart of the Ice Age Floods region in the early 1800s. In 1809 David Thompson of the North West Company established the trading post "Saleesh House" at Thompson Falls on the Clark Fork River. Lake Roosevelt NRA and Nez Perce NHP tell the story of the fur trade, and Nez Perce NHP, Lewis & Clark National Historic Trail, and Fort Clatsop National Memorial interpret the saga of Lewis and Clark. A coordinated interpretive approach would tie the exciting early history of the Northwest together and correct such omissions as the recognition and location of Saleesh House.

In the middle 1800s thousands of emigrants traveled the Oregon Trail along the Columbia River from below Wallula Gap to Oregon City to settle in the fertile Willamette Valley. The Oregon Trail is adequately interpreted, but additional sites along the Columbia River could add to the quality of interpretation. The U.S. Army played an

important role in surveying and constructing roads across the Columbia Plateau and Northern Rocky Mountains. This facet of Northwest history is not covered adequately in the National Park System. In many places the pathway of the Floods created a topography that aided in patterns of movement and settlement of the Northwest.

The discovery of gold and other precious metals in eastern Washington, northern Idaho, and western Montana brought streams of miners, travelers, and explorers into this sparsely settled area. Gold and silver were the source of great wealth and contributed to the rapidly changing settlement patterns in the mountains of the Northwest.

Developing the American Economy, Theme V

Extractive industries have always been tied to the development of the Northwest. As the wealth of the minerals, timber, water, and grazing land was realized, national and international business interests became involved in the economies of the Northwest. Miners searching for metals and other precious minerals focused their interest in northern Idaho and western Montana. The timber industry, utilizing private and public lands, produced timber products that enhanced local and regional economies. Fishing and the raising of livestock completed the triad of extractive industries through boom and bust. Nez Perce NHP interprets early mining in the area but misses the large number of mining sites in the Panhandle of Idaho. Grant-Kohrs Ranch National Historic Site, Deer Lodge, Montana, interprets ranching as it was near the Continental Divide.

Power and energy industries that made day-to-day lives easier for people throughout the region also helped develop the Northwest. During the last half of the 20th century, atomic energy and hydroelectric plants provided cheap energy for homes and businesses. Hydroelectric dams also provided dependable irrigation water for agricultural uses in what became known as the Inland Empire. The majority of these businesses unknowingly utilized remnants of the Floods—resources such as steep canyons, carved coulees, gravel bars, and scoured riverbeds—to construct their facilities.

In the early 1880s agriculture played an important part in the settlement of the Northwest. Wheat became the major crop for farmers in central and eastern Washington. When large amounts of water for irrigation became available in the 1940s, orchards and vineyards sprang up along the rivers and lands within the Columbia Basin Irrigation Project.

Riverboats and overland trails were the major forms of transportation during the early settlement of the Northwest. When the railroads expanded into the Northwest, railroad representatives sold land cheaply to farmers in order to develop a source of agricultural products. These products were then shipped to market and finished goods returned for sale to the farmers by a network of rails.

The development and the contribution of power, agriculture, and transportation are not interpreted comprehensively within the region.

Expanding Science and Technology, Theme VI

The disciplines of Physical Geography and Geology both have made extensive use of the Ice Age Floods region. In

> "The majestic [Grand] Coulee tells a heroic tale of vanished power far transcending that of Niagara, and beggering the leisurely story of . . . even the Grand Canyon of the Colorado."
>
> J Harlen Bretz

many parts of the Northwest, past geologic processes can be clearly seen because of the arid climate, lack of vegetation, and sheer scale of the geological events. Physical geography and geology come alive and are more easily understood when a visitor stands at Dry Falls gazing at the water-carved plunge pools, or discovers the strand (highwater) lines of a former glacial lakeshore 900 feet above the city of Missoula, Montana.

Transforming the Environment, Theme VII

The Ice Age Floods did much to alter the visual and physical character of the landscape along the pathways of the Floods. Although their impacts may have been less dramatic, man-made impacts have also transformed the environment. With the increase of population in the Northwest came the rapid development of towns and cities and problems associated with urbanization. Accompanying industrial development in the timber industry, mining, agriculture, and hydroelectric power generation contributed to additional transformation of the regional environment.

The Great Depression and the New Deal drastically changed the economies and landscape of the Columbia Basin with the development of Grand Coulee Dam and the Columbia Basin Irrigation Project. Today, the effects of irrigating the Basin can be seen in many areas within the Channeled Scablands of central Washington. The U.S. Bureau of Reclamation has an outstanding visitor center at Grand Coulee Dam that interprets the dam and irrigation project.

Changing Role of the United States in the World Community, Theme VIII

At the top-secret Hanford plant, located near Richland, Washington, plutonium was produced for use in one of the atomic bombs used to end World War II. The plant got most of its power from Coulee Dam and continued to provide material for atomic weapons and other uses for the United States through the Cold War era. The Columbia River Exhibition of History, Science and Technology in Richland, Washington, has several excellent exhibits that focus on development and life at Hanford during World War II.

Rarity and Integrity of the Resources

Public Law 105-391, Title III, "Additional Areas for National Park System," specifies that in addition to the test of "suitability and feasibility," consideration be given to a number of other factors, including "the rarity and integrity of the resources."

Rarity

The Ice Age Floods of the Pacific Northwest are the greatest scientifically documented floods known to have occurred in North America and are considered by geologists to be truly unique. It should be noted, however, that once geologists accepted the idea of catastrophic flooding, evidence of such events, and of glacial lakes, was found in Europe, Asia, and North America. Thousands of lakes were formed when ice started to melt, filling up deep valleys that were dammed up by silt, gravel, ice, and clay. Many of these lakes have drained over the years, but some still remain, including Lake Pend Oreille, Coeur d'Alene Lake, and Flathead Lake. Even those that have long since disappeared have left signs of their existence with features such as visible shorelines, lake strata, and outlet channels.

NPS Photo

Evidence of catastrophic flooding, such as this boulder field, stretches from western Montana, to the Willamette Valley, and to the mouth of the Columbia River.

Other Ice Age Floods

The largest known glacial lake is Lake Agassiz, which was named after Louis Agassiz, a Swiss-born geologist who gathered information on glaciers throughout Europe and North America. Agassiz was considered the "father" of the Ice Age concept. The lake is located in the Canadian Providence of Manitoba where Lake Winnipeg currently exists. Lake Agassiz was formed at the edge of the retreating glaciers around 8,000 years ago. It covered an area more than four times the size of Lake Superior. When the ice dam holding the water collapsed, the resulting flood was

enormous. Scientists estimate that globally the level of the ocean rose by 20 to 40 centimeters as a result of this flood! Unlike the Ice Age Floods, Lake Agassiz only flooded once, but it dramatically changed the landscape of the region.

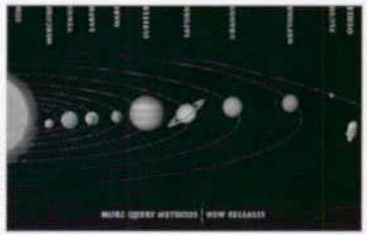
Ice Age Lake Bonneville, which existed around 14,500 years ago, covered more than 20,000 square miles in Utah and parts of Idaho and Nevada. For hundreds of years, the water level of Lake Bonneville maintained a fairly constant level. The water level dropped almost 400 feet when part of Red Rock Pass, which was holding back the water, eroded. The floodwaters flowed down the Snake River and joined the Columbia River near the Tri-Cities. For a short period of time, the resulting floodwaters from Lake Bonneville increased the size of the Snake River and the Columbia River by more than 20 times their normal flow. After the flood occurred, the water levels of the Great Salt Lake eventually subsided close to what they are now. Lake Bonneville drained only once, with catastrophic results.

Catastrophic floods also occurred in the Kuray Basin, which is located in the Altay Mountains in south central Siberia. The glacial lake in Kuray Basin was formed when ice filled the Aktash Valley and a glacier blocked the Chuja River in the Madjoi River Valley. The floods occurred when the ice dam holding back the water failed. The source lake and floods occurred sometime in the late Pleistocene period around the same time as the Missoula Floods. Remnants from the Altay Mountain Floods are much like those from the Ice Age Floods—scouring, high water marks, channelways, giant gravel bars, erratics, and huge ripple marks.

Geologists have estimated that the water in the Kuray Basin lake must have been at least 1,600 feet deep to form the landscapes in the area. Although research of the Kuray Basin floods is somewhat limited, the peak discharge of the floods may have been slightly greater than that of the Ice Age Floods. The floodwaters probably scoured the gorge in much the same way the Ice Age Floods scoured the Channeled Scablands.

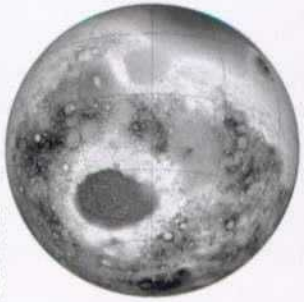
Even today, destructive floods from ice dams are still occurring, although on a much smaller scale. In 1982, for example, Hubbard Glacier blocked Russell Fjord in upper Yakutat Bay, Alaska. When the ice broke a torrent of brackish water emptied into the ocean. Similar floods have occurred in Alaska, western British Columbia, and Iceland.

Glacial lakes that form today are not nearly the size of Glacial Lake Missoula. Many, such as Sndre Strmfjord on the Greenland glacier, are small seasonal lakes, and they usually freeze up in the winter.



NASA Photo

Planet Mars, fourth from the sun.



NASA Photo

Channels and boulder fields on Mars resemble parts of the Channeled Scablands of eastern Washington

NASA Photo

NASA scientists studied the Channeled Scablands in Fall 1995 to prepare for the Mars Pathfinder mission.

Floods on Mars

Studies of early Martian history indicate that at one point the planet contained an abundance of water. The planet is covered with features that are best explained by the movement of water, either in catastrophic floods or by the slow movement of groundwater. The Mars Channels are thought to have been formed by catastrophic floods of water from massive groundwater reservoirs. The water would have flowed across the terrain, with the upper surface freezing and the lower depths continuing to flow, much as a frozen river might.

Researchers from NASA's Jet Propulsion Laboratory (JPL), Arizona State University, and the Lunar and Planetary Institute in Houston studied the Channeled Scablands area of eastern Washington because it is similar to Ares Vallis, a region of Mars located northeast of the Valles Marineris canyon system. The Mars Pathfinder lander and rover, which landed on Mars in July 1997, set down in Ares Vallis. Pathfinder was the first spacecraft to land on Mars since the Viking Lander 1 touched down on the surface of the planet in 1976. Ares Vallis is much larger than the Channeled Scablands, but the landscapes of the two are very similar.

According to scientists at JPL, a catastrophic flood similar to the Missoula Floods occurred on Mars in the Ares Vallis flood channel, washing rocks and sediments from highland regions into the flood basin. Millions of years ago much of Mars was covered with water, and massive floods flattened some parts of the planet while other floods gouged seven-mile-deep canyons. Many planetary scientists theorize that the water on Mars drifted into space about 3.5 billion years ago. Some water also appears to have frozen on the planet's surface, and some may have settled into the ground.

NASA researchers have investigated the spillover paleoflood channels connecting large basins in the northern plains of Mars. These channels are a series of braided channels approximately 500 km

NPS Photo

Islands of loess soil remain where the floods carved down to bedrock nearby.

long and 130 km wide that connect the Elysium and Amazonis basins. Scientists even suggest that some of these floods were moving at speeds of up to 100 miles per hour, could have lasted for weeks or even months, and were considerably larger than the Ice Age Floods.

The floods on Mars were on such a monumental scale that they probably would have altered the climate for the entire planet.

Scientists don't know exactly how the outflow channels on Mars were formed, and probably won't until they can do fieldwork on the planet. By coming to the Channeled Scablands, they gained valuable firsthand exposure to the kind of surface features a rover was likely to encounter at Ares Vallis.

Individual Floods Features

The rarity of the Ice Age Floods resources stems from the composite collection of Floods resources and their juxtaposition, rather than the rarity of a single feature. As part of the inventory process used in this study, Ice Age Floods resources across four states have been identified, located, and described. For

NPS Photo

Rhythmites in the Walla Walla valley, Washington, with each layer representing an individual flood.

M. Sear/Columbia Basin Herald

A Wilson Creek road offers a view of the composition of a longitudinal bar.

example, within the Channeled Scablands of eastern and central Washington, some of the different types of Floods features or resources that can be found include erosional and depositional features such as:

Erosional

- Hydraulic constrictions
- Basins and buttes
- Hanging valleys
- Plunge pools
- Basalt outcroppings
- Potholes
- Inner channels
- Coulees
- Streamlined loess hills
- Dry cataracts
- Longitudinal grooves

Depositional

- Erratics and huge boulders
- Gravel and sandbars
- Expansion bars
- Pendant bars
- Shoulder bars
- Berg mounds
- Rhythmites
- Braided channels

Taken individually, many of these features are not unique and would not be considered "rare." But when combined with other features, such as entrapped lakes, giant current bars, flood strandlines, and spillways, the array of Flood features is evidence of an incredible series of events that are indeed rare and unique.

Conclusion

Because the Floods region records the greatest multiple flooding event documented in North America, has similarities with the Mars landscape, and has a unique combination of individual Floods features, it is safe to say the Ice Age Floods region has a high degree of "rarity."

Similar Resources Already Protected

Public Law 105-391 directs that the following factor be considered: "Similar resources already protected in the National Park System or in other public or *private* [emphasis added] ownership." The majority of land within the Ice Age Floods region is privately owned. There are also specific Floods features that are protected by public ownership. Some private landowners are voluntarily protecting Floods features on their property. Because of the immense scale of the Floods region, the number of individual landowners runs into the thousands.

"My interpretations of the channeled scabland should stand or fall on the scabland phenomena themselves."

—J Harlen Bretz

Within the NPS, there are two areas in Wisconsin that relate directly to the last Ice Age: (1) the Ice Age National Scientific Reserve, and (2) the Ice Age National Scenic Trail. For the most part, the similarity ends with the words "Ice Age" in their titles.

The Ice Age National Scientific Reserve was set aside in 1964 to "assure protection, preservation, and interpretation of the nationally significant values of Wisconsin continental glaciation, including moraines, eskers, kames, kettle-holes, drumlins, swamps, lakes and other reminders of the Ice Age." The Ice Age National Scenic Trail was created in 1980 in an effort to connect the moraines as part of a system involving six of nine units of the Ice Age National Scientific Reserve. The moraines were evidence of the farthest advance of the last glacier in Wisconsin.

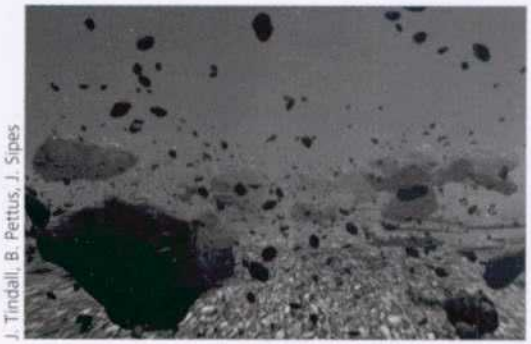
There are many differences, but three main differences are obvious:

1. Size—the Ice Age National Scientific Reserve encompasses 32,500 acres while the Ice Age Floods region covers more than 16,000 square miles (around seven million acres) and a linear distance of almost 600 miles.
2. Formation—the Wisconsin areas are tied, primarily, to the terminus of the Continental Icesheet that created their Ice Age resources and were formed by slow, gradual processes. The Ice Age Floods resources are tied to catastrophic flooding events that literally ripped across the Pacific Northwest.

3. Ice Sheet—the Wisconsin areas are related to the "Continental Ice Sheet," whereas the Ice Age Floods project is related to a separate ice sheet called the "Cordilleran Ice Sheet" which, for the most part, lay west of the Rocky Mountains.

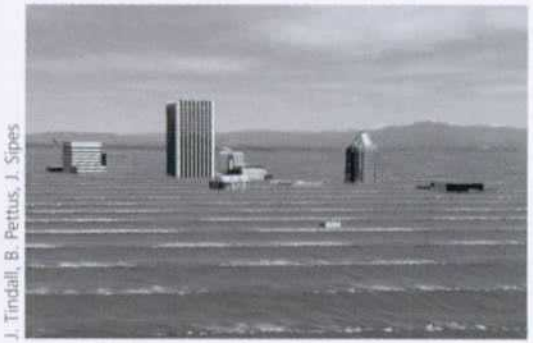
The Johnstown Flood National Memorial, in western Pennsylvania, commemorates the Johnstown Flood of 1889 which was caused by a break in the man-made South Fork Dam. The resulting flood caused the death of 2,209 people and injured thousands more in one of the worst disasters in our Nation's history. The Johnstown Flood National Memorial commemorates a significant disaster resulting from the failure of a man-made dam. The Ice Age Floods region would commemorate a series of geologic events. The two areas have little in common from a resource standpoint. The similarity exists in the management approach where a collaborative public-private partnership is the key to a successful project.

The Ice Age Floods region covers more than 16,000 square miles and a linear distance of almost 600 miles across Montana, Idaho, Washington, and Oregon.



J. Tindall, B. Pettus, J. Sipes

The floodwaters carved out more than 50 cubic miles of earth. House-sized boulders were bounced around as if they were pebbles.



J. Tindall, B. Pettus, J. Sipes

If the Floods occurred today, Portland, Oregon, would look like this, with 300 feet of water covering the city.

Interpretive Potential

The sheer magnitude of the Ice Age Floods offers a number of interpretive opportunities covering both geologic and cultural history of the Northwest. There are seven National Natural Landmarks (NNL) that form the framework of key interpretive Floods sites. Also, there are many Floods sites already on public land where there is little or no interpretation. If these sites and the NNL sites were linked as part of a coordinated interpretive approach along with other roadside interpretation, visitors to the Ice Age Floods region could gain a comprehensive understanding of this particular story of earth science.

The area could be publicized and local and regional Floods tour guides developed with assistance from local, county, and state tourism organizations and chambers of commerce. Because of its size the Floods region also lends itself to organized tours. The proposed coordinated interpretive efforts for the Ice Age Floods region would provide the visitor with a complete interpretive experience utilizing visitor centers, gateway communities to orient the visitors, roadside interpretive markers, guidebooks and brochures, audio-visual materials, and guided tours. Section J of this report covers how and where the interpretive effort should be directed.

Conclusion

Based on the geologic evaluations completed by the USGS and leading universities, and using the National Park Service Natural History themes, the various features and Floods Pathways of the Ice Age Floods region should be considered as highly suitable for consideration as a unit of the National Park System or for other national designation. A suitable management approach would be one that places emphasis on coordinated partnerships, is respective of the multitude of public and private ownerships, and is participatory in its approach. The addition of these Cultural History themes to the Natural History themes makes the Ice Age Floods region even more compelling and more clearly points to the exceptional degree to which this region qualifies for national recognition. However, it should be noted that the Floods region is not suitable for a national park or monument of more traditional designation.

2. *Feasibility*

Traditionally, the National Park Service uses the term "feasibility" in much the same way as the private sector uses the term "cost effectiveness." The two major questions are: (1) whether lands are configured in such a way as to allow for the protection of the land and its resources, and to provide for public uses, and (2) how much money it will take to operate the area. The answers to these two questions determine the feasibility of a project. *Criteria for Parklands* defines feasibility as follows:

> *To be feasible as a new unit of the National Park System an area's natural systems and/or historic settings must be of sufficient size and appropriate configuration to ensure long-term protection of the resources and to accommodate public use. It must have potential for efficient administration at a reasonable cost. Important feasibility factors include landownership, acquisition costs, access, threats to the resource, and staff or development requirements.*

The great gravel bar at Moses Coulee is more than three miles long and as high as a 30-story building.

Size and Configuration

The size of the Ice Age Floods region is sufficient to provide long-term protection of the resources and to accommodate public use. The "park without boundaries" concept focuses on using the resources found on existing publicly owned lands and along federal, state, and county roads for access. This approach negates the need for specific boundaries as seen in most proposals. Rather, the evidence of the Ice Age Floods pathways and its features determines the extent of the region. Public use can be accommodated on existing roads and trails, and visitor support facilities can be found in local communities located near or in proximity to the Floods Pathways.

Access

General access to Floods resources would be along existing federal, state, and local roads. In many cases, Floods resources can be seen from the highway or existing pullouts. In some cases, physical access to a Floods resource on private land

could be restricted, but the resource could still be viewed from a distance. This would allow visual accessibility without compromising the rights of the property owner.

Threats to the Resources

Threats to resources in many NPS units pose significant concerns to planners and future managers. In many cases, the potential threat to smaller NPS units is considerably greater than with larger units simply because there are fewer features, and any impact may be considerable. The Ice Age Floods region, on the other hand, covers an immense area and includes hundreds of individual features such as gravel bars, ripple marks, and glacial erratics. In general, it is safe to assume that most large-scale scenic resources in the Floods region probably will not be greatly affected by human exploitation; however, this may not be the case for smaller-scaled features. Public agencies would be encouraged to protect Floods features on the land they manage. Floods resources on privately owned land cannot be protected without the landowner's cooperation. Education of the public, including landowners with Floods resources, as to the value of the Floods resources is an important element of any interpretive program.

In some cases, gravel bars and similar resources have already been exploited, but the overall impact on the Floods resources is not significant. Smaller resources can be compromised by some landowners, but because of the large number of similar resources the overall effect is not significant.

Because none of the alternatives considered in this study depend upon the acquisition of private land for the success of the project, individual landowners retain all rights to use their land as they wish as permitted within existing local laws. Any arrangements between an individual landowner and local governments or private nonprofit land trusts would not fall within the purview of this study.

The loss of resources under the concept of this proposal is considered to be minimal.

Landownership

Although the majority of land within the Ice Age Floods region is in private ownership, many outstanding Floods resources are located on public land. In Montana many Floods resources are located on U.S. Forest Service land. Most of the Floods resources in Idaho are found on privately owned land, except for those found in Farragut State Park. The Floods resources in eastern Washington and the Channeled Scablands in central Washington are located on both publicly and privately owned land. Much of the public land is managed by either the Bureau of Land Management or the U.S. Fish and Wildlife Service. Public land areas include Sun Lakes-Dry Falls State Park, and the area around Lower Crab Creek, which is part of the Columbia National Wildlife Refuge. Floods resources in the Columbia Gorge are found in Oregon and Washington state parks, U.S. Forest Service lands, and private lands. Most lands within the Willamette Valley are privately owned, as are the lands along the lower Columbia River.

Acquisition Costs

No acquisition of privately owned land would be necessary to create an interpretive tour route for the Ice Age Floods region. Local governments may be interested in acquiring land for interpretive pullouts or additional parking for gaining better access to Floods features. In this situation, it would be the responsibility of the local government to work out an acceptable arrangement with the voluntary cooperation of a landowner. Public land managers would be encouraged to work together in an effort to protect and interpret the Ice Age Floods resources on the lands they administer.

Staff or Development Requirements

Requirements for staffing and development vary depending upon the management option implemented for the Floods region (*see Section L Management Options*). The alternatives for management, with one exception, examine the creation of a cooperative management structure with public funding for a support staff. An example of this structure can be seen in the New Jersey Coastal Heritage Trail, where the National Park Service assists a Commission by funding the operations of a support staff. The use of volunteers and the cooperation of nonprofit organizations can greatly reduce staffing costs.

Costs for developing new interpretive facilities and pullouts, or improving those that currently exist, are considered to be capital costs or investment costs. Funding can be obtained by a combination of approaches, including federal and state highway funds such as Transportation Efficiency Act Twenty-First Century (TEA-21) funds, grant programs, matching grant programs, and an initial start-up program funded by private sector foundation support in the authorizing legislation.

Conclusion

Given the number of public roads and highways following the Floods Pathways and the extent of Floods features that can be found on public lands within the region, it is feasible to interpret the Ice Age Floods across four states. But the degree of feasibility increases proportionately to the level of participation of local, state, tribal, and federal governments, and broad participation by interested citizens from throughout the region. The key to developing a cohesive approach to the Ice Age Floods is cooperative "ownership" of the joint management concept. All levels of government, as well as the private sector, stand to benefit in numerous ways from the creation of an Ice Age Floods interpretive tour route along flood pathways.

