July 2022
Water Policy Interim Committee

REPORT TO THE 68TH MONTANA LEGISLATURE

A CONSTANT REWORKING: EROSION AND THE LOWER FLATHEAD RIVER (SJ28)

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This report is a summary of the work of the Water Policy Interim Committee, specific to the Water Policy Interim Committee's 2021-2022 study as outlined in the Water Policy Interim Committee's 2021-22 work plan and Senate Joint Resolution 28 (2021). Members received additional information and public testimony on the subject, and this report is an effort to highlight key information and the processes followed by the Water Policy Interim Committee in reaching its conclusions. To review additional information, including audio minutes, and exhibits, visit the Water Policy Interim Committee website: www.leg.mt.gov/water.

A full report, including links to the documents referenced in this print report, is available at the Water Policy Interim Committee website: www.leg.mt.gov/water

SJ28: STUDY OF FLATHEAD RIVER EROSION

That the Legislative Council be requested to designate an appropriate interim committee or statutory committee, pursuant to section 5-5-217, MCA, or direct sufficient staff resources to review issues of erosion along the Flathead River, including:

1. compiling existing data on the causes and impacts of erosion on the Flathead River;
2. determining the impacts of recreational boat use to streambanks on the lower Flathead River and how to lessen those impacts; and
3. examining information gaps and collecting additional data, as necessary.

DRAFT FINDINGS

1. Erosion on the lower 21 miles of the Flathead River entering into Flathead Lake is a historical issue.
2. Sources of erosion include inundation by floods, wind- and storm-driven waves, spring runoff, and boat wakes.
3. Property owners have lost riverfront property due to eroding riverbanks, which results in stabilization efforts, such as bank armor, channel structures or bioengineering.
4. Boat traffic on this stretch of the Flathead River has increased since at least 1992.
5. Wake-reduction regulations are a tool to reduce erosion. Local stakeholders typically drive these regulations and restrictions, which often arise out of conflict between groups. The Legislature or the Fish and Wildlife Commission may authorize these regulations, which would affect recreational interests.
6. Property owners alongside other Montana rivers and lakes, such as the Missouri River and Lake Helena, experience