F l o o d s

Source Lake and Temporary Ponds During Floods

Lake	Maximum size (square miles)
Glacial Lake Missoula	2,900
Southern Washington	
Pasco & Quincy Basins	2,050
Walla Walla Basin	330
Lower Snake River	300
Above the Gorge	
Umatilla Basin	1,300
Intermediate and tributaries	150
The Dalles Basin	100
Willamette Valley	3,000
Total	10,710

F a c t s

F l o o d s

Approximate Depth Of Water Over Present-Day Areas

City or Place	Depth
Missoula, Montana	950 ft
Spokane, Washington	500
Yakima, Washington	200
Richland, Pasco, & Kennewick, Washington	900
Umatilla, Oregon	1000
The Dalles, Oregon	1000
Hood River, Oregon	900
Crown Point, Oregon	700
Portland, Oregon	300
Willamette Valley, Oregon	300
Woodland, Washington	300
Kelso & Longview, Washington	200
Astoria, Oregon	Present day sea level

F a c t s

Section 1

Study Process

1. Project Approach

Collectively, the project consultants worked with representatives of the National Park Service, the Ice Age Floods Institute (IAFI), and the Ice Age Floods Task Force to make decisions regarding the Floods study. The National Park Service served as the lead project manager. Jones & Jones was responsible primarily for process, organization, and final product development. The IAFI represented the private sector while the IAF Task Force represented the public sector.

Summary

The process developed for the Floods Study was intended to provide an opportunity for the scientific community, community leaders, local stakeholders, and the general public to become actively involved. A Study Team, whose role was to provide guidance, was organized, and the Floods region was divided into four Study Zones. Volunteers within each Study Zone took responsibility for inventorying Floods features. Extensive successful efforts were made to encourage public participation.

The *Ice Age Floods Study of Alternatives* focused on three major subjects:

- Inventory of significant flood features within the four-state area
- Development of concepts for coordinated interpretation and education programs about the floods
- Examination of alternative frameworks for cooperation among agencies and the private sector.

Process

- Define project goals, scope of work, timeline, products, and process
- Solicit public input and maintain open lines of communication
- Establish and organize Ice Age Floods Study Team
- Establish and organize Study Zone Working Groups
- Conduct Study Zone meetings
- Inventory Floods features
- Prepare Draft Report
- Review Draft Report
- Release Draft Report for public review and comment
- Conduct public workshops
- Review and make final changes to draft report
- Complete and present Final Report to Secretary of Interior for transmittal to Congress

2. *Project Schedule*

The *Ice Age Floods Study of Alternatives* was initiated in Fall 1998, with the final report scheduled to be completed by February 2001. Upon completion, the report was submitted to the Secretary of the Interior, and then transmitted to Congress.

Figure I-1 shows the original timeline for the project. The timeline for the study was tied directly into the project contract with the National Park Service, and was developed specifically to meet the objectives for the project.

Some flexibility was built into the project because of the complexity and scope of work, and because much of the work was to be completed by volunteers. Volunteer organizations have their own needs, time demands, and schedules, and it was important to ensure that participation would not be excluded because of time conflicts.

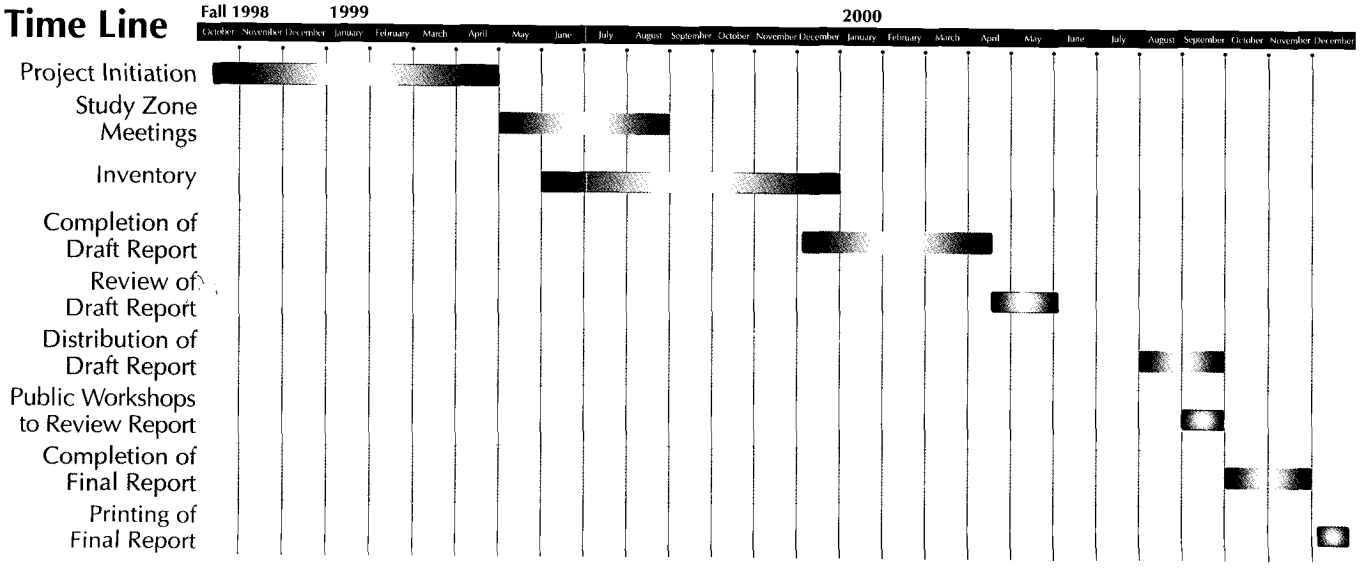
With minor exceptions, the project closely followed the defined schedule. Deadlines for having inventory forms completed were extended because of difficulties in getting some of the Study Zones organized and because there were more identifiable Floods features than anticipated.

3. *Formation of Study Team*

The common goal of the Study Team was the development of a coordinated interpretive and educational approach to tell the Ice Age Floods story throughout Montana, Idaho, Washington, and Oregon.

The Study Team included members of the original Ice Age Floods Task Force, members of the Ice Age Floods Institute, chairs of the four Study Zone Working Groups, National Park Service representatives, and the design and planning team from the consultants, Jones & Jones. The role of the Study Team was to offer suggestions, recommendations, and alternatives to the project consultants, who synthesized the information and produced the Final Report for submission to the National Park Service.

Figure I-1. Alternatives Study Schedule *(revised)*



Study Team Meetings

The first meeting of the Floods Study Team was April 15, 1999, in Spokane, Washington. The purpose of this meeting was to present the study process and the concept of Study Zones, and to organize the Study Team.

On Wednesday, October 13, 1999, members of the Ice Age Floods Alternatives Study Team met in Moses Lake, Washington, for the second planning workshop. The main purpose of this meeting was to develop recommendations from the Study Team and, in essence, create a "collective vision" of how the study region would be managed, interpreted, and designated. There was an overview of zone activities and the status of the inventory as well as reports on IAFI and Task Force activities. The morning session ended with discussions about putting the inventory into database format, the use of GIS for the project, development of graphics and final output, and the need for continuing outreach efforts. The afternoon was devoted to discussions about the timeline, report outline, suitability and feasibility, possible interpretive routes, and management options. Members even reached a consensus of what this "area" should be called: the Ice Age Floods Geologic Region. Later that evening, the Ice Age Floods Institute conducted its regular quarterly meeting. And on Thursday the Study Team participated in an all-day field trip of the Grand Coulee and Drumheller Channels.

On February 9, 2000, the Study Team met in Vancouver, Washington, to review the draft Alternatives Study. This meeting was the first time that the Study Team members had an opportunity to voice their suggestions for improvement and to review the Draft for potential problem areas. Each section of the Draft was reviewed in detail and discussed. Each Study Team member had his or her own copy of the Draft which was turned in, along with handwritten comments from each team member. The meeting was followed by an Ice Age Floods Institute meeting and a tour of the Portland-Vancouver Basin the following day.

The Glacial Lake Missoula Study Zone Working Group and Dale Middleton, Jim Sipes, and Reed Jarvis participated in a video-conference on February 18, 2000. This meeting gave the Missoula group the opportunity to share their opinions. Because of the distance and cost involved, many of the Missoula group could not attend the Vancouver meeting. Their suggestions included expanding some sections, using more graphics and sidebars, changing the reference to "spurs" into "loops" where possible, and sensitivity to the use of certain words that could be misunderstood.

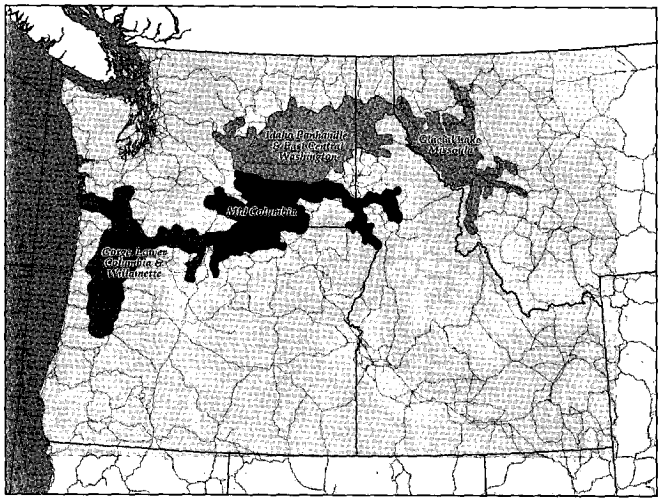
The next Study Team meeting was held in Missoula, Montana, on April 17, 2000. The Study Team reviewed the second draft, which was also the public agency review copy. They made a number of suggestions to improve the study and clarified points the study was trying to make. This was a critical step in preparing the public review draft. The next day the Study Team participated in an all-day field trip of the Glacial Lake Missoula resources, tying many of J. T. Pardee's calculations and field research to the actual sites.

The Study Team met again in mid-November 2000 to be briefed on the recommendations from the public workshops prior to sending the study to the Director of the National Park Service.

4. *Study Zone Working Groups*

Because the Floods path covers more than 16,000 square miles, the study area is too large to function as a single entity. To make the project easier to manage, it was organized into four Study Zones based upon geopolitical considerations:

- **Glacial Lake Missoula**—this Study Zone, which includes most of western Montana, is named for the glacial lake that was the source of water for the floods.
- **Idaho Panhandle & East Central Washington**—includes parts of both Washington and Idaho, including the Pend Oreille, Coeur d'Alene, Post Falls, Spokane, Odessa, Moses Lake, Coulee City, Grand Coulee Dam area, Channeled Scablands areas, Dry Falls, Potholes, and the area north of State Route 26. Route 26 was selected as the southern boundary for the zone because it is easily identifiable.
- **Mid Columbia**—covers the Snake and Clearwater Rivers in Idaho, and parts of southeastern Washington and northern Oregon, including the Tri-Cities, Walla Walla, the area south of State Route 26, Yakima, Umatilla, Hermiston, and west to the John Day Dam.
- **Gorge, Lower Columbia and the Willamette**—includes the area west of the John Day Dam, Stevenson, The Dalles, Hood River, Astoria, Portland, Eugene, Salem, Vancouver, Longview and up the Cowlitz River to Castle Rock.



Four Study Zones through Montana, Idaho, Washington, and Oregon

The Study Zone Working Groups had five major responsibilities:

- Conduct an in-depth inventory of local Floods features
- Conduct interpretive programs for local influence groups
- Work with the media to generate interest in the Study of Alternatives, and the Floods in general
- Host Study Zone meetings, and arrange for locations, dates, and publicity
- Host public workshops to review the draft report for this project

A chairperson was elected for each Study Zone. The primary responsibilities of the chairperson were to coordinate the inventory, manage the outreach programs, help shape the plan, and serve as the key contact for the Study Zone.

Three meetings were scheduled for each Study Zone. The first meeting was used to identify interested individuals, get each Study Zone organized, elect a chairperson, and begin the process of inventorying Floods features. The second meeting continued to focus upon the inventory process, and also included planning for future activities and community outreach efforts. The third meeting provided each Study Zone member an opportunity to review the draft report of the *Study of Alternatives* and to offer suggestions on ways to improve the report. Each meeting lasted two to three hours, with most being held on weekday nights to provide the greatest opportunity for public participation. The Study Zone meetings were open to the public, and efforts were made to publicize the meetings and to invite key individuals, including media representatives.

5. *Public Participation and Outreach*

A key concern of the National Park Service was to make sure there was a high level of public participation in the planning process for this project. As stated in PL 105-391, Congress has strengthened the planning process in an effort to address specific issues and concerns. Public input for the *Study of Alternatives* began at the Study Zone level. One of the purposes for creating the Study Zone Working Groups was to provide a mechanism from which close ties with local citizenry could be established in order to obtain their views and suggestions.

Since the story of the Floods is still not widely known in many areas, each Study Zone Team was encouraged to develop an interpretive team for informing the public of the Ice Age Floods and the *Study of Alternatives*. The task of the interpretive team was to work with local schools, organizations, and civic groups such as the Rotary, Lions, and Elks.

An outreach program was developed for local elected officials, decision-makers, and the local media in an effort to raise their interest in the Study and its potential. Each Study Zone received a slide program developed by the National Park Service's Lake Roosevelt National Recreation Area as well as a 30-minute and 6-minute videotape of a recent PBS television special of the Floods. Oregon Public Broadcasting in Portland, in the fall of 1998, produced this television special.

Some of the products developed for the outreach program of the Study of Alternatives include:

- **An Ice Age Floods brochure**—provided information about the study, timeframe, participants, and purpose of the study, with graphics showing the extent of the Floods and other features.
- **A web page** (www.nps.gov/iceagefloods)—provided the public with information about the project, points of contact, notice of upcoming public workshops and other events, and included the Public Review draft of the Study.

- **A six-minute videotape** condensed from the Oregon Public Broadcasting's *Ice Age Flood: Catastrophic Transformation of the West.* The 6-minute version, which was put together specifically for the Study of Alternatives, was particularly useful for giving people a quick overview of the floods and to set the stage for discussions about how to interpret the resources.

- **Study newsletters** at strategic times during the project. The purpose of these newsletters was to acquaint interested parties and the general public about the study itself.

- **Progress Reports** that were intended to help keep the Study Team informed as to status of the project.

- **A Draft and Final Report** of Alternatives included an analysis of suitability and feasibility of the Floods region for potentially becoming a unit of the National Park System. The study also included an analysis of the national significance of Floods features, along with a range of alternatives that were developed along with the Study Team. The Report addressed options for the coordination and cooperation among the various government agencies, as well as the private sector.

- **Public workshops** were conducted to increase awareness of the *Study of Alternatives* and to solicit public input. They were held in late September and early October 2000 in Portland, Oregon; the Tri-Cities, Washington; Missoula, Montana; Sandpoint, Idaho; and Seattle, Washington. A total of 300 persons attended the public workshops: 26 persons at the Portland meeting; 124 persons at the Tri-Cities meeting in Richland, Washington; 120 persons at the Missoula meeting; 22 persons at the Sandpoint meeting; and 7 persons at the Seattle meeting.

- **Written comments** were also solicited for a 60-day public review and comment period. In addition to comments from participants at the five public workshops, approximately 70 comment letters and e-mail letters were received from private individuals, organizations, and public agencies.

The general consensus of public input from both meeting attendance and written comments was that people generally supported the notion of some National designation to commemorate the Ice Age Floods, either along a designated National Geologic Trail or Floods Pathways. There was considerable support for National Park Service management of the Trail. There was also a strong support for a coordinated regional approach that includes a wide use of partnership and collaborative efforts to tell the Floods story throughout the region. Several reviewers urged that any Congressional designation not authorize the NPS or other entity to have any new land acquisition or regulatory authority in the establishment of the Trail. This concern has been underscored as a recommendation in the final study report.

Many reviewers suggested that various Floods features be afforded additional protection for public appreciation and further scientific study. Several reviewers stressed that hiking trails, horse trails, and water trails be utilized, in addition to auto tour routes, to view Floods features. Many reviewers were enthusiastic about the educational opportunities to expand

school earth science curricula to include the Floods topic. Finally, several reviewers suggested specific actions to enhance the project, including the development of new interpretive centers related to the Floods in places such as Missoula, Montana, and Portland, Oregon.

Outreach Efforts

The following is just a sample of some of the outreach efforts of the Study Team:

- **Newspapers and magazines**—Press releases about the Floods and the Study of Alternatives were sent to major newspapers, magazines, and electronic journals throughout the four-state area. Some of the newspapers contacted include: *Albany Democrat-Herald*, *Cascadia Times*, *Oregon News Network*, *Coeur d'Alene Press*, *Idaho State Journal*, *Idaho Statesman*, *Moscow-Pullman Daily News*, *Lewiston Morning Tribune*, *Missoula Independent*, *Missoulian*, the *Columbian*, *Olympian*, *Puget Sound Business Journal*, *Seattle Daily Journal of Commerce*, *Spokesman Review*, *Yakima Herald-Republic*, *Grant County Journal*, *Columbia Basin Herald*, *Coulee City News Standard*, *Davenport Times*, *Douglas County Empire Press*, *Free Press*, *Grand Coulee Star*, *Omak-Okanogan County Chronicle*, *Tri-City Herald*, the *Odessa Record*, the *Sprague Advocate*, *Wilbur Register*, *Quincy Valley Post-Register*, *Medical Lake Register*, *Othello Outlook*, and the *Wenatchee World*. Magazines and journals contacted include: *Green Teacher*, *Terrain: A Journal of the Built and Natural Environments*, *Discovery Magazine*, *Odyssey*, *Alternatives Journal*, *Awareness Magazine*, *E—The Environmental Magazine*, and *EcoLink*.

- **Web Links**—Reference to the *Study of Alternatives* was added to The EnviroLink Library (www.Envirolink.org/library), a grassroots online community dedicated to providing organizations and individuals with the most comprehensive, up-to-date environmental resources available. The listing includes a detailed explanation of the project and links to related topics and other resources.

- **Specific Articles**—A number of articles were written about the Ice Age Floods and about the Alternatives Study. Dan Spatz, executive editor and general manager of *The Dalles Chronicle*, wrote a timely article ("Interpretive 'trail' may follow ancient floods' course." *The Dalles Chronicle*, 6/21/99) that was picked up and distributed by the AP Wire. Other articles about the floods include: "Trail would explain Ice Age Floods," the *Daily Journal of Commerce*, 7/21/99; "Interpretive project slated for Northwest's Ice-Age floods," *Seattle Post-Intelligencer*; "Trail project to explain impact of Ice Age Floods," *Eastside Journal*, Sunday, 7/4/99; and "Remember the Floods," *Spokesman Review*, 05/30/99; "Ice Age Floods left their mark," *Seattle Times*, 6/4/00; "Flood area plan nears review," *The Dalles Chronicle*, 6/4/00; "A lasting mark: the Ice Age Floods revisited," *Landscape Architecture Magazine*, 5/00; "The Flood and the fury," *Tri-City Herald*, 6/25/00; "Project takes on story of region's Ice Age cataclysms," *The Oregonian*, 11/29/00. Numerous other articles have been published during the review phase of this document.

- **Presentations**—Presentations on the Ice Age Floods and the Study of

Alternatives were made to various groups across the four-state area, including the Geological Society of the Oregon Country, the Federation of Western Outdoor Clubs, the Washington State Transportation Commission, the Assistant Adjutant General of Washington State, selected schools in the Seattle area, WSU Spokane Branch Campus, Washington State Tourism Division, the American Planning Association Annual Meeting (in Seattle), Rotary and Kiwanis groups in Washington, and a Washington State Byways meeting.

- **Tours**—Tours are an excellent way to introduce the public to the wealth of Floods resources. The tours were co-sponsored by the NPS and the Ice Age Floods Institute. Local museums and Chamers of Commerce helped with the tour arrangements.

  On October 14, 1999, Richard Waitt, USGS, and Brent Cunderla, BLM, led an all-day field trip of the Grand Coulee and Drumheller Channels. Two buses and 91 people took a tour that included stops at Wilson Creek, Dry Falls, Blue Lake, Soap Lake, and Lower Goose Lake. Attendees felt that it was a wonderful experience having two experts share their knowledge and help make the study of the Ice Age Floods come alive.

  The Ice Age Floods Institute also sponsored a tour of the Portland-Vancouver Basin on February 10, 2000. It was conducted by Richard Waitt, USGS; Jim O'Connor, USGS; and Scott Burns, Portland State University. Stops were made at an overlook at the Rose City Golf Course, Rocky Butte east of Portland, Chamberline Hill boulder field, Lacamas Lake trough, and a gravel pit in the Mill Plain eddy-pendant bar.

  Another field trip, filling a bus, was held on May 18, 2001, covering the filling and sudden drainage of Glacial Lake Missoula. Ice Age Floods members and USFS geologist Jim Shelden and Norman Smyers conducted the tour that stopped at areas in Missoula, the Mission Valley, Markle Pass/Camas Prairie, and locations along the Clark Fork River.

  Bruce Bjornstad and Ann Tallman led a field trip through the Mid-Columbia Study Area on September 21, 2000, filling two buses. The stops included Wallula Gap, a roadside example of slackwater rhythmites near Walla Walla, Palouse Falls, and areas along the Washtucna Coulee, including a deposit from 75,000-year-old floods.

  The northern panhandle of Idaho was covered by a field trip starting from Sandpoint, Idaho, on September 28, 2000. The tour leaders were Roy Breckenridge, Idaho Geologic Survey; and Bryan Rowder, Manager of Farragut State Park, Idaho. One bus load of professional geologists, teachers, supporters, and interested citizens made stops at the northern shore of Lake Pend Oreille, Cabinet Gorge Dam (in the area occupied by the ice dam that created Glacial Lake Missoula), Farragut State Park, Rathdrum Prairie, and Spirit Lake.

- **Television documentaries**—A six-minute videotape was condensed from Oregon Public Broadcasting's *Ice Age Flood: Catastrophic Transformation of the West*. In addition, KSPS, a PBS television station in Spokane, plans to air a documentary on the Floods sometime during Spring 2001.

F l o o d s

What Is A Varve?

Varves are the individual layers in the layer-cake stratigraphy commonly found in lake deposits. For many lakes that freeze over the winter, the super-still water allows deposition of all the fine clays and organic material that were swirling around the lake during the past summer, thus forming a dark layer. In the spring and summer, when lake currents keep things more stirred up, only sand and silt are deposited—forming a light coarser layer. Thus each year, a couplet of layers forms—a dark-clay and organic-rich winter layer, and a light-silt and sand-rich summer layer. These couplets can be counted, like rings on a tree, to measure the time represented by the sequence of varves.

F a c t s

6. *Inventories*

One of the first tasks the Ice Age Floods Study of Alternatives was to complete a Floods resource inventory that covered features in all four states. The inventory located the most significant Floods features and provided a basis for developing an interpretive route of the Floods. It was important to determine critical information regarding accessibility and interpretive potential; this information could become the basis for future planning and management of an Ice Age Floods geologic region.

- Name and location of the Floods feature
- Type of land (private, public, or tribal)
- Geologic classification
- Description of the Floods feature
- Comparison of a specific Floods feature to similar features
- Potential interpretive value
- Visual and physical accessibility
- Proximity to other Floods features
- Types of recreation that currently occur
- Potential hazards or safety issues
- Existing, planned, or potential interpretive activities
- History, legends, myths, and stories associated with a Floods feature

The inventory process was structured so that the public, landowners, students and professionals could participate in the project as well as individually develop an appreciation and understanding of the Ice Age Floods resources.

Blank inventory sheets, along with a completed sample form, were sent to each of the four Study Zones. The inventory sheets offered instructions on how to fill them out and the process was fairly straightforward. Each Study Zone Working Group determined how it was going to accomplish the tasks necessary to complete the inventory forms.

Once the inventory forms were complete, the information was input into FileMaker Pro (FileMaker, Inc.), a popular stand-alone desktop database software application for Macintosh and Windows

users. Once completed users will be able to query, generate reports, and analyze data, as well as seamlessly import and export data from programs such as Oracle 7, or Microsoft SQL Server, Microsoft Access 97, or Microsoft Excel.

The inventory of the Ice Age Floods resources was also used to help determine Floods interpretive routes. To date, more than 350 Floods resources have been inventoried, and additional inventories are still being conducted. The Study Zone Working Groups, after identifying the resource sites, were asked to rank their Floods resource sites whenever possible, and those sites were located on a map of the study area. Using existing public roads, the sites were then connected into Pathways.

Additional inventories will be completed over the next few years to cover sites not included in the first analysis.

GIS Component

A Geographic Information System (GIS) dataset of Floods-related information was used during the planning phase of the *Study of Alternatives*, and will be available for other uses as well. The basic idea was to pull together existing GIS data, input new information collected as part of the study, and create a set of digital tools that can be used for future floods-related projects. The locations of floods features were taken from the inventory forms and used to define points in the GIS data layers. This process was useful for overlaying floods features on maps with such information as roads, land ownership and municipal areas.

The Floods Study Team identified pertinent thematic data layers of information as well as available sources for the information. These layers include information such as the major roads and highways, lakes and rivers, geopolitical

Bretz traversed the entire region first on foot and later in his trusty Dodge 4, an early enclosed-body car. He did this with parties of students and his wife, son, daughter, and collie dog.

—Vic Baker, "Joseph Thomas Pardee and the Spokane Flood Controversy"

boundaries, parks and recreation areas, visitor centers and museums, major trails, extent of flooding and glacial cover, and Ice Age Floods features.

Much of the GIS data used was developed as part of the Interior Columbia Basin Ecosystem Management Project (ICBEMP). The ICBEMP, which is chartered by the Chief of the Forest Service and Director of the Bureau of Land Management, covers eastern Oregon and Washington, Idaho, western Wyoming, western Montana, and portions of northern Utah and northern Nevada.

The final GIS data set was created with ArcInfo, the industry standard GIS program from ESRI, and viewed and manipulated primarily with ArcView.

Because the project covers a four-state area, most floods features, visitor centers, and even cities appear as dots, and roads and rivers appear as simple lines. The GIS data is small-scale for Phase I of this project, but recommendations are to add more detail and resolution in Phase II.

The inventory information eventually will be linked to ArcView, stored as tabular data in a series of rows and columns, and then saved as attributes. The link between map features and their attributes is the basic principle behind how a GIS program works, and is the source of its power. When the map features and attributes are linked, users will be able to access the attributes for any map feature or locate any feature from its attributes in a table.

The entire GIS database and associated attributes for the Floods is intended to be available to interested individuals once it is completed.

7. *Phase II for Inventory and GIS*

The next phase of the inventory, contingent upon funding, would expand upon this initial work and provide a much greater level of information and accuracy. This phase would build upon the initial inventory and would involve revisiting sites, locating them more accurately, improving the description, and reevaluating the resource in terms of interpretive potential.

This additional information could be obtained by revisiting sites and locating them more accurately on the ground by using the Global Positioning System (GPS). Larger floods features could also be measured on-site.

Each GIS thematic layer was categorized according to priority. The highest priority layers will be completed first for Phase I of the GIS development, with lower priority layers being finished as time permits. It is anticipated that less-critical data layers will be completed as part of Phase II. Phase II also recommends a much greater level of detail than was completed in Phase I because of time constraints.

The information obtained from the second inventory would be used to expand the scope and depth of interpretation and would allow development of a more complex route within the four Study Zones.

M. Sear/Columbia Basin Herald

Tours arranged by the Ice Age Floods Institute bring the visitors face-to-face with the evidence of the Ice Age Floods. At Wilson Creek, the visitor can appreciate Bretz's analysis and understand the Floods' impact on the land.

s e c t i o n j

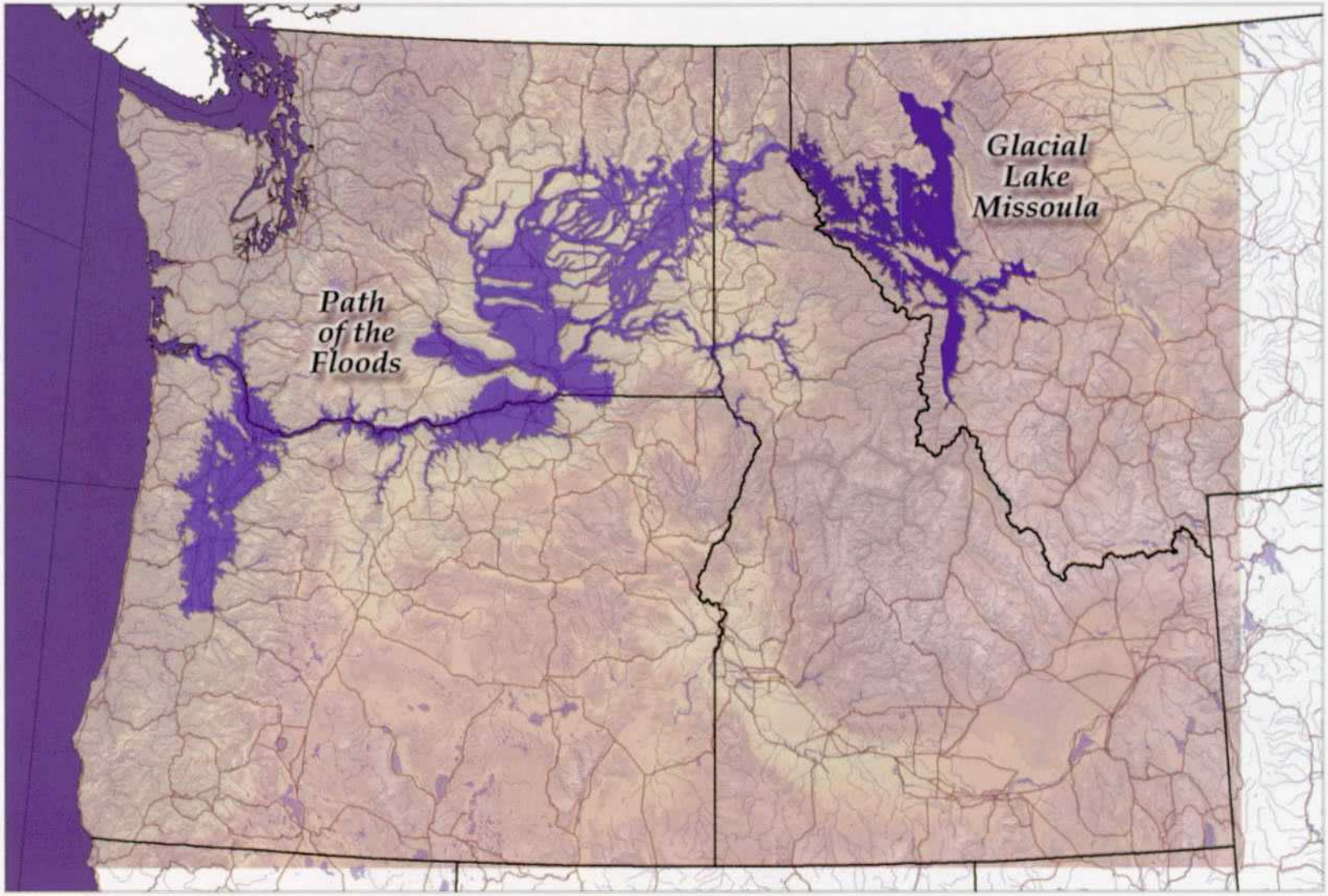
INTERPRETATION

Introduction

The Organic Act of 1916, which created the National Park Service, charged the NPS with not only the task of preserving and protecting the parks' resources, but also to "provide for the enjoyment of the same." The "enjoyment" mandate has come to mean interpreting the meaning and value of the parks' resources to the public. In most cases, interpretation can be provided on-site unless the area is too small or the resources too fragile. The larger the park or area and the larger the number of resources contained in that area, the more complex the interpretation becomes.

The challenge within the Ice Age Floods Study Region is to creatively address three major issues:

1. Identifying Ice Age Floods resources, which are scattered across a four-state area. These specifically include resources related to Glacial Lake Missoula and to the flooding events associated with ice dam failure.
2. Developing physical and visual access to specific Floods resources.
3. Developing an interpretive framework and program for the natural and cultural history of the Floods region.



Area impacted by Glacial Lake Missoula and the Floods

1. Basic Concept

The basic concept developed by the Study Team for interpreting the Floods story is that the study area, which covers a four-state area, be defined as an Ice Ages Floods Geologic Region. Within the Floods Region would be Floods Pathways that follow existing highways. These Floods Pathways would provide visual and physical access to significant Floods features and help link the features as part of a coordinated project.

There are a number of different approaches that can help a visitor understand and appreciate the many and varied aspects of the Ice Age Floods story. Because of the scale of the Floods region, a narrative approach may be the most effective way to develop an understanding of the larger story. This narrative could be in written format or be integrated with a number of multi-media alternatives. The majority of existing Floods features are best experienced in person, either by walking or driving to features, or by flying overhead. Interpretation at specific locations and regionwide could:

- Explain the story of the Floods resources both at specific sites and at regional and other interpretive centers
- Place a site into the context of the larger Floods story
- Explain the geologic background of a site prior to the Floods
- Interpret the cultural history of an area as influenced by the Floods, tying in the dynamic historic story with the geology of each area.

M. Sear/Columbia Basin Herald

Tour groups mix with school groups at Dry Falls Interpretive Center to see remarkable remnants of the Ice Age Floods.

F l o o d s

The Ice Age Floods Created Palouse Falls

Before the great floods, the Palouse River flowed down Washtucna Coulee to join the Columbia River in the Pasco Basin. The huge torrents of the Floods filled and overflowed Washtucna Coulee and swept across the divide down into the adjacent Snake River Valley. This enormous overflow carved back the divide in one place enough to capture the Palouse River, diverting it south to the Snake. The lower 10 miles of the Palouse now flow through a deep spillway. Its last descent is over a 200-foot cliff: Palouse Falls.

F a c t s

2. *Development of a Floods Tour Route Approach*

The original planning concept was to develop Floods Tour Routes and to direct visitors to selected Floods features near major Interstates and U.S. Highways. These routes would be defined as being "primary" or "secondary" based upon the type of road and the number of significant Floods features nearby. After discussions with geologists and other Floods experts, it was agreed that this approach was overly simplistic and would not work as originally intended. With the number and variety of Floods resources, it was felt that visitors would gain greater appreciation and understanding if a number of Floods Tour Routes were identified and marked, allowing a greater variety of sites to visit. If time is limited, visitors could choose conveniently located sites along their way. If they have several days, visitors could see a greater number of sites.

This modified planning concept focused on identifying Floods Pathways that would follow U.S. Highways as well as state highways and local roads, but would stay off interstate highways as much as possible. In some instances, non-motorized trails and water trails could link to certain Floods features. There would be no "hierarchy" of routes based upon importance to the Floods story; all would simply be defined as Pathways providing access to significant Floods features. In many ways, this approach is more in keeping with the paths taken by the original floods.

It should be noted that the original concept was described as an interpretive motor tour, but was rapidly expanded to include auto, train, tour boat, airplane, bicycle and even hot air balloon tours.

F l o o d s

Hydraulic Dam

What is a hydraulic dam? It is the restriction of the rate of water flow caused by a narrowed reach in a river valley. During a valley-filling flood, the narrows restrict flow, thus causing water upstream to pond partly and temporarily. The most spectacular example of a hydraulic dam during the Ice Age Floods was Wallula Gap, which restricted nearly 200 cubic miles of water in a huge, temporary pond in Pasco basin. On the lower Columbia, a narrows near Kalama also briefly ponded floodwater. This narrows thus helped to back up floodwater upstream, flooding not only the Portland–Vancouver basin but also the Willamette Valley to beyond Eugene.

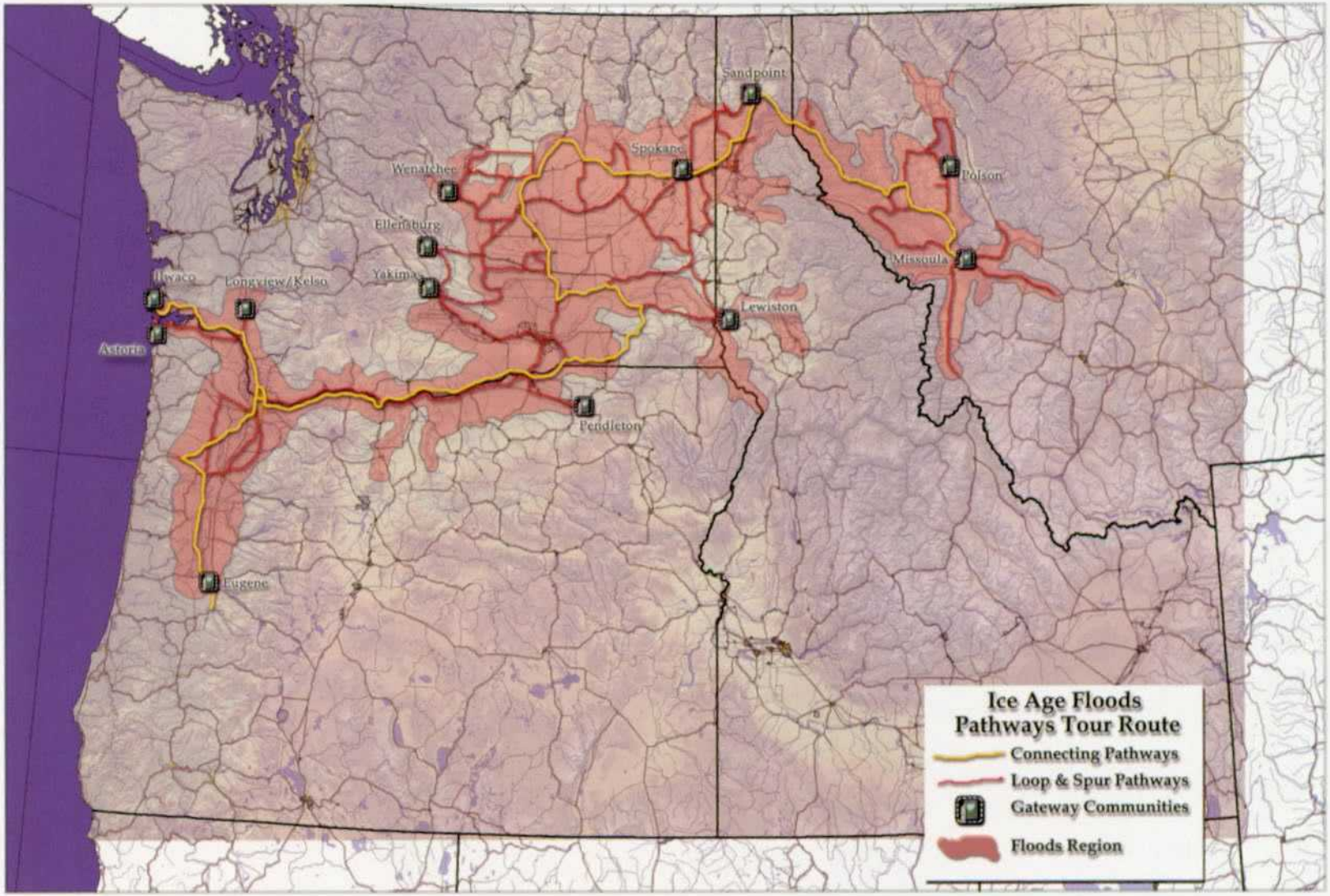
F a c t s

3. The Process of Determining the Most Effective Tour Route

Determining which existing roads and highways would be designated as "Pathways" was based upon two criteria: (1) path of the original flood waters, and (2) the location of significant Floods features, including Glacial Lake Missoula.

The Floods resulted from the release of water impounded in western Montana by ice dams near the mouth of the Clark Fork River. Glacial Lake Missoula extended far upstream from Missoula in several valleys. The lakeshore came within about 15 miles of the contental divide. The volume of water from the Floods was so great that it followed several different channels across the Idaho Panhandle. When the floodwater reached the relatively flat Columbia Basin of eastern Washington, it spread out across three major drainage areas on its way to the Columbia River, Wallula Gap and the Columbia Gorge. At the Gorge, the water was confined to the steep river valley. Farther down the Columbia River, a hydraulic dam was formed at the narrows at Kalama, Washington, and the backwaters flooded south into the Willamette Valley. The Floods continued down the lower Columbia to the ocean, which was 40 miles west of present-day Astoria, Oregon. It was important that Floods Pathways allow a visitor to follow the path of the floodwater from Missoula to the mouth of the Columbia at the Pacific Ocean.

The inventory of the Ice Age Floods resources was used to help determine pathways of the Floods. To date, more than 350 Floods resources have been inventoried, and additional inventories are still being conducted. The four Study Zone Working Groups, after identifying the resource sites, were asked to rank their Floods resource sites whenever possible, and those sites were located on a map of the study area. The intent of the Pathways was to provide access to these sites.



Floods Pathways, Loops, Spurs, and Gateway Communities

F l o o d s

Well-Traveled Meteorite

The Willamette meteorite is the largest ever found in the United States, weighing 31,107 pounds. It was found in 1902 two miles northwest of West Linn, Oregon, at an elevation of 380 feet above sea level. Apparently, an iceberg carried the meteorite along with granite erratics from either the Cordilleran ice sheet or the Purcell lobe in British Columbia to the Willamette Valley. The meteorite must have been moved with the glacial iceflow to near Lake Pend Oreille and then carried downstream with one of the great Ice Age Floods.

F a c t s

4. *Recommended Routes of the Pathways*

Pathways

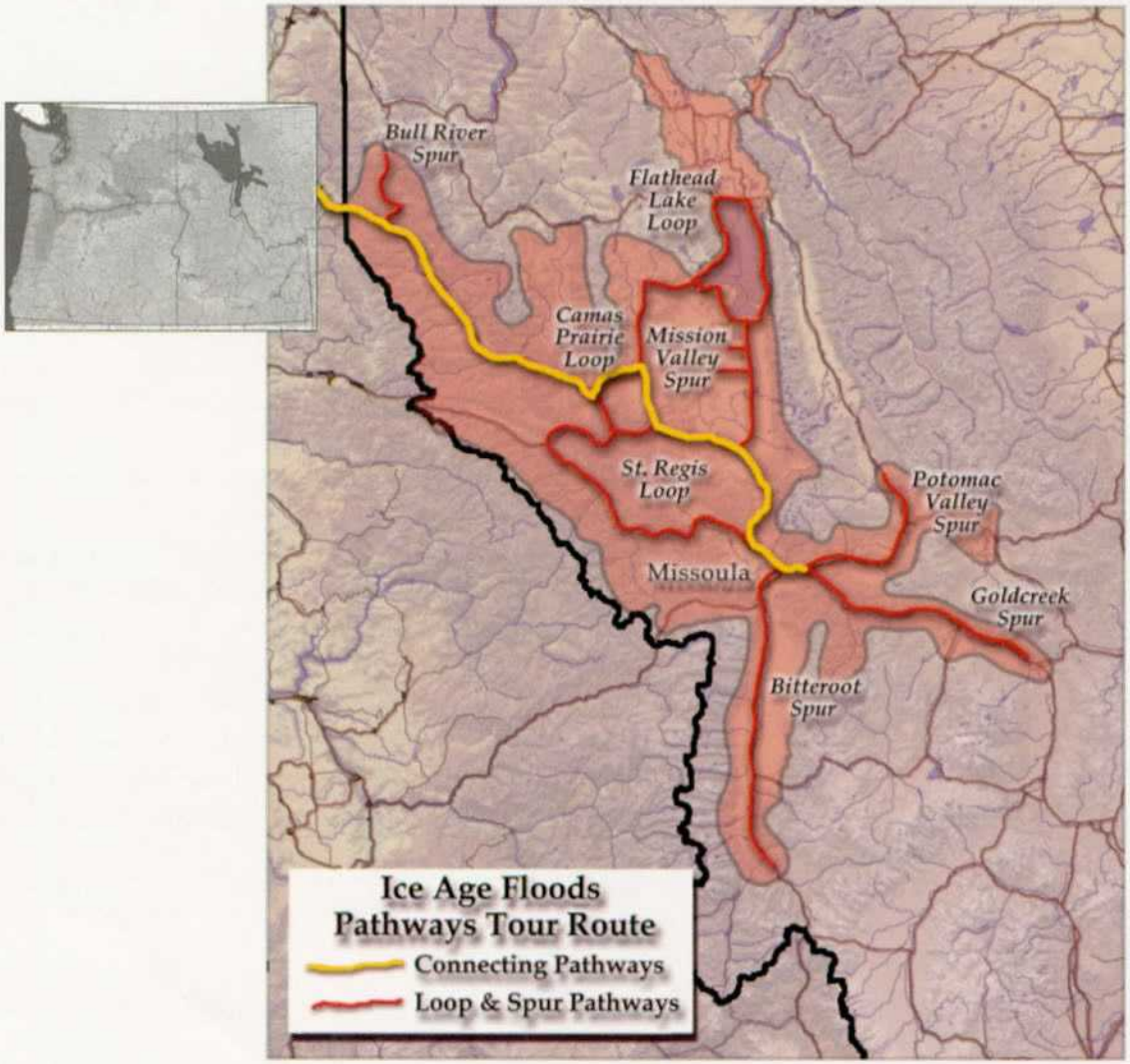
An earlier discussion of the development of a tour route approach examined the desirability of using the term "Pathways" over "Primary" and "Secondary" Floods routes. The use of the generic term "Pathways" does not denote a hierarchy of routes, but is intended to indicate to visitors the various alternatives they can take to see Floods resources. These various alternatives include CONNECTING Pathways, LOOP Pathways and SPUR pathways. Wherever appropriate, Floods Pathways should utilize existing designated state and National Scenic Byways. Public agencies should coordinate with state transportation departments on these opportunities. These recommended routes are intended to be conceptual in nature to illustrate the basic approach. More detailed management planning will be needed to determine specifically the location of routes and interpretive facilities once the area is formally designated.

Gateway Communities

Related to the Pathways are "Gateway Communities," which would be the entry points into the Ice Age Floods region and the network of Flood Pathways. These Gateway Communities to the Floods region are important, because at these points visitors would find out about the interpretive and educational opportunities of the Ice Age Floods region and select portions of the region that might be of interest. Criteria used to identify Gateway Communities should include: (1) proximity to Floods features, (2) significant representative features, (3) accessibility, (4) proximity to the perimeter of the Floods region, (5) connectivity to existing roads, and (6) ability to provide visitor services.

The Study Team identified the following Gateway Communities within or adjacent to the Ice Age Floods Region and the major connecting highway or highways:

- Missoula, Montana—I-90, U.S. Highway 93 and State Route 200
- Polson, Montana—U.S. Highway 93 and State Highways 28 and 35
- Sandpoint, Idaho—U.S. Highway 95 and State Route 200

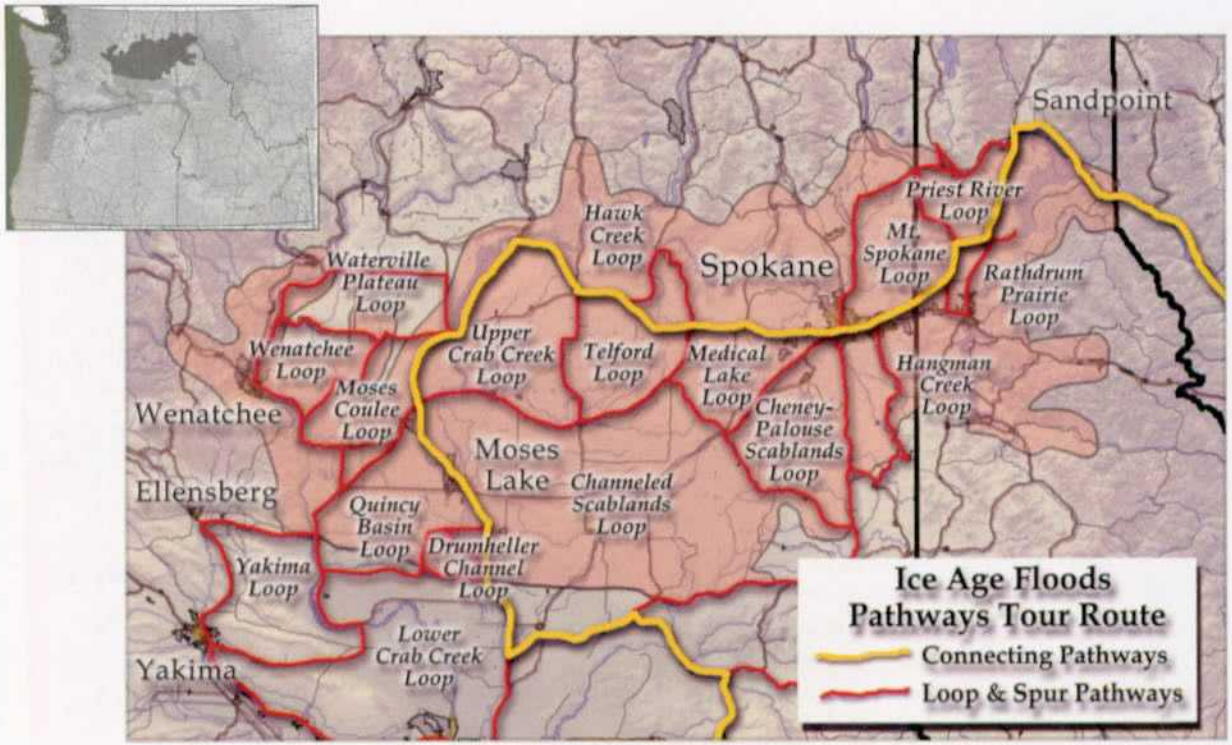


Tour route in the Glacial Lake Missoula Study Zone

- Lewiston, Idaho—U.S. Highways 95 and 12
- Spokane, Washington—I-90 and U.S. Highways 2 and 395
- Wenatchee, Washington—U.S. Highway 2
- Ellensburg, Washington—I-90
- Yakima, Washington—I-82, U.S. Highway 12 and State Routes 22 and 24
- Longview/Kelso, Washington—I-5 and State Route 4
- Pendleton, Oregon—I-84 and U.S. Highway 395
- Eugene, Oregon—I-5 and State Route 58
- Astoria, Oregon—U.S. Highways 101 and 30
- Ilwaco, Washington—State Route 100 (near U.S. Highway 101).

Pathway Routes (Connecting and Loop/Spur Pathways)

The routes of the Pathways range from simple to highly complex, especially in the Channeled Scablands of eastern Washington.



Tour route in the Idaho Panhandle and Central Washington Study Zone

Montana

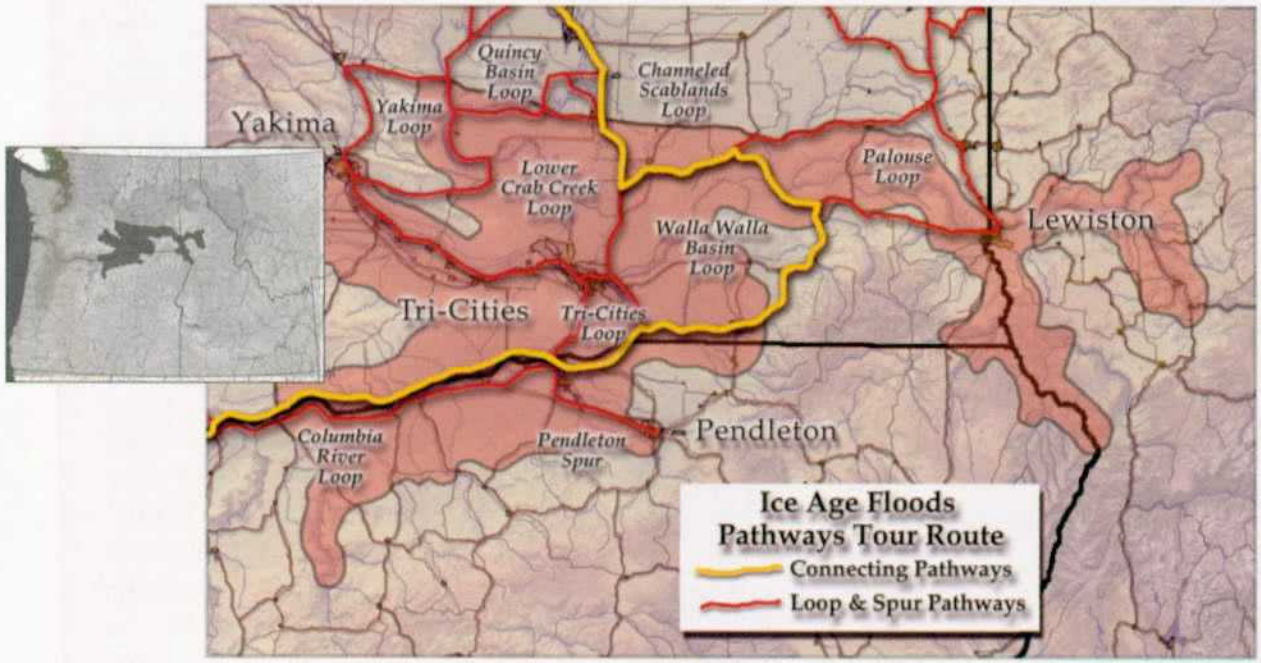
In Montana the Pathways follow I-90 west from Goldcreek to Missoula on the Goldcreek Spur. The Bitterroot spur runs north from Hamilton via U.S. Highway 93 to Missoula. The Potomac Valley Spur leads from Missoula to Milltown and north on State Route 200 and north on State Route 83 to Salmon Lake. Along these spurs are Floods features that are well-exposed, including wave-cut shorelines on the mountains bordering Missoula.

The Floods Pathways route begins in Missoula and proceeds west on I-90 to State Route 93/200 and north to Ravalli, west on State Route 200 to Route 382 and north Camas Prairie and south on State Route 28 to Plains and west on State Route 200 to the Idaho state line. The Flathead Lake Loop proceeds from Ravalli on U.S. Highway 93 to Polson and east and north on State Route 35 to State Route 82 near Big Fork. The loop continues west to Somers and south on U.S. Highway 93 to Polson. The Camas Prairie Loop continues south on State Route 28 at Elmo, past Camas and Hot Sprints to Plains, east on State Route 200 to Perma and north on Route 382. The St. Regis Loop begins at Missoula and progresses west on I-90 to St. Regis, north on State Route 135 to State Route 200 and east to Ravalli and south to I-90 and Missoula. The Camas Prairie Loop passes south of Camas. The giant ripples on Camas Prairie were formed by the fast-moving bottom waters of Glacial Lake Missoula during its draining.

Along these spurs, features evidencing Glacial Lake Missoula are well-exposed, including wave-cut shorelines at Missoula and giant ripples at Camas Prairie formed by fast-moving bottom waters of the lake during its draining.

Idaho

As the ice dam repeatedly failed, flood waters from numerous Glacial Lake Missoulas crashed into the landscape of northern Idaho. The Pathways continue

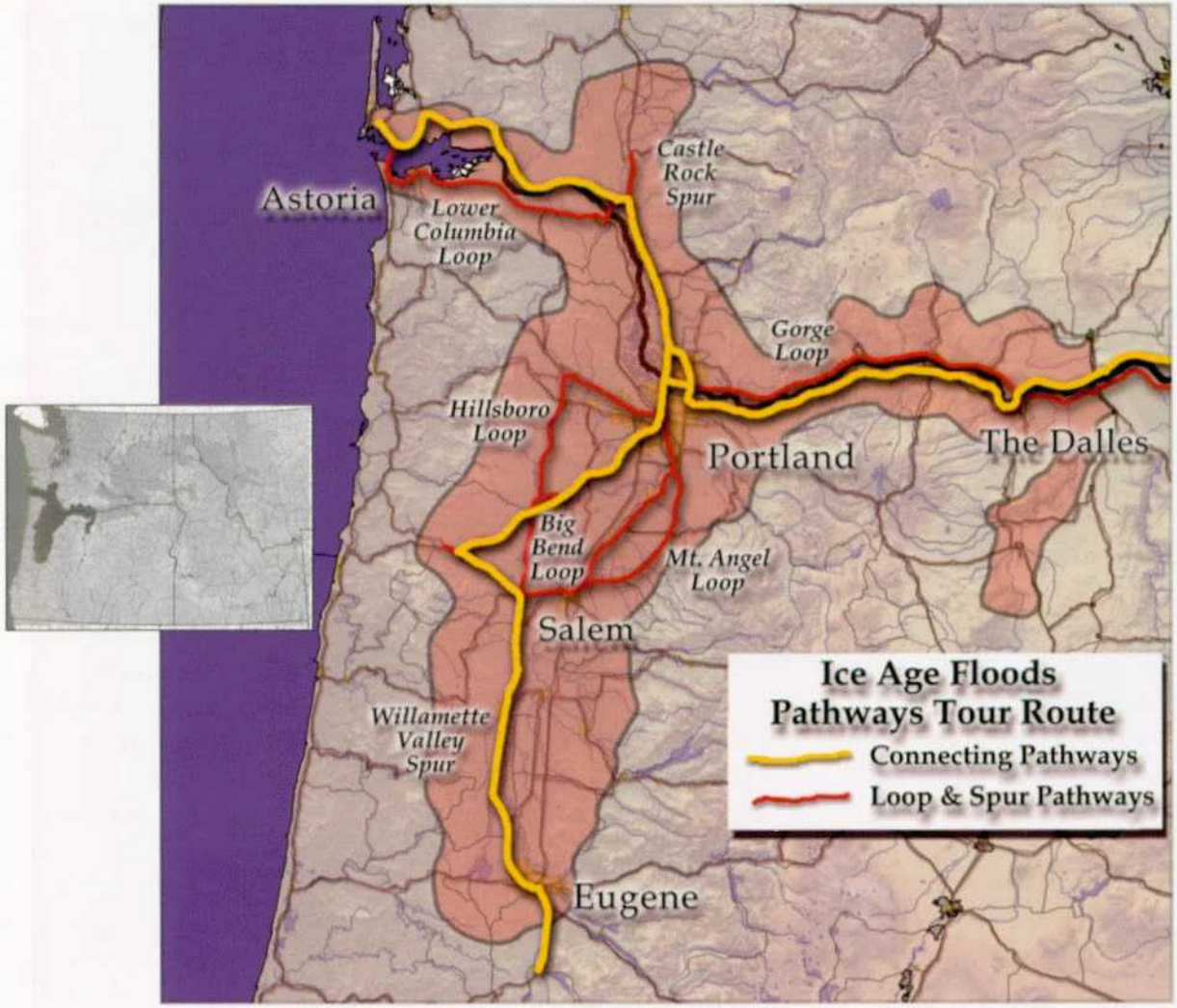


Tour route in the Mid Columbia Study Zone

along State Route 200, which is under study as a Scenic Byway by Idaho DOT, to the northern edge of Lake Pend Oreille and Sandpoint. Here the waters flooded west toward Priest River on U.S. Highway 2, southwest along the Purcell Trench on U.S. Highway 95, and mostly south through Lake Pend Oreille and over Farragut State Park. At Rathdrum Prairie, east of Spirit Lake, the Floods created giant ripple marks and left gravel bars and sediments as a record of the Floods passage. The Rathdrum Prairie Loop on State Routes 54 and 53 takes visitors to Post Falls, where the flood waters may have reached speeds of 50 to 60 miles per hour. I-90 from Coeur d'Alene to the Washington State border provides views of landscapes impacted by the Floods.

Washington

Floodwaters rushing into Washington flowed down the Spokane River Valley along the current route of I-90. The Mt. Spokane Loop from Priest River and Newport passes Mt. Spokane State Park, which offers superb views back into Idaho and the Spokane Valley. Near Spokane, the waters split, with one arm following the Spokane River to its junction with the Columbia River. The other spills over into the Cheney-Palouse drainage. The Cheney-Palouse can be seen from U.S. Highway 95, which parallels Hangman Creek. The Turnbull National Wildlife Refuge, near Cheney, contains significant Floods features. The Cheney-Palouse Scablands Loop follows U.S. Highway 195, county roads to Rosalia and Malden, and State Highway 23 at St. John, then northwest I-90 at Sprague. Here visitors return to Spokane via I-90 or continue northwest to Harrington on State Route 23 and then north to Davenport. U.S. Highway 2, which goes through Davenport from Spokane, defines the Medical Lake Loop. Columbia Plateau Trail State Park also provides opportunities for the public to review Floods features. The Telford Loop, off U.S. Highway 2, follows State Route 28 to Odessa and then north on State Route 21 to Wilbur. This Loop and the Channeled Scablands Loop goes through the heart of the Channeled Scablands, which is dotted with many lakes and scour channels. The



Tour route in the Gorge, Lower Columbia, and the Willamette Study Zone

Channeled Scablands Loop includes the area generally south of Odessa and contains a maze of flood-related coulees such as Lind, Washtucna and Weber Coulees. State Routes 260, 26 and 21 provide access to much of this area. Each road in the area leads the visitor to another Floods channel or scour area.

To the north of U.S. Highway 2 at Davenport, the Hawk Creek Loop takes visitors to the Columbia River and the mouth of the Spokane River and then back to U.S. Highway 21 east of Creston. Here the Pathways continue along U.S. Highway 2 to Wilbur and State Route 174, which leads to Grand Coulee, Grand Coulee Dam and the Columbia River. The roaring floodwaters enlarged Grand Coulee as they headed southwest to Dry Falls, poured over the eastern coulee wall, and created a maze of channels, buttes and dry cataracts. State Highway 155, built on the floor of the Grand Coulee, is a spectacular drive leading to Coulee City and nearby Dry Falls.

Dry Falls, located on State Route 17, is part of the Sun Lakes-Dry Falls State Park. It is a premier site because of

existing facilities and the fact that it is the scene of a major cataract. The section of State Route 17 from Dry Falls to Soap Lake follows the course of the lower Grand Coulee. Closely related to Dry Falls is the area included in the Upper Crab Creek Loop. Immediately west of the Telford Loop, the Upper Crab Creek Loop includes Wilson Creek, which is located on State Route 28 from Soap Lake to Odessa. Wilson Creek was one of the areas originally studied by Bretz. Other significant Floods resources are located within the Upper Crab Creek Loop. To the west of State Route 17 is a complex of three Loop Pathways: Waterville Plateau, Wenatchee, and Moses Coulee Loops. The Waterville Plateau Loop on U.S. Highway 2 west of Coulee City includes the area that would have been the southern terminus of the ice sheet. It contains some gigantic erratics adjacent to the highway. U.S. Highway 2 continues along the Columbia River above Wenatchee where U.S. Highway 97 follows along the east bank of the Columbia to East Wenatchee and into the Moses Coulee Loop. Moses Coulee was carved by the Floods. Continuing east on State Route 28 brings the visitor to Quincy Basin, a remnant of Lake Lewis, and to the Quincy Basin Loop. For visitors wishing to proceed west, State Route 283 intersects with I-90 at George and proceeds past Frenchman Coulee to the Columbia River, Vantage, and Ellensburg. Visitors could continue on State Route 243 to the Drumheller Channels Loop. Along the Lower Crab Creek in the Columbia National Wildlife Refuge lies a marvelous collection of butte and basin Floods remnants. After viewing this area, visitors could proceed north to Moses Lake and I-90, or go south on State Route 17.

Continuing south on State Route 17 to State Route 260, visitors encounter two Loop Pathways, the Walla Walla Basin and Palouse Falls Loop. The two can be combined into one rather large loop that leads to Lewiston, Idaho, and back along U.S. Highway 12 past Walla Walla. Just off U.S. Highway 12 on State Route 261 is Palouse Falls State Park, a dramatic Ice Age Floods creation. All the roads into the general areas lead to the Tri-Cities, which lie near the confluence of the Snake, Columbia, and Yakima Rivers. The Yakima Valley Loop goes from Ellensburg on I-82 and leads past Yakima where State Route 24 leads to the western edge of the Lower Crab Creek Loop. The Tri-

Cities Loop follows U.S. Highway 730 to Wallula Gap, a narrow constriction of the Columbia River that caused the waters to temporarily back up and create Lake Lewis. In basins created by Lake Lewis are excellent examples of rhythmites and other depositions, as well as erosional features related to the Floods.

Washington and Oregon

Beyond Wallula Gap, Floods waters inundated the Umatilla and Dalles Basins, creating Lake Condon. Along this part of the Columbia River, two highways parallel the river—I-84 on the south bank and Washington's State Route 14 on the north bank. Together, these two routes form the Columbia River Loop. The Pendleton Spur of I-84 leads to the Columbia River at Umatilla. Between here and The Dalles, State Route 14 provides visitors outstanding views of the river and the effects of the Floods. Visitors could cross onto I-84 and the Historic Columbia River Highway to Crown Point. Crown Point is 700 feet above the river level and was topped by floodwaters during the Ice Age Floods. State Highway 14 and I-84 form the Gorge Loop, which runs from The Dalles to Portland. North of Portland on I-5, the Pathways continue to the Kelso/ Longview area. The Castle Rock Spur connects Castle Rock and the Kelso/ Longview area. The Pathway turns west on Washington State Route 4 on the north bank of the Columbia to Megler near the meeting of the Columbia River and the Pacific Ocean. U.S. Highway 30 leads from Portland to Astoria along the south bank of the Columbia River, forming the Lower Columbia Loop.

Oregon

Just to the west of Crown Point is the Portland-Vancouver Basin. A hydraulic dam at Kalama Gap forced flood waters to back up into the Willamette Valley and swirl around the landscape near Portland. Interstates I-84, I-205, and I-5, U.S. Highways 26 and 30, and State Route 99-W and 99-E all lead to Floods resources in the Portland area. The Hillsboro Loop leaves Portland on U.S. Highway 26 to State Route 47 and south to State Route 99-W. Following State Routes 213 and 214 will lead visitors to the Mt. Angel Loop. The Big Bend Loop leads visitors southwest of Portland on 99-W to State Route 22 west of Salem. South of Portland, I-5 and State Routes 99-W, 99-E. 18, 22, 34, 228, and 126 lead to Flood resources in the Willamette Valley as far south as Eugene. The Willamette Valley spur runs from Salem to Eugene.

Curtis Archer

States have interpretive highway signs about the Floods, but there is no standardized format for easy recognition.

NPS Photo

On the Waterville Plateau, house-sized boulders were transported great distances by the glaciers.

5. *Interpretive/Educational Potential of Recommended Route*

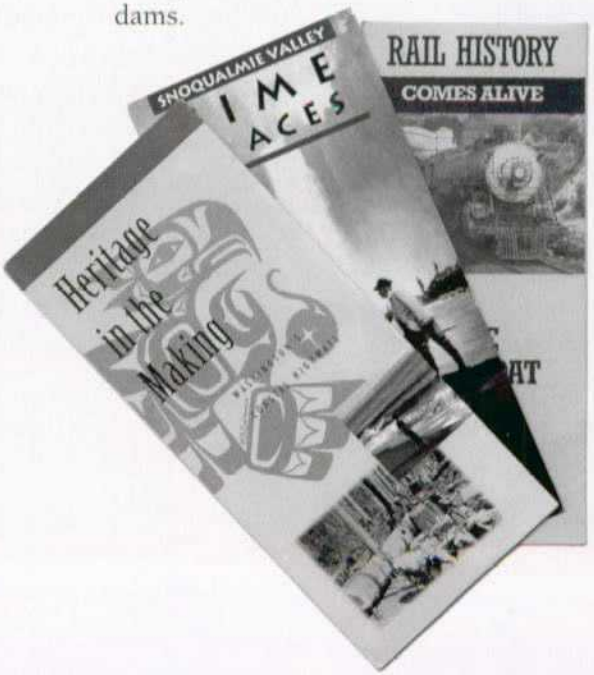
Under the mandate of PL 105-391, the "interpretive and educational potential" should be considered when examining an area. There are a few existing interpretive signs and facilities along the Floods Pathways that are oriented to a specific location but they do not provide a coordinated interpretive approach of the Floods. Tying existing interpretive sites into a more cohesive system will help visitors understand the links among individual Floods features.

Interpretive/Educational Materials

There is no single "best" interpretive tool; some approaches and tools work better at specific locations than others. *Interpretation is the key that ties all the Floods resources within the Ice Age Floods Region together*. Many of these interpretive methods can provide employment for local subject matter experts and together with the sales of interpretive materials add to the economic base of the local area. By tying interpretation into local museums, existing visitor centers, and Chamber of Commerce offices, additional information on the cultural heritage of specific areas can be distributed. A list of potential interpretive methods could include:

- Printed tour guides for visitors.
- Wayside exhibits near specific Ice Age Floods resources.
- Interpretive centers for orientation and interpretation, which would be developed at critical locations across the four-state area.
- Videos of the Ice Age Floods story to be shown at visitor centers, and sold to the public.
- Books on the Ice Age Floods, which should be written at various levels and in various languages.
- Pamphlets covering specific geographic areas or subjects.
- Computer games that include aspects of the Floods story.
- Multi-media applications to stimulate interest in the Ice Age Floods story. These could be sent out in advance to individuals or groups prior to their visit to the Floods Region.
- Audio car and TV tapes to describe what Flood resources the visitor is seeing.

- Travel maps covering the Ice Age Floods and specific areas.
- On-line resources.
- Personal tours and guided trips for visitors to the Floods Region.
- Exhibits to be shipped to local museums and visitor centers in or near the region.
- Special study group programs, such as Elderhostel or summer schools for all generations.
- School programs in the region to promote involvement in preserving Floods resources.
- Interpretive centers at hydroelectric dams.



Interpretive Efforts Within the Area

The area covered by the Ice Age Floods Region has many sites, parks and areas in which interpretation emphasizing other themes is already taking place. A sampling of these areas includes:

- Lewis and Clark National Historic Trail—MT, ID and WA
- Oregon National Historic Trail—OR and WA
- Lake Roosevelt National Recreation Area, WA
- U.S. Forest Service Interpretive Centers, National Forests in MT, ID, OR, and WA
- Columbia River Gorge National Scenic Area, USFS—OR and WA
- U.S. Fish and Wildlife Refuges—WA and OR
- Tribal Cultural Centers—MT, ID, OR and WA
- Historic Columbia River Highway Scenic Byway—OR
- Heritage Corridors Program—WA
- State Parks—MT, ID, OR, and WA
- Scenic Byways Program—ID, OR, and WA
- County Museums and Historical Societies—MT, ID, OR, and WA
- Visitor Information Centers and Chamber of Commerce Offices—MT, ID, OR, and WA
- Privately-owned museums—MT, ID, OR, and WA
- Montana Natural History Center, MT
- Mirabeau Point, WA
- Maryhill Museum, WA
- North Central Washington Museum, WA
- Columbia River Exhibition of History, Science and Technology (CREHST), WA

These facilities and routes provide an opportunity to interpret the Ice Age Floods within existing programs or for expansion to include the Floods story.

Interpretive overlays from various sources enrich visitors' experiences and can provide unexpected pleasures. The various organizations involved with the Floods story offer a rich tapestry of natural and cultural interpretation that can only be strengthened by cooperation.

floods

Landslides in the Gorge—Not A Result of the Ice Age Floods

The Ice Age Flood ran down the generally "U"-shaped, steep-walled Columbia Gorge without greatly changing it. Landslides occasionally descended into the gorge both before and after the great floods. The largest is the Bonneville Landslide about 500 years ago. Nearly 14 square miles of material slid into the Columbia River creating a temporary dam and lake that rose to an elevation of 277 feet. This event has been remembered in local Native American legends as the origin of the "Bridge of the Gods." Lewis and Clark identified this strange topography as a landslide and stated that it caused the dangerous rapids they called the "Cascades of the Columbia."

facts

6. *Interpretive Media Prescription/Alternatives*

There are several types of interpretive methods that could be used to tell the story of the Ice Age Floods and the cultural history of the Ice Age Floods region.

a. **On-Site Interpretation**—For many Floods resources, the most effective way to provide interpretation is to do so on site. If, for example, interpretive material is addressing gravel bars, the interpretive site should be located near the feature. If a visitor can actually touch a Floods resource without damaging it, the better the potential interpretive impact will be. Because of the large scale of Floods resources such as ripple marks and gravel bars, a view from farther away can enable the visitor to appreciate the feature better: In certain situations, if visitors stood on top of a ripple mark, they might not be able to recognize the feature. Future planning will address exactly where various interpretive facilities or overlooks should be located. For example, one question would be "Is it better to interpret the Floods related glacial lakes from the floor of the valley, or should the interpretive site be located on the the lake's shoreline 800 feet above the valley floor?"

b. **Orientation and Interpretation**—There are two components of the proposed interpretive program for the Ice Age Floods Region: (1) Orientation, and (2) Interpretation. When visitors first arrive in the Ice Age Floods region, they will want to know what educational opportunities are available, and where various interpretive sites are

located. This process is typically referred to as "Orientation." Orientation can be provided to potential visitors in a number of ways. One approach would be to use audio-visual techniques that can be sent to interested individuals, or made available in the Gateway Communities that lead into the Floods region. Orientation can also continue throughout the region by using road signs, tour guides, pamphlets, interpretive signage, and tour maps to help direct visitors. Websites can be used to reach a broad audience.

The second component of the proposed interpretive program is the actual interpretation process. Freeman Tilden, in his *Interpreting Our Heritage*, stressed the point that "Information, as such, is not Interpretation. Interpretation is revelation based on information. But they are entirely different things." Interpretation would occur through printed tour guides, wayside exhibits, museum exhibits, pamphlets, maps emphasizing specific aspects of the Floods, personal tours, and guided trips that focus on the Floods. All of the information can, according to Tilden, lead to a "revelation" for the visitor.

Floods features around Flathead Lake (Montana) are already being interpreted through a series of boat tours. The boat captain of a local tour company has included Floods features as part of a tour around the lake. In many ways, this is one of the better methods to see Floods features because the leisurely speed of the boat allows enough time for a quality interpretive experience. Chartered planes can provide the best views for areas such as the Channeled Scablands.

The development of interpretative waysides along Floods Pathways could be tied into each of the four states' Departments of Transportation (DOT). The various state DOT's could administer the Highway Heritage Marking and Scenic Byway programs as part of partnership programs.

Making interpretive materials available for visitors to take home with them when their trip is completed can reinforce interpretation. Books, audio and video tapes, computer games, and inexpensive items such as postcards can all provide reinforcement of the visitor's experience.

c. **Education**—To many people, the term "education" is similar in concept to interpretation. In this study, however, "education" refers to educating the public about the

Ice Age Floods region and Pathways in an effort to engender a sense of protection and "possessory" interest. One way this could be accomplished is through public presentations in the cities and towns included in and surrounded by the Ice Age Floods region. Using the concept of cooperative management and responsibility, it is important that residents understand and support the goals and objectives of the Floods region. Partnerships at the state and local levels would have to be built and maintained through the education process. This process would be ongoing as new residents move into the area and as new leaders develop and mature.

The Ice Age Floods Institute can play a significant role in education and by providing additional opportunities in outreach programs and grant writing.

One specific area that has great promise for the Institute is working with local school districts to incorporate the story of the Floods in earth science curricula. College and post-graduate studies and research would also be encouraged.

d. **Tourism and Economic Benefits**—The educational and recreational benefits of developing the Floods region and Pathways have been explained, but there is also a component of interpretation that is related to economics. Providing quality interpretive recreational travel opportunities for visitors to the region has a direct relationship to the length of visitors' stays and to the lodging, food service, and other facilities they require. Additionally, the production of interpretive materials is a potential source of revenue for local entrepreneurs. With increased visitation to the region, additional interpretive and tourism-oriented opportunities become economically viable. The Channeled Scablands can best be seen and comprehended from the air; this characteristic could lead to an increase in scenic flights in small planes or hot-air balloons. At the present time, there are no interpretive boat trips through Wallula Gap, but the potential for developing such a service would be enhanced with the proposed Floods region. As seen in places such as Scotland and Ireland, the profusion of bed and breakfast accommodations would be expected to increase in direct proportion to an increase in visitation. There are adequate accommodations within the Floods region at the present time. An increase in the number of visitors would provide expanding opportunities for the hospitality industry.

7. *Coordinated Interpretive Program*

At the present time, there is no coordinated interpretive program for the Floods at the federal, state, and local levels. Among the responsibilities of a project or public agency support staff would be coordinating interpretation throughout the Ice Age Floods region. The goals would be to: 1) develop standards for directing visitors to the various Floods resource sites; 2) identify similar interpretive approaches at these sites; 3) recommend improvements to existing interpretive efforts; and 4) work with local museums and visitor centers to encourage participation in the region's interpretive efforts. Within the past year the Port of Walla Walla has started preliminary planning, with help from the Ice Age Floods Institute, for a large wayside exhibit near Wallula Gap. Avista, a northwest power company, has shown interest in expanding and improving the interpretation at its hydro sites. More than 60 scientists and educators gathered in the Channeled Scablands to study Floods resources in the area. In addition, the Idaho Department of Transportation is studying State Highway 200 for "scenic byway" status.

M. Sear/Columbia Basin Herald

Ice Age Floods resources are evident all along the pathways of the floods and allow the visitor to obtain a vivid understanding of the power of the floods.

In Washington State the Washington State Department of Transportation, in partnership with other state and federal agencies, including the Washington State Arts Commission, the Department of Community, Trade and Economic Development, the Interagency Committee on Outdoor Recreation, the Department of Natural Resources, the State Parks and Recreation Commission, the Washington

Commission for the Humanities, Bureau of Land Management, and the NPS, are supporting an effort to promote cultural tourism along approximately 100 miles between Othello and Grand Coulee Dam, along State Routes 17 and 155 in central Washington.

Such efforts point to the recognized need for coordination to help standardize the production of interpretive material and to provide technical assistance.

Signage

Perhaps the most basic way to help visitors appreciate the Floods story is through a coordinated system of signage that can both convey information and help with orientation. Such a signage system is essential because of the size and complexity of the Floods region. For visitors to fully understand the story of the Floods and the impact the Floods had upon the land, they need to experience individual Floods features. In addition, they need to understand how all of these features were formed and how each is a piece of a much larger puzzle.

Across the region there are few interpretive signs that refer to the Floods. Most of those that exist are very informative and tell a part of the Floods story.

When visitors are traveling through the Floods region, they need to be able to follow easily a particular Floods Pathway and to identify and locate individual Floods features. Signage for the Floods region could be implemented a number of ways: 1) incorporating a Floods logo and/or title on existing or future signs, 2) developing a small sign that could be attached to existing or future signs, or 3) developing new standard signs that could be used along highways to identify Pathways as well as specific Floods features. In all instances, signing would be coordinated with state transportation departments.

Each sign should include a name, such as "Ice Age Floods Geologic Trail," and a logo that needs to be developed. This logo could visually include concepts relating to the Ice Age, formation of the ice dam and the resulting Glacial Lake Missoula, the power and force of the Floods once the water was released, the

NPS Photo

Intertwining canyon networks were cut by the Ice Age Floods.

NPS Photo

Giant ripple marks at Camas Prairie, Montana

NPS Photo

The great floods left a lasting mark on the landscape.

extent of the Floods region, or the impact the Floods have had on the land.

For the Floods Pathways, which follow existing highways, each sign should also include the name of the loop, or spur. These signs could be color coded for ease in following a specific loop.

Signage can also be used to help visitors get a better understanding of what they are seeing. For example, visitors entering the Channeled Scablands could be greeted with signage and interpretive literature that says "Entering the Ice Age Floods Geologic Region" or something to the effect that "You are about to enter an unusual geologic landscape similar to that on the Planet Mars."

Each community and organization would still have the opportunity to develop its own signage. The more these types of signs relate to the Floods region, the easier it will be for visitors to understand the larger story of the Floods.

NPS Photo

Flood waters unable to flow through the Wallula Gap backed up to a height that overflowed the bluffs to the right.

NPS Photo

Crown Point, located at the western portal of the Columbia River Gorge National Scenic Area, was topped by Flood water some 700 feet deep.

NPS Photo

Grand Coulee, upper center, channeled the flood waters to Dry Falls, 20 miles south. Today, the Columbia Basin Irrigation District pumps water into Grand Coulee to support a vast irrigation system.

8. Development and Enhancement of Interpretive Facilities

One of the tasks of the Floods Study Team was to determine if any new facilities would be needed to help interpret the Floods story, or if any facilities needed renovating or expanding. In the planning discussions with the Study Team, five major interpretive center locations were identified. Three of these would be new facilities while two would require the renovation of existing facilities.

Major Interpretive Sites

- *Missoula, Montana*—(to be developed). Beginning in western Montana, the source of the Floods waters, there is a need to construct an interpretive facility to provide orientation to the Ice Age Floods region and to interpret Glacial Lake Missoula. The principal features of this site are the wave-cut shorelines marking lake levels of Glacial Lake Missoula far above today's valley floor. Such an interpretive center could stand alone or be constructed in cooperation with an existing site. The local, state and federal government officials in the area are interested in developing partnerships with interested agencies and the private sector to develop an Ice Age Floods Visitor Center.

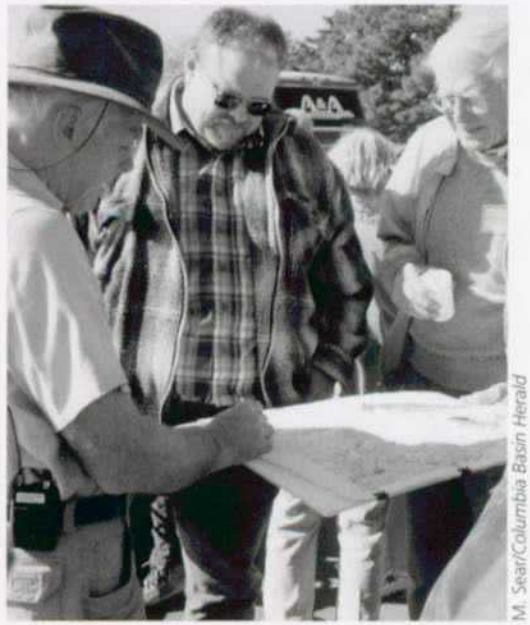
- *Clark Fork River/Cabinet Gorge, Idaho*—(to be developed). The area around Cabinet Gorge and the mouth of the Clark Fork River is a key geologic and interpretive area because it is the location of the ice dam that created Glacial Lake Missoula. Future planning should focus on the location of a major interpretive and orientation facility and supporting services. This would tie into current planning being done to designate Idaho State Route 200 as a scenic byway.

- *Sun Lakes-Dry Falls Interpretive Center, Washington*—(expand existing site). The J Harlen Bretz Visitor Center at Sun Lakes-Dry Falls Interpretive Center has 63,059 visitors a year (1999 figures). The

limited program uses a relatively small facility that is often overloaded during the height of the visitor season. Sun Lakes-Dry Falls Interpretive Center is a premier Floods interpretive site and is near the core of the Floods resources in the central Washington area. Working with the Washington State Parks and Recreation Commission, local communities, and the National Park Service, future planners could determine the most appropriate manner of expanding the facility and services. The Washington State Department of Transportation is currently working with local citizens to develop a Corridor Management Plan for State Highway 17, which passes by Dry Falls. Among other items, the Corridor Management Plan will cover opportunities for increasing the number of wayside exhibits and other interpretation.

- *Wallula Gap, Washington*—(to be developed). Wallula Gap is a significant and highly visible Floods resource. The Port of Walla Walla is planning an interpretive wayside area just to the north of the Gap on U.S. Highway 12 that will include the Floods story. The next step is to secure funding for construction and operation of the visitor facility. If this area is not suitable for future expansion, the local community and future planners could determine where an interpretive facility could be located to provide orientation and interpretation. In any case, some interpretive facility covering the Floods should be located at the Gap to tie the interpretation directly to the resource.

- *Columbia Gorge Discovery Center and Wasco County Historical Museum*, The Dalles, Oregon—(expand exhibits at existing site). The Discovery Center currently interprets the Ice Age Floods and their impact on the Gorge. The area around The Dalles has a number of significant Floods resources that are easy to see and visit. With the anticipated increase in the number of Floods-related visits, more exhibit space will be needed for greater in-depth interpretation and orientation.

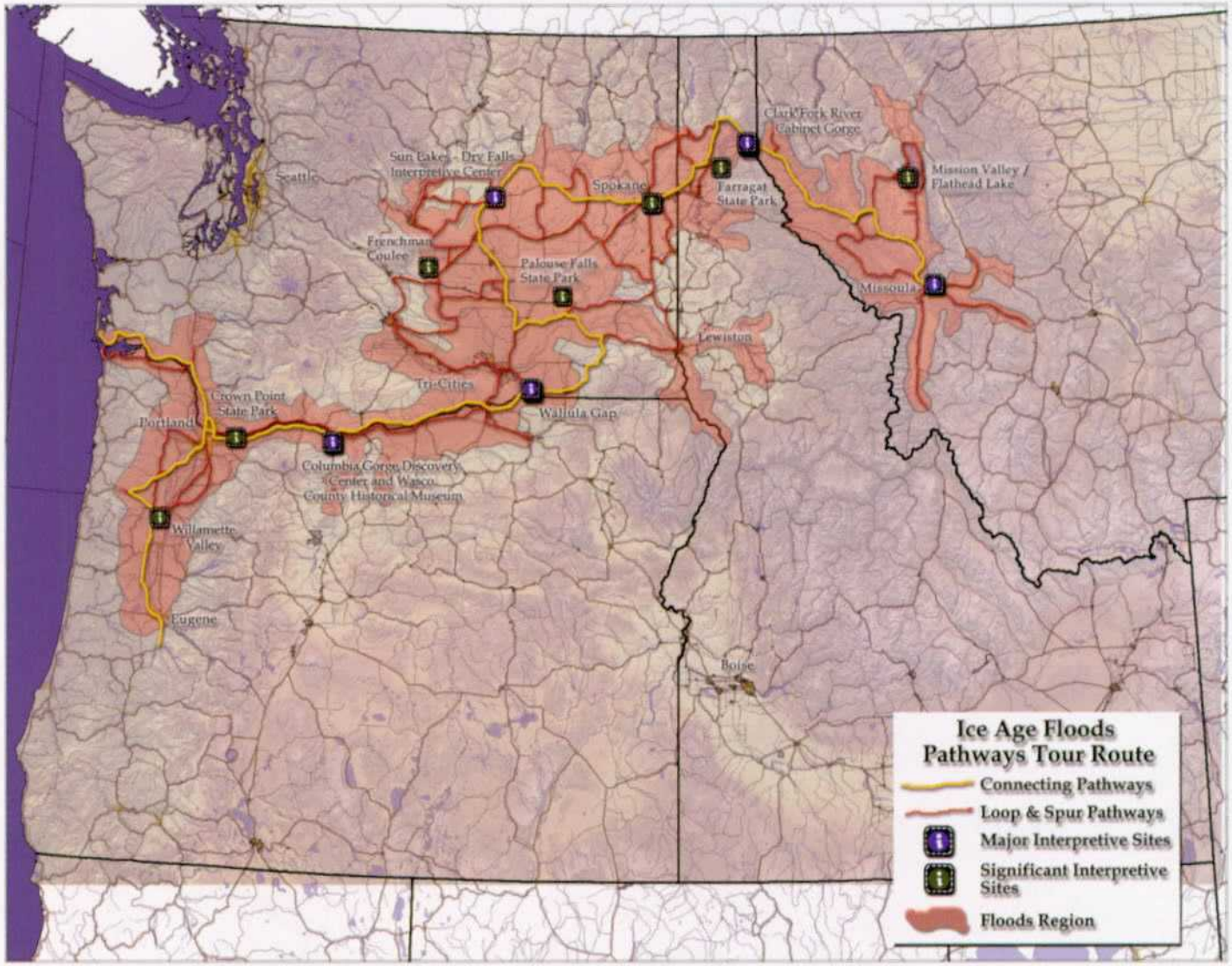


M. Sear/Columbia Basin Herald

Orientation is the essential first element of interpretation. Here Richard Waitt diagrams the course of the Floods at Dry Falls.

One grasps Bretz's evidence most firmly by viewing it in the field. . . .

Richard Waitt, USGS



Ice Age Floods major interpretive sites, Floods Pathways, Loops, Spurs, and other significant interpretive sites.

F l o o d s

Snake River Flowed Backwards

The Ice Age Flood waters surged across the Channeled Scablands, across the Palouse, and into the Snake River with such a discharge the river was backflooded 80 miles east to beyond present Lewiston, Idaho. On the banks of the Snake River south of Lewiston, a gravel bar laid down by the single Ice Age Bonneville Flood is overlaid with flood sands from several Ice Age Missoula Floods.

F a c t s

NPS Photo

A huge haystack rock, transported by a glacier, 10 miles west of Sims Corner, Washington

9. *Other Significant Interpretive Sites*

In addition to the five Major Interpretive Sites, the Study Team identified other examples of sites where the Floods story could be told. Other existing interpretive facilities such as local visitor information centers, museums, and cultural centers will also be impacted by the increased visitation to the region and could be identified as sources of Floods information. Partnerships with these local interpretive facilities should be developed to enhance the present level of interpretation and to assist the facilities in developing additional interpretive materials. Emphasis should be on the utilization of existing facilities where possible.

Some of the significant areas for interpreting the Floods story include:

- *Mission Valley/Flathead Lake, Montana*—(to be developed). The Mission Valley contains several Floods features, including Markle Pass, Camas Prairie and strandlines from Glacial Lake Missoula. Flathead Lake is possibly a remnant of Glacial Lake Missoula and one of the last remaining glacial lakes in the lower 48 states. These are great places to view Floods resources.

- *Farragut State Park, Idaho*—(expand existing site). Farragut State Park on the south end of Lake Pend Oreille is where the flood waters burst out from the broken ice dam. A small display is planned for the visitor center, and there is a wayside exhibit near the lake. With an increased interest in the Floods, the park may find the demand for additional interpretation will overwhelm current facilities. Avista, a regional power company, is planning to upgrade the interpretation at all of its hydroelectric facilities, including Cabinet Gorge at the mouth of the Clark Fork River. The Study Team is assisting planners at Avista with their interpretive efforts.

- *Spokane Area, Washington*—(to be developed). The Spokane area is an ideal site for locating an orientation and interpretive facility in conjunction with I-90 and other U.S. highway routes entering the area. At the present time, there is no such

facility in the vicinity of Spokane. There has been no discussion with the local or state officials regarding the location of a visitor center, but with the increased interest in and the economic potential from the Ice Age Floods region, the opportunity becomes more attractive. There is a Floods interpretive sign in Riverside State Park in Spokane.

- *Frenchman Coulee, Washington*—(to be developed). Frenchman Coulee is very close to I-90 and can be reached by taking Exit 143. It was formed as flood water drained from Grand Coulee and the Quincy Basin. The water dropped 500 feet in a series of huge waterfalls to the Columbia River. This site is an ideal area to interpret or introduce the Ice Age Floods and is in relatively pristine condition.

  Also of interpretive value are resources located at Ginkgo Petrified Forest State Park across the Columbia River at Vantage, Washington.

- *Palouse Falls State Park, Washington*—(expand existing site). Sixteen miles south of Washtucna, the Palouse River drops 198 feet into a gorge six miles north of the Snake River. The Palouse River that flowed down the Washtucna Coulee was diverted south by the Ice Age Floods. Washington State Parks and Recreation Commission maintains a modest park here with Floods interpretation.

- *Crown Point State Park, Corbett, Oregon*—(enhance existing site). Crown Point State Park at the west entrance to the Columbia Gorge stands at 700 feet above the river and is an interesting Floods landmark. It was inundated during the time of the peak floods. An adjacent area, Portland Women's Forum State Park Scenic Viewpoint, overlooks Crown Point and could be considered for enhanced exhibits to handle the increased visitation and provide an outstanding interpretive experience.

- *Willamette Valley, Oregon*—(to be developed). At the present time, there is no facility in the greater Portland area and Willamette Valley to interpret the Ice Age Floods and their impact on the Valley. The I-5 corridor is heavily traveled and there is a need for an orientation/interpretive facility in this area. By working with the local communities, future planners could determine the best location for such a facility.

There are a number of other opportunities to locate additional interpretive facilities or upgrade existing facilities to accommodate the visitors to the Ice Age Floods region. The Study Zone Working Groups can survey their respective areas and discuss the interpretive opportunities with the local communities. For example, within the Channeled Scablands of east-central Washington, the communities of Grand Coulee, Odessa, Moses Lake, and Othello are expected to have increased visitation with the designation of the Ice Age Floods region. These communities already provide visitor services in a remote and rural area, and will need technical and financial assistance to enhance and expand current interpretive facilities. Other communities within the Ice Age Floods region could, over the years, demonstrate needs for interpretive facilities and join in partnership programs with Ice Age Floods managers to enhance the visitor experience.

summary

Since 1872, the National Park System has grown from managing only large tracts of wilderness to cooperatively managing programs in urban and suburban areas. This progression has resulted in more and more involvement by the public in planning and management. Using existing nontraditional areas as models, the Ice Age Floods proposal describes an interpretive tour route, called a "Geologic Trail" or "Floods Pathways," through Montana, Idaho, Washington, and Oregon, utilizing existing federal, state and local governmental land ownerships. The key to its successes, and the core of the Ice Age Floods proposal, is the written agreements among all levels of government and the private and nonprofit sectors. These agreements will form a series of partnerships to manage and interpret the Floods region.

section k

Management Considerations

1. *Examination of Similar Projects*

Beginning with the establishment of Yellowstone National Park in 1872, areas administered by the National Park Service have grown in size and complexity. They range from large wilderness areas in the West and Alaska, to historic areas predominantly in the East, to complex urban parks in New York and San Francisco, to cooperatively managed areas in urban and suburban regions of the country. A common thread in today's nontraditional management spectrum is the involvement of the Secretary of the Interior and in many cases, the Director of the National Park Service.

Over the last two decades, Congress has created a number of nontraditional areas, including (1) *Affiliated Areas,* which are not part of the National Park Service but have NPS assistance; (2) *National Heritage* areas, which are not part of the National Park Service but have NPS assistance while being managed by various partnerships; (3) *Wild & Scenic Rivers,* which are managed by federal agencies including the NPS; and (4) the *National Trail System,* managed by federal or state agencies. There are four examples of National Heritage Corridors that are Affiliated Areas of the NPS: Illinois & Michigan Canal, Illinois; Delaware River Valley, Pennsylvania, and the Blackstone River Valley, Massachusetts, all managed by federal commissions; and the Quinebaug and Shetucket River Valley, Connecticut, which is managed by a nonprofit organization.

The structural organization of these National Heritage areas might be adapted to the Ice Age Floods region. In such partnership structures, the key to success is the clear definition of responsibilities and duties. In the Blackstone River

Valley National Heritage Corridor, for example, the legislation that created the Heritage Corridor provided for partnerships between two states and their many agencies, 20 local governments, the National Park Service and other federal agencies, and many of the Valley's business and civic organizations. These are all coordinated by a Congressionally authorized commission. The organizational structure for the Blackstone River Corridor incorporates these provisions:

The Commission

- Defines roles
- Sets clear goals
- Formulates effective cooperation among those involved
- Conducts fund-raising campaigns from governments and private sources
- Provides professional expertise

The Federal Government (National Park Service)

- Prepares and implements the management plan
- Provides interpretive services
- Sets consistent standards
- Includes base funding within regular NPS appropriations
- Provides expertise in management
- Provides expertise in preservation, restoration, interpretation and education
- Provides expertise in resource protection outside the boundaries
- Acquires funding through the Land & Water Conservation Fund.

The State Governments

- Provide leadership and preliminary planning
- Serve on the Commission.
- Collaborate across state lines with similar state agencies
- Work with the Commission to assist in information, technical assistance, program funding and award grants

Local Governments

- Provide local planning to support the project
- Develop zoning and initiatives to support the project
- Inform the Commission of important issues

Business, Industry and Labor

- Partnership with individual businesses and private sector, such as the Chambers of Commerce and Tourism Councils.

These interrelationships demonstrate the high degree of complexity needed to manage the Blackstone River Valley NHC. The willingness to participate and the commitment to the concept of a partnership area is formalized by a series of cooperative agreements with the participants. There are many examples of agreements that have been used successfully in other nontraditional areas that could be adapted for use in the Ice Age Floods concept.

2. *Configuration*

The configuration of the proposed Ice Age Floods region could best be characterized as a "linear, nontraditional area without boundaries." The area that was inundated by the Floods now forms the region that serves as the Study Area. This area was investigated for significant Floods resource sites that were identified through the inventory process. These resource sites could be connected by a series of interpretive "pathways" or routes. Using this concept of boundary-less, interconnected interpretive sites, it becomes clear why existing NPS terminology does not meet the needs of the Ice Age Floods concept. The term "Region" best describes the overall configuration of the area, and the term "Pathways" best describes the routes or paths of the torrent of water from the Floods.

NPS Photo

In many locations, the Floods Pathways are clearly etched on the landscape

F l o o d s

Moses and Grand Coulees

Grand Coulee and Moses Coulee to the west largely were formed by the Missoula Floods. A lobe of the Cordilleran Ice Sheet descended into the Okanogan Valley, blocked the Columbia River, and covered 500 square miles of the Waterville Plateau west of Grand Coulee. The south terminus of the Okanogan lobe is clearly marked by an abrupt south limit of lumpy, rocky moraines. The ice-dammed Columbia River backed up to form Glacial Lake Columbia, a huge version of the lake now ponded by Grand Coulee Dam. Lake Columbia's overflow—the diverted Columbia River—occupied Grand Coulee between Ice Age Floods events.

F a c t s

3. *Socioeconomic*

The socioeconomic impacts of the Ice Age Floods concept are difficult to evaluate. Caution in projecting increases in the amount of visitation was constantly voiced by representatives of state tourism groups. Tourism is dependent on so many variables—the overall economy, weather, cost of fuel, trends in vacations, disposable income, available time for travel, etc.—that projections of increased tourism are out of favor. But even while being cautious, tourism representatives stated they expect tourism to increase simply by adding an additional attraction and by adding regional tours involving a new topic area. There apparently is a critical mass in which the combination of attractions offers so much to the visitors that they will forgo travel to other areas in order to visit the Pacific Northwest. By developing an Ice Age Floods region, the economies of a largely rural area, which is generally dependent on agriculture, logging, mining, etc., will be strengthened.

Almost all of the Floods resources are remote from urban centers, and as a result, visitors will have to plan day trips to the region or even stay overnight. In many cases, the level of occupancy for the hospitality industry is already high during the visitor season. With additional visitors traveling through the Floods region along Pathways tour routes, more accommodations would be needed.

Tourism ranks as one of the three most important generators of outside income in Montana, Idaho, Oregon and Washington. To reflect this rank, increasing tourism is one of the major goals of the Ice Age Floods concept. Of all the many nontraditional area goals that were examined, New York's Seaway Trail's purpose stood out among the others. It states that the trail was created to: ". . . promote the trail as a tourist destination and to encourage regional economic development through tourism." Opportunities to enhance regional tourism may result from the Ice Age Floods tour routes.

Because there will be no federal land acquisition proposed, land in the Floods region would not be removed from the local tax rolls. The increase in visitation and the potential increase in duration of those visits could add more money to the hotel/motel and sales tax base and state gasoline tax income. Encouraging the continued development of spring and fall seasonal travel would also serve to spread out the positive economic benefits affecting the regional tourism industry. Thus, the general economic picture should favor the creation of the Ice Age Floods interpretive trail or Pathway because visitors coming to view Floods resources would benefit the economy of the region.

F l o o d s

Not-So-Dry Falls

Separating the tandem canyons of upper and lower Grand Coulee is Dry Falls (now within Sun Lakes–Dry Falls State Park). Dry Falls serves as a stark reminder of the magnitude of the Ice Age Floods. At the height of the Floods, water nearly 400 feet deep poured over the lip of the Falls, showing but a wrinkle on the floodwater's surface. Today, the 350-foot cliffs, plunge pools and lakes show that the Falls were over three miles wide or five times the width of Niagara Falls. At the height of the Floods, water poured not only over the Falls, but also over cataracts farther east.

F a c t s

summary

The Study Team narrowed the management alternatives for the Ice Age Floods region to four. All would involve public-private partnerships:

Local/State Designation:

1. No Action—continued management at the local level.

2. Coordinated Effort—creation of a Quad-State Commission for coordination and an Interagency Technical Committee representing federal, tribal, and state agencies to assist Commission staff.

Federal Designation:

3. National Geologic Trail—designating the Floods pathways managed by the National Park Service, with an Interagency Technical Committee representing the federal, tribal, and state agencies and a Trail Advisory Committee to assist the Trail Manager and staff.

4. National Geologic Region—formal designation of the region Floods pathways with management under a Congressionally authorized Commission and an Interagency Technical Committee representing federal, tribal, and state agencies to assist Commission staff.

section I

MANAGEMENT ALTERNATIVES

1. *Introduction*

The National Park Service's *Criteria for Parklands* defines the framework in which "Management Alternatives" should be considered. The section on "Management Options" states:

> *Alternatives to National Park Service management might adequately protect resources even if they are significant, suitable, and feasible additions to the System. Studies of potential new park units evaluate management alternatives that may include continued management by state or local governments, Indian tribes, the private sector, or other federal agencies, technical or financial assistance from established programs or special projects; management by others as a designated national natural landmark, a national wild and scenic river, a national trail, a biosphere reserve, a state or local park,* or some other specially designated and protected area, or cooperative management between the National Park Service and other entities *[emphasis added]. Alternatives involving other federal agencies include designation of federal lands as wilderness, areas of critical environmental concern, national conservation areas, national recreation areas, marine or estuarine sanctuaries, research natural areas, and national wildlife refuges. Additions to the National Park System will not usually be recommended if another arrangement can provide adequate protection and opportunity for public enjoyment.*

In analyzing various management approaches for the Ice Age Floods region, it was obvious from the outset that a traditional National Park or Monument designation with a defined boundary, and traditional management

was inappropriate. The scale of the Floods region and the extent of private lands within the region make such an approach out of the question. This analysis was fully supported and affirmed in meetings with members of the Ice Age Floods Study Team. The sentiment of the Study Team was that the Ice Age Floods region not be considered as a traditional unit of the National Park System, but instead be considered for a management category involving a more cooperative approach.

After studying the various options for management, the Study Team suggested that the National Park Service have a major role in the project. They agreed that NPS should focus primarily on assisting in interagency coordination, taking a lead role in overall interpretation, and providing general technical assistance for the Floods region.

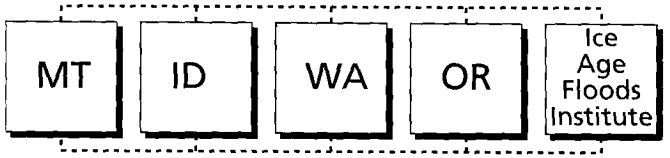
The proposed Management Alternatives reflect the need for a coordinated approach that stresses cooperation among federal and state land management agencies, tribal, state and local governments, and the private sector.

Common to all the alternatives is the involvement of the Ice Age Floods Institute, whose participation provides an organized base of support representing keenly interested citizens. Many of these citizens have professional experience in geology, education, and other project-related fields. Additionally, Alternatives 2, 3, and 4 involve an Interagency Technical Committee that would recommend solutions to technical problems and represent the professional side of its member agencies.

2. *Management Alternatives*

Local/State Designations

alternative 1
No Action



Alternative 1—Existing Conditions (no congressional action or overall planning)—Continued separate management by federal, state, tribal, local agencies and private sector, with no national or multistate involvement.

a. **Concept**: The federal and state land management agencies, state Departments of Transportation, tribal, and local governments would continue to have the option to develop their own Floods-related interpretive programs and facilities.

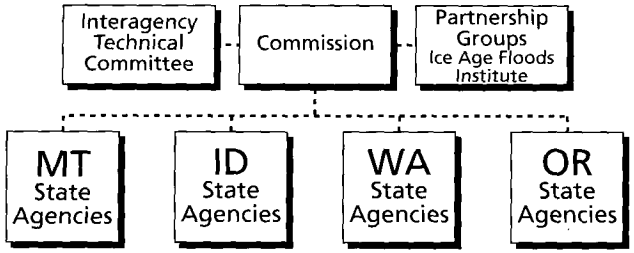
b. **Intergovernmental Agreements**: Intergovernmental agreements would be at the discretion of individual agencies.

c. **Landownership**: There would be no changes in the landownership.

d. **Acquisition Costs**: There would be no acquisition costs.

e. **Staff and Development Costs**: Staff and development costs would be the responsibility of each agency.

alternative 2
Quad-State Commission



Alternative 2—Quad-State Cooperation—The four states (Montana, Idaho, Washington, and Oregon) would create a Quad-State Commission for designation and management of state tour routes.

a. **Concept**: The four states would combine forces to develop a four-state compact that would create a commission for coordinating planning, management, and interpretation along the route of the Floods. This approach is based upon an understanding that all four states would have a mutual interest in developing a comprehensive interpretive tour route along the Floods pathways.

b. **Management**: Through a written compact authorized by the state legislatures of Montana, Idaho, Washington, and Oregon, a quad-state commission would be formed to oversee the development and operation of an interpretive tour route. Appointments to the Commission would be made by the governors of each of the four states from nominations submitted by tribes, counties, and municipal governments within the region.

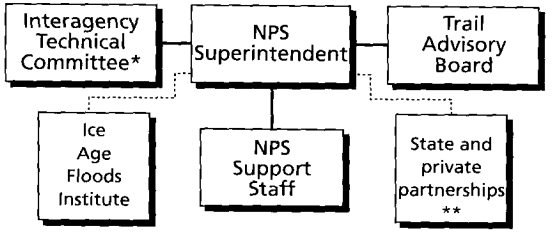
c. **Intergovernmental Agreements**: The Quad-State compact would authorize the Commission to enter into agreements with federal land management agencies, state, tribal, and local governmental agencies, and the private sector in order to create a comprehensive interpretive tour route. Funding for development, operations, and maintenance of the interpretive program and facilities could be from local and state appropriations. Private sector support may also be available.

d. **Landownership**: There would be no changes in landownership; although, it would be appropriate to consider acquiring parcels of land for interpretive pullouts.

e. **Acquisition Costs**: There could be minor costs for acquisition of land for interpretive pullouts by local or state government entities.

f. **Staff and Development Costs**: Some of the development cost for any additional staff or facilities could be borne by state appropriations, as well as by private sources. Operational funds would largely be a state expense.

alternative 3
National Geologic Trail



*USFS
USGS
BLM
BOR
USF&WS
State agencies
Tribes

**States
Tribes
Counties
Land owners
Business
Nonprofits

Federal Designations (Congressional authorization would be required)

Alternative 3—National Geologic Trail—This alternative would call for Congress to authorize the establishment of the Ice Age Floods National Geologic Trail. This trail would be managed by a National Park Service Manager with additional support staff. Assistance would come from a trail advisory board, an interagency technical committee, and the nonprofit Ice Age Floods Institute.

a. **Concept**: Under this management alternative, Congress would authorize the establishment of an Ice Age Floods National Geologic Trail. This trail would be the first of its kind in the nation. The Ice Age Floods National Geologic Trail would in essence be the national designation of the Floods Pathways tour route. In some instances, non-motorized trails and water trails could link to certain Floods features.

b. **Management**: The National Geologic Trail would be managed by a National Park Manager and small support staff. The NPS would be responsible for overall trail management and would coordinate interpretive and educational approaches to telling the story of the Ice Age Floods along the Floods Pathways. NPS emphasis would be on developing a coordinated interpretation, education, and resource stewardship effort among public agencies and tribal governments having Floods features on their lands. A comprehensive management plan would need to be prepared to help provide guidance for future management and public use of the trail.

   Coordination would be sought among federal and state agencies, tribal, and local governments having an interest in the Ice Age Floods. This assistance would be formalized through the formation of an Interagency Technical Committee (IAC). The IAC would be composed of individuals representing state, tribal, and federal agencies; these individuals would have expertise in geology, interpretation, education, tourism, resource management, or related fields. The IAC would be expected to augment Trail staff expertise in a variety of areas.

The Trail Manager and staff would be aided by an Advisory Board comprised of representatives appointed from the various public land management agencies, local, state, and tribal governments, and interested nonprofit organizations and private citizens. Their focus would be to assist in the operation of the Geologic Trail.

The Ice Age Floods Institute would play an important role in the operation and development of a National Geologic Trail. Among other functions, the Institute would seek supplemental private funding support for operation and development of the trail. The Institute would also play a key role as an advocate for educational programming, and would work to promote tourism and economic opportunities along the Trail.

c. **Intergovernmental Agreements**: The National Park Service would enter into written agreements with state, tribal, and federal land managing agencies within the Floods region. This agreement would articulate how each would participate in the project and would provide a formal framework for coordination. The agreement would define roles and responsibilities on matters related to education and interpretation, resource management, visitor facility development and operation, and scientific research. Partnership agreements could be formed with local governments and private sector entities to aid in the management and operation of the National Geologic Trail.

d. **Landownership**: It is recommended that the NPS not be given any authority by Congress to acquire land or promulgate new regulations as part of its management responsibilities for the National Geologic Trail. Local or state governments and nonprofit organizations may acquire parcels of land from willing private owners for improvements such as roadside pullouts and wayside exhibits where public highway right-of-way proves inadequate.

e. **Acquisition Costs**: There could be minor costs for acquisition of land for interpretive pullouts by local or state government entities.

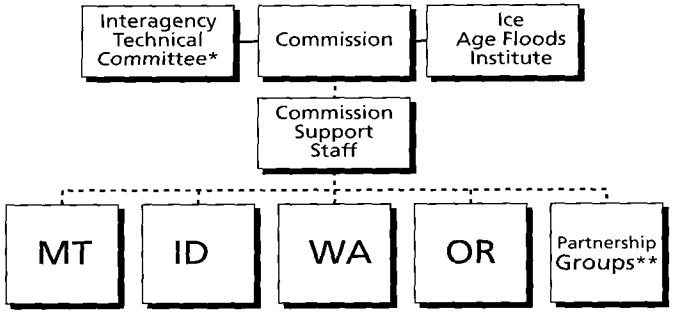
f. **Staff and Development Costs**: Under this option, the National Park Service would be expected to fund the operational cost of the Trail Manager and staff, as well as routine office and travel expenses. However, the successful development, maintenance, and operation of the Trail and associated facilities and programs would require funding support from a variety of both public and private resources. This support would include funding for such things as interpretive highway or trailhead wayside exhibits, information kiosks, visitor centers and contact facilities, trail brochures, and educational program media and development.

Initial funding for developing trail facilities identified through the comprehensive management planning process would be a joint responsibility of the NPS and other partner agencies at the state and federal level. Private sector organizations could provide support wherever appropriate. Potential funding sources such as TEA-21 enhancement funds and private sector support leveraged through the Ice Age Floods Institute could also be explored.

The federal share of costs estimated to implement this option is as follows:

- Estimated annual operating costs (NPS staff and office support) $500,000
- Estimated capitol development costs (phased over several years) ..... $8 to $12 million

alternative 4
National Geologic Region



Sample of State Participation

State
- DOT/Highway
- Tourism
- Parks
- DNR
- Mines/Minerals/Geology
- County and local governments

*NPS
USFS
USGS
BLM
BOR
USF&WS
Tribes
FHA
State agencies
Universities

**Private sector
Communities
Land owners
Business
Nonprofits

Alternative 4—National Geologic Region—This alternative would result in a newly designated area encompassing parts of four states that share the geologic history of the Ice Age Floods. A Floods Pathway tour route would be established to view Floods features. The project would be managed by a Commission with support staff and a broad-based partnership among numerous public and private entities.

a. **Concept**: Under this management alternative, Congress would authorize the establishment of an Ice Age Floods National Geologic Region and Floods Pathways interpretive route. It would be managed by a Commission and supported by an executive director and support staff. Assistance would be provided by an interagency technical committee, and the nonprofit Ice Age Floods Institute. As with Management Alternative 3, the National Geologic Region would include a Floods Pathways tour route that would follow existing public roads and highways. In some instances, non-motorized trails could link to certain Floods features.

b. **Management**: The Floods Region and Floods Pathways tour route system would be managed by an Ice Age Floods Regional Commission appointed by the Secretary of the Interior. Nominations for the Commission would be solicited from the governors of each of the four states in the Floods region, as well as from tribal governments and public land managing agencies. An executive director and small support staff would be employed by the Commission to assist in the operation and management of the Floods Pathways interpretive route. Staff from the National Park Service would be available to the commission to assist in development and operation of a coordinated interpretive approach to telling the Ice Age Floods story.

The primary role of the Commission would be to encourage a coordinated approach to telling the story of the Ice Age Floods along the Floods Pathways. Commission emphasis would be on a coordinated effort among public agencies having Floods features on their lands. Cooperation would be sought among tribal, state and federal geology professionals, education specialists, tourism and

economic development officials, and private sector groups and individuals having an interest in the Floods.

A management plan would need to be prepared to help provide guidance regarding the future management and public use of the Floods Pathways and their resources. This plan would also articulate roles and responsibilities of the various partners.

An interagency Technical Committee (IAC) comprised of state, tribal, and federal agency professionals in the fields of geology, interpretation and education, and resource management would assist the Commission in operating and managing the Floods Pathways interpretive route.

The Ice Age Floods Institute would also play an important role in the operation and development of a National Geologic Region and Floods Pathways. Among other functions, the Institute would seek private funding support to complement Commission and other public expenditures. The Institute would also play a key role in coordinating educational efforts and in promoting tourism and economic opportunities.

c. **Intergovernmental Agreements**: The Commission would enter into written agreements with state, tribal, and federal land managing agencies within the Floods region. These agreements would articulate how each entity would participate in the project and would provide a formal framework for coordination on matters related to education and interpretation, resource management, and scientific research. Partnership agreements could be formed with local governments and private sector entities to aid in the management and operation of the National Geologic Region and Floods Pathways interpretive route.

d. **Landownership**: It is recommended that the Commission be given no authority to acquire land or promulgate new regulations as part of its management responsibilities for the National Geologic Region and Floods Pathways. Local or

state governments and nonprofit organizations may acquire parcels of land from willing private owners for improvements such as roadside pullouts and wayside exhibits where public highway right-of-way proves inadequate.

e. **Acquisition Costs**: There could be minor costs for acquisition of land for interpretive pullouts by local or state government entities.

f. **Staff and Development Costs**: The Commission is expected to receive funds from the Department of the Interior through Congressional appropriation. These funds would support the necessary staff to provide overall management for the Floods Region and Floods Pathways interpretive route. This funding would also provide for an executive director and support staff along with routine office and travel expenses. However, the successful development, maintenance, and operation of the Floods Pathways interpretive route and associated facilities would require both public and private funding support for interpretive highway or trailhead wayside exhibits, information kiosks, visitor centers and contact facilities, trail brochures, and educational programs.

Funding for developing trail facilities identified through the comprehensive management planning process would be a joint responsibility of the Commission and partner agencies at the state and federal level. Private sector support could supplement these funds wherever appropriate. Potential funding sources such as TEA-21 enhancement funds and private sector support leveraged through the Ice Age Floods Institute could also be explored.

The federal share of costs estimated to implement alternative 4 is as follows:

- Estimated annual operating costs
  (Commission staff and support) $500,000

  (NPS staff and support) $100,000

- Estimated capitol development costs
  (phased over several years) ..... $8 to $12 million

3. *Cost Sharing*

Development and Annual Operation Costs are addressed as a range, in dollars, for each of the Management Alternatives. It is too soon for the actual site design for specific interpretive areas within the Floods region. As a result, it is difficult to determine accurate costs for developing facilities at these areas. The amount of federal funding needed to cover development costs could be reduced contingent upon the level of participation by state, tribal, and local governments and/or the private sector.

One example of participation by the public/private sector is the development of an interpretive wayside on the Columbia River at Wallula Gap by the Port of Walla Walla. Another is a proposed improvement at Cabinet Gorge Dam being planned by AVISTA, a regional power company. Cabinet Gorge Dam is near the mouth of the Clark Fork River and was the site of the ice dam that created Glacial Lake Missoula.

The Port of Walla Walla's efforts are interesting because of the involvement of the public and private sector. The National Park Service, Ice Age Floods Institute, and members of the Mid-Columbia Study Zone Working Group assisted in the early planning for the new pullout and wayside exhibit on U.S. Highway 12 bordering the Columbia River. The Port will provide for two interpretive panels on the Ice Age Floods at no cost. An interpretive planning contractor contacted the Study Team to inquire as to the feasibility of AVISTA enlarging their small interpretive facility at Cabinet Gorge Dam to provide for additional interpretation of the Floods. If the interpretive areas are expanded, it will be at no cost to the public.

These two examples illustrate what can be done given local understanding of interpretive needs while planning improvements, and illustrates the willingness of local governmental and private groups to participate in what they consider a worthy project. When one of the Management Alternatives is selected, further detailed planning will be done to address specific development costs.

4. *Financing the Project*

Under Alternative 1 (No Action) there would be no significant expenditures in development or operating costs. Alternative 2 (Quad-State Cooperation) would commit the four states to fund a commission and development costs with some possible assistance from others. The states and commission could decide jointly on the number of personnel needed to develop and operate the tour routes.

Under Alternative 3 (National Geologic Trail), the federal government would fund a portion of the development and operating costs of the Trail, including the National Park Service support staff. Partnership programs would be developed with each participating state using written agreements that spell out the degree of participation. Under Alternative 4 (National Geologic Region), the federal government would fund a commission and support staff and a portion of the development costs. Additional field staff personnel costs would be borne by the four states under the terms of a cooperative agreement. Additional funds would be sought from the Federal Highway Administration and the private sector.

In the preliminary meetings discussing the draft study, the question of how the proposed Ice Age Floods region would be financed was raised frequently. The answer was that it is within the purview of Congress and the legislatures of the four participating states to determine how the proposal could be funded. One of the major concerns of the Study Group was that the federal and state governments be required to absorb development and operating costs at the expense of current operations. However, cost sharing would equitably distribute the burden so that it was not substantial to any one entity. Funding support from private sector sources would also be sought.

The interpretive section of this study recommends the designation of "Gateway Communities" or entry points into the network of Floods Pathways. Twelve Gateway Communities were identified as significant locations where

visitors could obtain information and learn about the interpretive opportunities within the Floods region. The majority of these communities already have Chamber of Commerce and/or Visitor and Convention Bureau Offices that could function as visitor facilities and would not need development money.

A key to implementing the interpretation of the Floods will be the construction of a new major visitor center in Missoula, Montana, smaller facilities at Cabinet Gorge, Idaho, and Wallula Gap, Washington. Improvements to existing centers are also needed at Sun Lakes–Dry Falls State Park, Washington, and the Columbia Gorge Discovery Center and Wasco County Historical Society, The Dalles, Oregon. The funding for development of these visitor centers will have to be a collaborative effort involving federal, state, tribal, and local governments, together with the private sector.

On a smaller scale, other significant interpretive sites will need upgrades of existing facilities and the construction of new facilities in areas such as: Flathead Lake, Montana; Farragut State Park, Idaho; Frenchman Coulee, Washington; Palouse Falls State Park, Washington; Crown Point/Women's Forum State Park, Oregon; and within the Willamette Valley.

Regardless of the management approach selected, all share the cooperative/ partnership concept. The difference lies in how many levels of government are involved. There are a variety of funding sources at different levels of government. For example, the federal government can allocate funding through the Department of the Interior, Department of Agriculture, and the Department of Transportation's TEA-21 program. Federal funding would address development and operational costs. Additional funds would come from the state and local governments and the private sector in partnership with the federal government.

Successful partnership programs are operating around the United States; they reduce funding impacts and spread financial responsibility around. Over a period of years, the revenue generated by increased tourism could do much to offset the expenses of cooperatively operating an Ice Age Floods project. Donations from the private sector could be sought for specific projects as well as for grants from various businesses and foundations.

5. *Economic and Tourism Potential of the Recommended Route*

Much of the area included in the Ice Age Floods region continues to rely on agriculture, forest products, mining, selected manufacturing, transportation, and tourism. Except for the more urbanized areas of the region, the Information Age has not greatly affected the economy of the rural Pacific Northwest.

"Economists recognized the effect of variables on the economy, especially as they relate to travel and tourism. The U.S. economic conditions determine the amount of travel, type of travel, and travel destinations. Under the current good economic times, people are traveling more, traveling by plane, and traveling to destinations farther away. Worldwide economic conditions determine where to travel based on the exchange rate (best dollar value)," *Montana Bureau of Business and Economic Research, Outlook 2000.* Despite the fact that travel statistics for the 2000 travel season may be skewed because of the rapid increase of gasoline prices, various projections show a small increase in travel across the Pacific Northwest.

Over the past decade, the term "Cultural Tourism" has been added to the travel lexicon. The tourism industry has divided tourism into various subdivisions, such as day hike, nature/photo, special events, fishing, sporting events, boating, and cultural tourism. Visitors to the Ice Age Floods region can be counted as "Cultural Tourists," but they also are likely to be involved in other types of tourism during their visit.

Some of the 1999 travel and economic figures for the four states are interesting:

- Nonresident travelers spent $1.6 billion in Montana, directly supporting over 27,600 jobs and producing $54 million in proprietary income.
- In Idaho, visitors spent $1.7 billion, supporting 24,000 jobs and generating over $134 million in local and state taxes.
- Travelers to Washington generated about $10 billion, supporting 126,000 jobs and $488 million in

state tax revenue and $189 million for local jurisdictions.

Total travel spending in Oregon for 1999 was $5.5 billion with 79,000 jobs directly related to travel. Tax receipts for the same period were $198 million.

Using these figures, the tourism and economic picture for the four-state area would be:

- Tax Revenue (total) ..... $1.06 billion
- Travel Spending ..... $18.8 billion
- Number of Travel-related Jobs 256,600

Impacts on the economies of the four states within the Ice Age Floods region can best be summarized by the following quotes: Dean Runyan Associates stated, "The travel industry is one of the most important segments of the Idaho economy. . . ."; the Washington State Tourism Office said, ". . . a new study shows tourism is one of the state's growth industries." Oregon officials report, "The travel industry is an important component of the state's economy. In some areas of the state, travel and tourism is the major industry."

With the addition of the Ice Age Floods tour route, the tourism industry gains an additional attraction that should result in increased visitation. The four participating states should be able to recoup their initial development cost investment from increased tax revenue in a relatively short period of time. The Oregon Tourism Commission, in their "Cultural Heritage Tourism in Oregon," brought up an interesting observation regarding the extension of the lengths of visits to Oregon. *"In 1998, 26.7 million travelers lengthened* [emphasis added] *their trip because of cultural events and activities—61%* [emphasis added] *added part of one day; 30% added one night* [emphasis added]; *5% added two nights* [emphasis added]; and 4% added three or more nights." Cultural Heritage tourists tend to spend more money on their visits. The Oregon Tourism Commission noted: "They [the tourists] also spend more money per trip: $210 more per trip than the average U.S. traveler; stay 1.4 nights longer; and are more likely to stay in commercial accommodations."

The *Montana Business Quarterly* also noted: "Baby boomers don't want Disney World," says Sharalee Smith of the Fort Benton Restoration Society, a group that helped raise $100,000 for a bronze memorial to a loyal and tireless hero of the town, Shep the dog. Her comments were reported in these pages last year, as were the results of an industry study which compared the spending habits of so-called cultural tourists with the average; the average tourist spent $425 per person per trip, while the cultural tourist spent $615.

The Ice Age Floods tour route would allow residents and visitors to view real, tangible resources that directly relate to the natural heritage and settlement patterns of the region. The Floods tour route has the potential to generate revenue for both the public and private sector. With the commitment and assistance of the four state Departments of Tourism and Tourism Commission, along with the local Visitors and Convention Bureaus, the tour route could be a national and international attraction.

6. *The Future Role of the Ice Age Floods Institute*

Although it is now undergoing dramatic growth, the Ice Age Floods Institute is likely to remain a volunteer organization for some time to come. However, it is clear that some restructuring should be undertaken in order to adapt to the current situation of increased public interest in the Floods story. As that interest continues to grow, the Institute will develope a broader, more effective, and representative Institute membership that reflects both the extent of the region and the diversity of the interested partners.

On an interim basis, pending the adoption of a formalized cooperative project, the Institute will try to coordinate Floods-related activities. In addition, the Institute will continue to:

- Function as a source for information and referral regarding activities related to the Floods.
- Conduct authoritative one-day field trips for the public.
- Provide a newsletter directed to interested agencies, organizations, businesses and individuals.
- Maintain an expert Scientific Advisory Panel that can provide technical review to assist individuals and organizations in their interpretive projects.
- Encourage local groups and business organizations to explore possibilities for developing Floods-related projects in their respective areas.
- Develop contacts with agencies, local governments, educational institutions and organizations with an interest in natural history, outdoor recreation and tourism.

In addition, the Institute is in a strong position to define new projects that will attract private and corporate funding and sponsorship, including:

- Enhancing the Institute website as an information resource.
- Developing materials for interpretation, interpretive training,

curriculum use, sightseeing, and other purposes.

- Conducting field seminars.
- Conducting symposia on new and continuing research topics.
- Reprinting significant out-of-print historical materials (reports, papers, and maps).

As another instance of partnering, the Northwest Interpretive Association could cooperate with sales and distribution of materials in the region.

Looking a little further into the future, the Institute should continue to establish a track record that will serve as a basis for submitting grant applications to fund major projects. It is hoped that within a few years the group can achieve a level of income from memberships, programs, contributions and sponsorships that will make it possible to employ paid staff.

On the basis of this Study, the Institute will be preparing for the long-sought recognition of the Floods region as a nationally recognized area in which many agencies will be actively involved in a collaborative interpretive program. When that happens, the Institute will be ready to work as the principal private-sector partner and affiliated association. Even if the immediate outcome of the Study should be much less positive than is hoped for, the Institute will continue to develop public awareness and understanding of the Floods, with a special concern for the authoritative coordination of interpretive presentations.

Section m

Environmental Consequences

Section 303 (Study of Addition of New National Park System Areas) of Public Law 105-391 states, "Each study shall be completed in compliance with the National Environmental Policy Act of 1969." The purpose of the National Environmental Policy Act, commonly called NEPA, is to, "*. . . encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation. . . .*" [Emphasis added.]

This section addresses the impact of each proposed management alternative with regard to the Natural, Cultural, and Socio-economic environments. In addition, it presents the pluses, minuses, and potential impacts of each alternative as well as provides a comparative analysis for decision-makers.

Management Alternative 1
(Existing Conditions)

Natural Environment

Implementation of Alternative 1 would be expected to have neither a measurable positive nor negative impact on the natural environment of the study region. Some private sector initiatives involving individuals or groups may result in helping protect specific Floods features.

Cultural Environment

Implementation of Alternative 1 would be expected to have neither a measurable positive nor negative impact on the cultural environment of study region.

Socio-economic Environment

Better coordination at the local level could be beneficial for visitors, and this change may lead to some positive economic benefit.

Without a coordinated interpretive effort across the four-state region, the Floods story could be fragmented and

inconsistent for visitors as they travel from one area to another.

Opportunities for development of interpretive programs and facilities exist, but the costs for these improvements would have to be borne by local governments and the private sector. No specific state or federal designations or new initiatives related to the Floods story would be included under this alternative. As a result any potential benefit from matching state and/or federal funding support would be limited.

There are no significant adverse cumulative impacts associated with the implementation of this alternative. However, the lack of a coordinated effort to interpret the Floods story could be a limitation for visitors to the region.

Management Alternative 2

Natural Environment

Implementation of Alternative 2 would be expected to have a modest positive impact on the natural environment of the Floods region. Some private sector initiatives may provide additional protection of specific Flood features. Initiatives involving state managed lands, such as state parks, could provide additional protection for Flood features.

Cultural Environment

Implementation of Alternative 2 would be expected to have neither a measurable positive nor or negative impact on the cultural environment of the Floods region.

Socio-economic Environment

A coordinated interpretive approach involving a four-state initiative would be expected to result in a positive economic benefit for the region. This benefit would be due to an anticipated improvement in informational programs targeted to visitors. Additionally, both area residents and visitors to the region could obtain a better understanding of the Ice Age Floods.

State designation and written compacts or agreements could assist in a coordinated interpretive program and provide state funds to match local and private sector contributions. Through a coordinated effort the interpretive story of the Floods would be less fragmented and more consistent for visitors.

Under this alternative, there is an opportunity for agencies within the four states to enhance Floods-related activities while maintaining individual state management of sites. State funding for the coordinated interpretive approach would depend upon the ability of each state legislature to appropriate adequate funds to cover development and operational costs. Funding equity issues among the states may pose a concern because appropriations would be required from each of the four state legislatures.

No specific federal designation or new federal initiatives related to the Floods story would be included under this alternative. As a result any potential benefit from matching federal funding support would be limited.

There are no significant adverse cumulative impacts associated with the implementation of this alternative. The joint participation of the four states in the project region should provide the public with enhanced opportunities to learn more about the Floods story. There may be more attention given to the stewardship of Floods features because of better coordinated efforts and greater public awareness. There will need to be a commitment of state funds to support a quad-state cooperative effort. Federal funding sources for the project would not be available because emphasis would be at the state and local level.

Management Alternative 3

Natural Environment

Implementation of Alternative 3 would be expected to have a modest positive impact on the natural environment of the Floods region. Some private sector initiatives may provide additional protection of specific Floods features. Coordinated initiatives involving lands managed by both state and federal agencies, such as state parks, recreation areas, wildlife refuges, and other sites, could provide additional protection of Flood features.

Cultural Environment

Implementation of Alternative 3 would be expected to have neither a measurable positive nor negative impact on the cultural environment of the study region. Through National Geologic Trail designation, some cultural features could be highlighted as part of the trail's interpretive program. This interpretive focus could include how people currently use and live on lands that were shaped by the Ice Age Floods thousands of years ago.

Socio-economic Environment

Designation of a National Geologic Trail would provide national attention and recognition to the four-state area. This recognition would increase visitation to Flood sites and nearby communities. Through a coordinated effort, the interpretive story of the Floods would be less fragmented and more consistent for visitors.

A coordinated effort by the National Park Service and other partners would enhance the experience of visitors to the Floods region. This enhanced experience could result in a positive benefit to the economy of the region due to improved information programs for visitors. Additionally, both area residents and visitors to the region could obtain a better understanding of the Ice Age Floods.

National Geologic Trail designation would be expected to lead to Congressional funding support for NPS trail staff to assist in project coordination. This assistance would

result in a modest economic benefit in the investment of wages and operational expenditures in and around the community in which the trail office is located. Federal and other funds expended for development and interpretation of various flood sites could lead to a considerable economic benefit to the region. These funds would be in addition to matching state, local, and private sector funding.

Under this alternative, the management of the National Geologic Trail would be the primary responsibility of National Park Service personnel. Efforts would need to be made to ensure the desired coordinated approach to interpretation, education, and marketing of the Floods story would be inclusive and collaborative, and represented a consensus among the various public and private entities involved.

There are no significant adverse cumulative impacts associated with the implementation of this alternative. The National Geologic Trail designation, coupled with proposed partnership activities involving the NPS, the four states in the Floods region, tribal governments, and public agencies should provide the public with enhanced opportunities to learn more about the Floods story. There may be more attention given to the stewardship of Floods features because of better coordinated efforts and greater public awareness. There would also need to be a commitment of both state and federal funds to support the cooperative effort. The allocation of annual operating funds by the National Park Service to support the National Geologic Trail will impact existing annual operating support provided other NPS units unless additional funding can be secured.

Management Alternative 4

Natural Environment

Implementation of Alternative 4 would be expected to have a modest positive impact on the natural environment of the Floods region. Some private sector initiatives may provide additional protection of specific Flood features. Coordinated initiatives through the Commission and its partners involving lands managed by both state and federal agencies could provide additional protection of Floods features.

Cultural Environment

Implementation of Alternative 4 would be expected to have neither a measurable positive nor negative impact on the cultural environment of the Floods region. Through National Geologic Region designation and establishment of Floods tour routes, the interpretive program could highlight cultural features of the present-day landscape. This interpretive focus could include how people currently use and live on lands that were shaped by the Floods.

Socio-economic Environment

Designation of a National Geologic Region and the development of the Ice Age Floods Pathways tour route program would provide national attention and recognition for the four-state area. This designation could increase visitation to Floods sites and nearby communities. Through a coordinated effort, the interpretive story of the Floods would be less fragmented and more consistent for visitors.

The Commission's efforts to coordinate interpretation should help visitors better understand the Floods story and should result in a positive economic benefit for the region.

Through designation of a National Geologic Region and development of the Pathways tour routes, Congress would be expected to provide funding support for Commission staff. This support would result in a modest economic benefit in the investment of wages and operational expenditures in and around the community in which the Commission office is located. Federal funds for development and interpretation of various flood sites and tour routes could lead to considerable economic benefit to the region. These funds would be in addition to matching funds from state, local, and private sector efforts.

A Commission management approach brings the aura of "National" status to the project while maintaining a cross-section of federal, state, tribal, local, and private interests through Commission appointments. However, the Commission approach also creates a level of management complexity that will challenge Commission members, its staff, and its partners. The collaborative approach of the Commission and its formal relationship to state and federal agencies and the Ice Age Floods Institute should provide a framework for other partnerships in the Floods region. The Commission management structure may also result in broader and more direct participation by state governmental entities. Nominations to the Commission would be sought from the govenors of each state, thus more directly involving state, tribal, and local entities.

There are no significant adverse cumulative impacts associated with the implementation of this alternative. The National Geologic Region and Floods Pathways designation, coupled with proposed partnership activities involving the Ice Age Floods Regional Commission, the four states in the region, tribal governments, and public agencies, should provide the public with enhanced opportunities to learn more about the Floods story. There would be more attention given to the stewardship of Floods features because of better coordinated efforts and greater public awareness. There would also need to be a commitment of both state and federal funds to support the cooperative effort. The allocation of annual operating funds by the Department of the Interior (DOI) to support the Commission would impact existing annual operating support provided to DOI agencies unless additional funding can be secured.

section n

Most Effective And Efficient Management Alternative

General

Public Law 105-391 directs that the Secretary of the Interior "shall consider whether direct National Park Service management or alternative protection by other public agencies or the private sector is appropriate for the area . . ." and ". . . shall identify what alternative or combination of alternatives would in the professional judgment of the Director of the National Park Service be the most effective and efficient in protecting significant resources and providing for public enjoyment. . . ."

After careful consideration of the four management alternatives presented in the *Ice Age Floods Study of Alternatives and Environmental Assessment,* the National Park Service has determined that Management Alternative 3, which establishes the Ice Age Floods National Geologic Trail (Floods Pathways), is the most effective and efficient alternative. Under Alternative 3, the NPS would assume a lead role in Trail management. The NPS has ongoing responsibilities for numerous sites and programs having major interpretive and collaborative elements such as the New Jersey Coastal Heritage Trail and the Underground Railroad. The NPS has the demonstrated expertise and experience in promoting resource stewardship and interpretation of resources, and can be an effective leader and partner in working with numerous public- and private-sector entities in the region.

During the review of the draft report, the public and agency partners widely supported national designation of an Ice Age Floods National Geologic Trail that

follows the pathways of the Floods. They also supported the use of a collaborative approach to interpret the Floods.

Congressional authorization would be required to establish the Ice Age Floods National Geologic Trail in parts of Montana, Idaho, Washington, and Oregon, and to establish NPS administration of the Trail. It would be recommended that any requirement for the development of a comprehensive trail management plan incorporates the study goals of a well-coordinated interpretive and educational approach among the various public and private sector entities within the four-state region.

As suggested in the study report, it would be further recommended that the National Park Service not be given any specific land acquisition or new regulatory authority concerning the management of the National Geologic Trail. NPS responsibilities for Trail management should not have any effect on the legal jurisdiction of any local, state, or tribal government entity along the designated trail area. Federal agencies managing Floods resources within their lands would be expected to coordinate closely with Trail staff and partners regarding the interpretation and protection of Ice Age Floods resources.

In addition to coordinating Trail management among public and private entities within the region, the National Park Service also supports other specific components of Management Alternative 3, including the establishment of an Ice Age Floods National Geologic Trail Advisory Board composed of representatives from various public and private sector entities. Also supported is the continued important role of non-profit organizations, including the Ice Age Floods Institute, in furthering educational, tourism, and economic opportunities in conjunction with the Trail and the story of the Floods.

As the study report suggests, an authorization for annual operational funds for Trail staff and management support, along with an authorization for capital development funds, is needed to provide the necessary support for services and interpretive facilities associated with the development of the Ice Age Floods National Geologic Trail. In year-2000 dollars, annual operating costs are estimated to be $500,000, plus a total appropriation of $12,000,000 for capital development needs that can be allocated over several fiscal years.

appendices

APPENDICES

A—Reference List

B—Glossary of Terms

C—Study Team Participants

D—Public Law 105-391

E—Four State Resolutions

F—Similar Projects

appendix a

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Appendix B

Glossary of Terms

Back-arc Spreading—The region of crustal spreading between a volcanic archipelago and the continental interior.

Bars—Eddy or Shoulder Bars—Formed downstream from promontories or recesses.

Pendant Bars—Extended downstream behind the protection of a rock island or other obstruction.

Expansion Bars—Formed where the water spreads out after passing through a narrow point and deposits material.

Basalt—A dark-colored fine-grained extruded volcanic rock, rich in iron and magnesium, that is chiefly composed of plagioclase and pyroxene.

Basin—A large circular or elliptical depressed area in a landscape.

Braided River—A stream system so overloaded with sediment that there are many dividing and rejoining channels.

Colonnade—The lower portion of a lava flow with well-formed parallel shrinkage columns, usually vertical.

Columnar Jointing—Long joints, usually vertical, in volcanic rock that splits into columns as the rock cools and contracts.

Continental Glacier—A thick ice sheet covering a large part of a continent.

Coulee—A dry trench-like intermittent streambed or wash.

Delta—A low, flat tract of land at the mouth of a river, composed of stream-deposited sediment, and triangular in shape from an aerial view.

Entablature—The upper portion of a lava flow that displays irregular thin shrinkage columns.

Erratic—A large rock that is not of local origin and has been moved to its location by glacial ice.

Fault—A break in the earth's crust along which movement has taken place. Frequently occurs as a zone of numerous smaller faults.

Fault Trace—Intersections of faults on the ground surface (horizon); also called fault line.

Fauna—The entire animal population living in a given area, environment, or time span.

Flood Basalt—A plateau basalt. Successive flows of high temperature fluid basalt from fissure eruptions merge to form a continuous flat plateau.

Flora—The entire plant population living in a given area, environment or time.

Floodplain—The flat area where a stream or river may overflow.

Glacier—A mass of ice and snow that moves downhill because of gravity.

Graded Bedding—Rapid sedimentation leaving a distinctive texture of coarse grains followed by fine grains in a single layer. See Rhythmites.

Hanging Valleys—Smaller glacial valleys feeding into a deeper main glacier trough.

Jökulhlaup—An ice dam failure or glacial outburst

Kolk Lake—A hole eroded by rushing water at the base of a broken dike; a deep pool, eddy or scour area which has filled with water.

Lithosphere—The outer 60 miles of the earth between the crust and mantle where the rocks are harder and more brittle.

Lode—Deposits in which ores have been emplaced into rock formations where they occur in veins.

Loess—Non-stratified silt, clay, and dust, originating as glacial sediment, but re-deposited by wind. Wind-blown silt.

Magma—A silica-rich molten fluid that appears on the surface as lava and that cools underground as a pluton.

Magma Chamber —A magma reservoir in the shallow part of the lithosphere.

Plunge Pool—A spot at the base of a waterfall where the descending force of the water strikes the bottom and carves out a basin. A deserted plunge pool is one whose waterfall has migrated upstream.

Pothole—A bowl-shaped depression in a rock surface that has been carved by the whirling action of stones in a stream bed.

Rhythmites—Layers consisting of gravel or sand at the base, followed by silt on top, representing separate flooding events.

Rift—A distinct, roughly linear trough or depression on the earth's crust that reflects a pulling apart of the crust due to tension.

Ripple Marks—Deposits left by currents flowing over the bottom that shape the sediments into smooth, parallel, ridge rows resulting in washboard-like ripples that are regularly patterned.

Sand—Rock and mineral fragments ranging in size between 1/16 and 2 millimeters in diameter.

Scabland—An irregular land surface of basalt that has been scoured of its soil cover by floods.

Spillways—Low divides that have been overtopped by floodwaters.

Strand—Beach and very shallow coastal area dominated by shoreline processes, particularly wave processes.

Subduction Trench—A distinct linear groove on the earth's crust marking the boundary between two colliding tectonic plates in which one plate slips beneath another.

Submarine Canyon—A steep V-shaped trench along or across a continental shelf or deep ocean floor.

Till—Loose sediment deposited by glaciers.

Watershed—The total area drained by a stream system.

appendix c

Study Team Participants

In order to complete a study of this magnitude, many people donated their time, energy, and experience. Their willingness to do so is greatly appreciated by the authors of this study. These volunteers represent many fields and professions and include geologists, librarians, professors, teachers, park managers, museum directors, tribal planners, business leaders, and retirees, just to name a few.

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appendix d

Public Law 105-391

FROM TITLE 16 OF THE U.S. CODE, AS AMENDED BY P.L. 105-391, TITLE III

16 USC Sec. 1a-5

TITLE 16 - CONSERVATION

CHAPTER 1 - NATIONAL PARKS, MILITARY PARKS, MONUMENTS, AND SEASHORES

SUBCHAPTER I - NATIONAL PARK SERVICE

Sec. 1a-5. Additional areas for National Park System

(a) General authority

The Secretary of the Interior is directed to investigate, study, and continually monitor the welfare of areas whose resources exhibit qualities of national significance and which may have potential for inclusion in the National Park System. Accompanying the annual listing of areas shall be a synopsis, for each report previously submitted, of the current and changed condition of the resource integrity of the area and other relevant factors, compiled as a result of continual periodic monitoring and embracing the period since the previous such submission or initial report submission one year earlier. The Secretary is also directed to transmit annually to the Speaker of the House of Representatives and to the President of the Senate, at the beginning of each fiscal year, a complete and current list of all areas included on the Registry of Natural Landmarks and those areas of national significance listed on the National Register of

Historic places which areas exhibit known or anticipated damage or threats to the integrity of their resources, along with notations as to the nature and severity of such damage or threats. Each report and annual listing shall be printed as a House document: Provided, That should adequate supplies of previously printed identical reports remain available, newly submitted identical reports shall be omitted from printing upon the receipt by the Speaker of the United States House of Representatives of a joint letter from the chairman of the Committee on Natural Resources of the United States House of Representatives and the chairman of the Committee on Energy and Natural Resources of the United States Senate indicating such to be the case.

(b) Studies of areas for potential addition

(1) At the beginning of each calendar year, along with the annual budget submission, the Secretary shall submit to the Committee on Resources of the House of Representatives and to the Committee on Energy and Natural Resources of the United States Senate a list of areas recommended for study for potential inclusion in the National Park System.

(2) In developing the list to be submitted under this subsection, the Secretary shall consider -

(A) those areas that have the greatest potential to meet the established criteria of national significance, suitability, and feasibility;

(B) themes, sites, and resources not already adequately represented in the National Park System; and

(C) public petition and Congressional resolutions.

(3) No study of the potential of an area for inclusion in the National Park System may be initiated after November 13, 1998, except as provided by specific authorization of an Act of Congress.

(4) Nothing in this Act shall limit the authority of the National Park Service to conduct preliminary resource assessments, gather data on potential study areas, provide technical and planning assistance, prepare or process nominations for administrative designations, update previous studies, or complete reconnaissance surveys of individual areas requiring a total expenditure of less than $25,000.

(5) Nothing in this section shall be construed to apply to or to affect or alter the study of any river segment for potential addition to the national wild and scenic rivers system or to apply to or to affect or alter the study of any trail for potential addition to the national trails system.

c) Report

(1) The Secretary shall complete the study for each area for potential inclusion in the National Park System within 3 complete fiscal years following the date on which funds are first made available for such purposes. Each study under this section shall be prepared with appropriate opportunity for public involvement, including at least one public meeting in the vicinity of the area under study, and after reasonable efforts to notify potentially affected landowners and State and local governments.

(2) In conducting the study, the Secretary shall consider whether the area under study -

(A) possesses nationally significant natural or cultural resources and represents one of the most important examples of a particular resource type in the country; and

(B) is a suitable and feasible addition to the system.

(3) Each study -

(A) shall consider the following factors with regard to the area being studied -

(i) the rarity and integrity of the resources;

(ii) the threats to those resources;

(iii) similar resources are already protected in the National Park System or in other public or private ownership;

(iv) the public use potential;

(v) the interpretive and educational potential;

(vi) costs associated with acquisition, development and operation;

(vii) the socioeconomic impacts of any designation;

(viii) the level of local and general public support; and

(ix) whether the area is of appropriate configuration to ensure long-term resource protection and visitor use;

(B) shall consider whether direct National Park Service management or alternative protection by other public agencies or the private sector is appropriate for the area;

(C) shall identify what alternative or combination of alternatives would in the professional judgment of the Director of the National Park Service be most effective and efficient in protecting significant resources and providing for public enjoyment; and

(D) may include any other information which the Secretary deems to be relevant.

(4) Each study shall be completed in compliance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).

(5) The letter transmitting each completed study to Congress shall contain a recommendation regarding the Secretary's preferred management option for the area.

(d) New area study office

The Secretary shall designate a single office to be assigned to prepare all new area studies and to implement other functions of this section.

(e) List of areas

At the beginning of each calendar year, along with the annual budget submission, the Secretary shall submit to the Committee on Resources

of the House of Representatives and to the Committee on Energy and Natural Resources of the Senate a list of areas which have been previously studied which contain primarily historical resources, and a list of areas which have been previously studied which contain primarily natural resources, in numerical order of priority for addition to the National Park System. In developing the lists, the Secretary should consider threats to resource values, cost escalation factors, and other factors listed in subsection (c) of this section. The Secretary should only include on the lists areas for which the supporting data is current and accurate.

(f) Authorization of appropriations

For the purposes of carrying out the studies for potential new Park System units and for monitoring the welfare of those resources, there are authorized to be appropriated annually not to exceed $1,000,000. For the purposes of monitoring the welfare and integrity of the national landmarks, there are authorized to be appropriated annually not to exceed $1,500,000. For carrying out subsections (b) through (d) of this section there are authorized to be appropriated $2,000,000 for each fiscal year.

-SOURCE-

(Pub. L. 91-383, Sec. 8, as added Pub. L. 94-458, Sec. 2, Oct. 7, 1976, 90 Stat. 1940; amended Pub. L. 95-625, title VI, Sec. 604(l), Nov. 10, 1978, 92 Stat. 3518; Pub. L. 96199, title I, Sec. 104, Mar. 5, 1980, 94 Stat. 68; Pub. L. 96-344, See. 8, Sept. 8, 1980, 94 Stat. 1135; Pub. L. 103-437, Sec. 6(b), Nov. 2, 1994, 108 Stat. 4583; Pub. L. 104-333, div. I, title VIII, Sec. 814(d)(1)(I), Nov. 12, 1996, 110 Stat. 4196; Pub. L. 105-391, title III, Sec. 303, Nov. 13, 1998, 112 Stat. 3501.)

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Resolution of Support of the Montana Department of Commerce For an Ice Age Floods Study by the National Park Service

WHEREAS, the United States Department of the Interior, National Park Service is seeking federal funding for a study of the Ice Age Flood features that are seen in portions of western Montana, the Idaho panhandle, eastern Washington, northern Oregon and the Columbia River Valley through the gorge to the ocean, and

WHEREAS, the Ice Age Floods study will be a study of alternatives for the interpretation and management of significant geologic features left by Glacial Lake Missoula and

WHEREAS, the Ice Age Floods study is proposed to be accomplished through an interagency task force made up of federal, state, and local government entities within the four state area, and

WHEREAS, the Montana Department of Commerce, through its Travel Montana program and other appropriate economic development programs, is interested in working cooperatively with other agencies and individuals to develop management plans and to interpret our natural resources to the public, and

WHEREAS, the Seattle Support Office of the National Park Service is seeking written support of its efforts to complete the Ice Age Floods study.

NOW, THEREFORE, the Montana Department of Commerce does hereby express its support for the Ice Age Floods study as proposed by the National Park Service and expresses its desire to be a part of the interagency task force

Adopted this 17th Day of April, 2000

Dr. Peter Blouke, Director

"Working Together to Make It Work"

Resolution of Support
of the Idaho Park and Recreation Board for
an Ice Age Floods Study
by the National Park Service

WHEREAS, the United States Department of the Interior, National Park Service is seeking federal funding for a study of the Ice Age Flood features that are seen in portions of western Montana, the Idaho panhandle, eastern Washington, northern Oregon, and the Columbia River valley through the gorge to the ocean, and

WHEREAS, the Ice Age Floods study will involve a study of alternative approaches to the interpretation and management of flood features to the public, and

WHEREAS, the Ice Age Floods study is proposed to be accomplished through an interagency task force made up of federal, state, and local government entities within the four state area; and

WHEREAS, the Idaho Park and Recreation Board maintains and operates state parks that were affected by Ice Age Floods, and

WHEREAS, the Idaho Park and Recreation Board is interested in working cooperatively with other agencies and individuals to develop management plans and to interpret our natural resources to the public, and

WHEREAS, the Seattle Support Office of the National Park Service is seeking written support of its efforts to complete the Ice Age Floods study.

NOW, THEREFORE, the Idaho Park and Recreation Board does hereby express its support for the Ice Age Floods study as proposed by the National Park Service and expresses its desire to have State Parks staff actively involved in the interagency task force.

ADOPTED THIS 29 DAY OF OCT., 1998

Glenn E. Shewmaker, Chairman

Ernest J. Lombard, Vice Chairman

Robert M. Haakenson, Member

Beverly L. Boyd, Member

Jean S. McDevitt, Member

Monte Q. Later, Member

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Resolution of Support of the Washington State Parks and Recreation Commission for an Ice Age Floods Study by the National Park Service

WHEREAS, the United State Department of Interior, National Park Service, is seeking federal funding for a study of the Ice Age Flood features that are seen in portions of western Montana, the Idaho panhandle, eastern Washington, northern Oregon, and the Columbia River valley through the gorge to the ocean; and

WHEREAS, the Ice Age Floods study will involve a study of alternative approaches to the interpretation and management of flood features to the public; and

WHEREAS, the Ice Age floods study is proposed to be accomplished through an interagency task force made up of federal, state, and local government entities within the four state area; and

WHEREAS, the Washington State Parks and Recreation Commission maintains and operates many parks in eastern Washington and along the Columbia River to the ocean that illustrate Ice Age Flood features; and

WHEREAS, the Washington State Parks and Recreation Commission is interested in working cooperatively with other agencies and individuals to develop management plans and to interpret our natural resources to the public;

AND, WHEREAS, the Seattle Support Office of the National Park Service is seeking written support of its efforts to complete the Ice Age Floods study.

NOW, THEREFORE, the Washington State Parks and Recreation Commission does hereby express its support for the Ice Age Floods study as proposed by the National Park Service and expresses its desire to have State Parks staff actively involved in the interagency task force.

ADOPTED THIS 24TH DAY OF APRIL, 1998

Jack Shreve, Chair

Clyde Anderson, Commissioner

Mel Wortman, Commissioner

Bruce Hilyer, Commissioner

Robert Petersen, Commissioner

Joan Thomas, Commissioner

Mickey Fearn, Commissioner

RESOLUTION OF SUPPORT OF THE OREGON PARKS AND RECREATION DEPARTMENT FOR AN ICE AGE FLOODS STUDY BY THE NATIONAL PARK SERVICE

WHEREAS, the United States Department of the Interior, National Park Service is seeking federal funding for a study of the Ice Age Flood features that are seen in portions of western Montana, the Idaho panhandle, eastern Washington, northern Oregon, and the Columbia River valley through the gorge to the ocean, and

WHEREAS, the Ice Age Floods study will involve a study of alternative approaches to the interpretation and management of flood features to the public, and

WHEREAS, the Ice Age Floods study is proposed to be accomplished through an interagency task force made up of federal, state, and local government entities within the four state area; and

WHEREAS, the Oregon Parks and Recreation Department maintains and operates state parks that were affected by Ice Age Floods, and

WHEREAS, the Oregon Parks and Recreation Department is interested in working cooperatively with other agencies and individuals to develop management plans and to interpret our natural resources to the public, and

WHEREAS, the Seattle Support Office of the National Park Service is seeking written support of its efforts to complete the Ice Age Floods study.

NOW, THEREFORE, the Oregon Parks and Recreation Department does hereby express its support for the Ice Age Floods study as proposed by the National Park Service and expresses its desire to have State Parks staff actively involved in the interagency task force.

Adopted This 21 Day of December, 1999

Robert L. Meinen

Robert L. Meinen, Director

appendix f

Similar Projects

1. *Historic Trails*

Oregon National Historic Trail

The general route of this trail stretches from Independence, Missouri, to Oregon City, Oregon. This 2,170-mile-long trail passes through Missouri, Kansas, Nebraska, Wyoming, Idaho, and Oregon. As the harbinger of America's westward expansion, the Oregon Trail was the pathway to the Pacific for fur traders, gold seekers, missionaries, and emigrants. Beginning in 1841 and continuing for more than 20 years, an estimated 300,000 emigrants followed this route from Missouri to Oregon on a trip that took five months to complete.

The National Park Service Comprehensive Management and Use Plan describes the official route and lists 235 historic sites and seven cross-country segments. It also makes recommendations for resource protection, trail management, and markers. Many of the sites and segments are on public land and are open to visitors. Others are located on private lands. The approximate route can still be followed by automobile, and opportunities are available to travel by foot, horse, or mountain bike in many places. Information on trail routes and history is available from the National Park Service Long Distance Trails Office. Information on accessibility and travel conditions along the cross-country segments is best obtained from local offices of the Bureau of Land Management or the U.S. Forest Service.

Lewis and Clark National Historic Trail

In 1804, Meriwether Lewis and William Clark were sent out by President Thomas Jefferson to find a transportation link between the Louisiana Territory and the

"Oregon Country." In addition, Lewis and Clark were to acquire knowledge of the vast and unexplored west of the nation as they covered more than 8,000 miles in two years. As they journeyed from the Mississippi to the Pacific Ocean, they meticulously recorded observations of the characteristics, inhabitants, and resources of the country through which they passed. Their journey lit the imagination of the American people about this country and its destiny. Its scope and achievements have made the Expedition one of the most dramatic and significant episodes in the history of the United States.

Today it is possible to retrace portions of this historic route by following the Lewis and Clark National Historic Trail, which was Congressionally designated as the first Historic Trail in 1978. The water route taken by the Expedition can be retraced by boat, and some parts of the overland route have been or are being developed for travel by horseback, foot, and bicycle. Motor routes that approximately follow the route of the historic expedition are uniformly marked and connect a series of memorials, museums, visitor centers, interpretive exhibits, and historic sites along the trail. The National Park Service administrates the trail in cooperation with federal, state, and local agencies, nonprofit organizations, and private landowners. The Lewis and Clark National Historic Trail was recognized in 1999 as one of twelve National Millennium Trails.

2. *Scenic Trails*

Ice Age National Scenic Trail

The effects of the advancing and retreating glaciers of the last Ice Age created an unmistakable legacy in the State of Wisconsin. Thousands of formations left on the glacial landscape give the area its remarkable beauty and diversity.

In the 1950s, a 1,000-mile-long trail was first envisioned generally to follow the terminal moraines of the most recent glaciation and to connect Ice Age formations. In order to achieve this, a nine-unit Ice Age National Scientific Reserve was created in 1971. In 1980 Congress recognized the national significance of the trail by designating it a National Scenic Trail. The National Park Service administers the trail in cooperation with the Wisconsin Department of Natural Resources and the Ice Age Park and Trail Foundation. Much of the work to develop and maintain the trail has come from volunteers.

As of 1998, 227 miles of the trail have been certified by the NPS as part of the Ice Age National Scenic Trail. An additional 250 miles of completed trail segments are also open for public use and enjoyment for auto tours, hiking, cross-country, and nature walks.

Natchez Trace National Scenic Trail

The Natchez Trace National Scenic Trail is 694 miles in length and located in Alabama, Mississippi, and Tennessee. The Trail Segments include several existing portions of the historic Natchez Trace that lie within the boundaries of the Natchez Trace Parkway. Completed sections of this trail are found alongside the Natchez Trace Parkway near Rocky Springs and Jackson, Mississippi, and Nashville, Tennessee. The trail is also a unit of the National Trails System and was established March 28, 1983. Public-use opportunitities consist of auto tours, guided tours, biking, hiking, and nature walks.

Potomac Heritage National Scenic Trail

The designation of a Potomac Heritage National Scenic Trail corridor, enacted and signed in 1983 as an amendment to the National Trails System Act, is being

used by communities in Virginia, Maryland, the District of Columbia, and Pennsylvania to develop and make connections among trails, historic sites, and a range of recreational and educational opportunities. Three trails are currently recognized as "official" segments of the Potomac Heritage National Scenic Trail: the 184.5-mile C & O Canal Towpath, managed by Chesapeake & Ohio Canal National Historical Park; the 17-mile Mount Vernon Trail, managed by George Washington Memorial Parkway; and the 75-mile Laurel Highlands Trail, managed by Laurel Ridge State Park, Pennsylvania Department of Conservation and Natural Resources.

Existing trails are complemented by many local and regional trails, on land and water, with many more in the early stages of development. Local governments and citizen groups are using the corridor designation (1) to support a variety of trail projects, (2) to increase educational, conservation, and development opportunities, and (3) to realize benefits from the extensive growth in ecotourism.

3. *National Heritage Trail*

New Jersey Coastal Heritage Trail

The New Jersey Coastal Heritage Trail project was conceived and designed to recognize the importance of New Jersey's coastal area in our nation's history. The trail's project area stretches more than 275 miles along the New Jersey coast. The trail's authorizing legislation directed the NPS, in cooperation with the State of New Jersey, other Federal agencies, local governments, and private entities, to inventory sites within the project area and to prepare a plan for protecting and interpreting those sites.

The heritage of the New Jersey coastal area is explored through interpretation of five interrelated themes—maritime history, coastal communities, relaxation and inspiration, coastal habitats, and wildlife migration. Each theme is based upon aspects of the area's heritage, and together they illustrate the interaction of natural and cultural influences and the coastal environment.

The New Jersey Coastal Heritage Trail project is being developed and implemented through the cooperative efforts of the Federal government, the State of New Jersey, county and city governments, nonprofit organizations, and individual site managers. The NPS is the Federal government's lead agency on this project. Although primarily a vehicular route along public roads, the Trail connects coastal areas with their local recreational opportunities into an overall trail package.

4. *National Heritage Corridors*

Illinois and Michigan Canal National Heritage Corridor

The Illinois and Michigan Canal National Heritage Corridor was created in 1984 when Congress enacted legislation that recognized the area's unique contributions to the nation's development. Public Law 98-398 established a corridor defined by the Illinois and Michigan Canal from Chicago to LaSalle, Illinois. It also established the National Heritage Corridor Commission to be made up of 19 members. They include the Director of the NPS, three representatives of state and local governments, five members nominated to represent the interests of history/archaeology/recreation/ conservation, five members nominated to represent the interests of business/industry, one member of the county board representing each county, and one member of the board of a forest preserve district.

Formed by business and community leaders from northeastern Illinois to promote Federal designation of the Illinois and Michigan Canal National Heritage Corridor, the Canal Corridor Association is a nonprofit organization managed by a volunteer board of business, industry and community leaders, and a professional staff. The Association works toward the economic revitalization of the Illinois & Michigan Canal National Heritage Corridor by drawing on the shared past of a region founded on the nineteenth-century I & M Canal, by forging public and private partnerships, and by offering technical assistance in historic preservation, land conservation, and economic development.

Blackstone River Valley National Heritage Corridor

The Blackstone River Valley illustrates a major era of America's past: the Age of Industry. The communities along the banks of this river were the first to experience the change brought about by the revolutionary way of using waterpower and labor in America. They evolved from an isolated agrarian society to industrialized interdependent communities. Evidence of the way people lived during this turning point in history can be seen in the thousands of

structures and landscapes still found in the area, such as mill villages, roads, trails, dams, mill ponds, agricultural and natural environments, and ethnic traditions in neighborhoods, languages and foods.

The Blackstone River Valley National Heritage Corridor is a region of nearly 400,000 acres located in central Massachusetts and northern Rhode Island. The National Corridor was designated by an Act of Congress in 1986 to preserve and interpret the unique and significant value of the Blackstone Valley. It includes cities, towns, villages and almost one million people. The Federal government does not own or manage any of the land or resources in the corridor. Instead, the National Park Service, two state governments, dozens of local municipalities, businesses, nonprofit historical and environmental organizations, educational institutions, private citizens, and a unifying Commission work together in partnerships to protect the Valley's special identity and prepare for its future. The Corridor can be seen by bicycle, watercraft, train, automobile, and foot.

Delaware and Lehigh National Heritage Corridor

The Lehigh Navigation System and the Delaware Canal, constructed from 1817 to 1845, opened the region and its resources to development, brought great wealth, spurred industrial innovations, and led to the founding and growth of today's canal towns. It was America's last and longest operated towpath canal, and it is now the most fully intact and accessible towpath canal in the nation. The canals are the threads that connect the rich historic, cultural, and recreational resources of the Corridor.

The Delaware and Lehigh Canal National Heritage Corridor is a 150-mile-long region in eastern Pennsylvania that follows the historic routes of the Delaware Canal and the Lehigh Navigation System. Within the corridor are scenic rivers, historic canals and towns, mountains, green valleys, natural areas, recreation, remnants of early industries, distinctive religious heritage,

and active cultural arts. Designated by Congress in 1988, this Heritage Corridor is now the subject of an intensive, cooperative effort by citizens to plan for conservation of the valley's heritage and the enhancement of the region's quality of life. Many partnership organizations and agencies, at local, state, and federal levels, act to collaborate for the Corridor's future. There are many ways to enjoy the Corridor, including hiking, auto tours, and boating. The entire Delaware Canal Towpath and 32 miles of the Lehigh Towpath are National Recreation Trails.

Quinebaug and Shetucket Rivers Valley National Heritage Corridor

Quinebaug and Shetucket Rivers Valley National Heritage Corridor encompasses about 850-square-miles in the northeastern corner of Connecticut. Stretching from Norwich north to the Massachusetts border and from Coventry east to Rhode Island. It has been called "the last green valley" in the Boston-to-Washington megalopolis. Close to Hartford, Providence, and Worcester but far enough away to avoid the urban sprawl of recent years, this region remains predominately rural. Roadways winding through rolling hills link the region's many small towns, villages, farmlands, and forests. Old mills dot the lowlands along the Quinebaug and Shetucket rivers and their tributaries.

In the past 50 years, many changes have come to this area. Many of the farms and factories have been put to new uses, such as housing, antique and craft shops, recreation, and high-tech industry. Amid these economic changes, this region has retained its fundamental attributes of lush woodlands, clean streams, rivers, ponds, and lakes; authentic sites representing distinct periods of American history; and opportunities for individuals and families to enjoy a rural, small-town lifestyle.

Quinebaug and Shetucket Rivers Valley National Heritage Corridor is a special kind of park in that it embraces 25 towns with numerous villages and a total population of about 250,000. The federal government does not own or manage any of the land as it does in traditional national parks. Instead, citizens, businesses, nonprofit cultural and environmental organizations, local and state governments, and the National Park Service are working together to preserve the region's cultural history and to perpetuate its natural heritage.

NPS Photo

Multnomah Falls, Oregon

5. *National Scenic Area*

Columbia Gorge National Scenic Area

The Columbia River Gorge is a spectacular river canyon cutting through the volcanic rock of the Cascade Mountain Range. As the only sea-level river flowing through the Cascades, the Columbia is both a natural wonder and an important transportation corridor. Recognizing this interest, Congress passed an act creating the 292,000-acre Columbia Gorge National Scenic Area, which is managed by the U.S. Forest Service. There are many recreational opportunities in CGNSA, including windsurfing, boating, hiking, auto tours, biking, and other activities.

Along with other interpretive themes, the Columbia Gorge National Scenic Area does provide some interpretation of the Ice Age Floods story.

6. *National Historic Parks*

Klondike Gold Rush National Historic Park

There are two units of the Klondike Gold Rush National Historical Park: one in Seattle, Washington, and one in Skagway, Alaska. The Seattle Unit of the Klondike Gold Rush National Historical Park commemorates the city's role as the most important staging area for the gold rush of the 1890s.

In Skagway, Klondike Gold Rush National Historical Park lies in one of the world's most spectacular geographic areas, characterized by an almost endless array of islands, mountains, glaciers, rivers, lakes, and forests. Fortunately, within this unspoiled geographic setting, the United States and Canada have been able to preserve a wealth of historic structures and artifacts. Visitors, particularly those that hike the Chilkoot Trail, are likely to see these last tangible reminders of the gold rush days: telephone wire and poles, boots, bedsprings, horseshoes, and rusty cookware, to name a few. The park in Skagway preserves a dozen gold rush–era buildings, forming the heart of the historic district. The park and town are popular summer destinations for road and cruise ship passengers. The contrast between the scenic grandeur and the humble remains of the stampeders' possessions and temporary structures is what helps to make a visit to the park an unforgettable experience.

Nez Perce National Historic Park

There are 38 separate sites of the Nez Perce National Historic Park scattered across the states of Idaho, Oregon, Washington, and Montana. They have been designated to commemorate the legends and history of the Nez Perce people and their interaction with explorers, fur traders, missionaries, soldiers, settlers, gold miners, loggers, and farmers who moved through or into the area.

The areas encompassing these sites display the great diversity of the American West—topography, rainfall, vegetation, and scenery—ranging from the semiarid regions of Washington, to the lush high mountain meadows of

Idaho and Oregon, to the prairies of Montana. As you travel from site to site, one gradually senses the importance of the land in contributing to the rich and diverse cultural history of the Nez Perce people.

Touring this park is unlike traveling in most parks, for this one is as much an idea as it is actual physical property. In some cases the idea is the stronger force, for the physical remains of the past have either disappeared or the original appearance has been greatly altered.

7. *National Reserves*

Ice Age National Scientific Reserve

Some of the effects of the most recent advance of the continental ice sheet, the Wisconsin Stage, are dramatically evident in the state of Wisconsin. Striking evidence is visible in drumlins, kames, kettles, glacial lakes, moraines, and eskers scattered throughout the landscape. The Ice Age National Scientific Reserve was created to preserve and protect this legacy of the last glacial stage.

The Ice Age National Scientific Reserve is composed of nine units containing resources significantly characteristic of the continental glaciation in Wisconsin. Collectively these units are approximately 32,500 acres in size and are connected by the 227-mile long Ice Age National Scenic Trail. As authorized by Congress, management of the Reserve is a cooperative venture of federal, state, and local governments to preserve and interpret these resources.

8. *Other*

The Seaway Trail

The New York State Seaway Trail is a 454-mile scenic route that runs parallel to Lake Erie, the Niagara River, Lake Ontario, and the St. Lawrence River. The Trail passes through 10 counties and connects cities, villages, fishing ports, state parks, museums, and 42 historic sites. The Trail is noted for its mixed usage by automobile, bicycle, bus, motorcoach, and RVs. The Seaway Trail was selected as a National Scenic Byway by the U.S. Department of Transportation due to its unique landscape, which has been sculpted by the forces of nature and has great historical interest.

The Trail is managed and marketed by Seaway Trail, Inc., a private corporation that was created in 1978 "*to promote the Trail as a tourist destination and encourage regional economic development through tourism* (emphasis added)."

It is interesting to note that the purpose of the Trail is tied directly to tourism and economic development, recognizing the economic benefits of tourism.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS-D-1463 April 2001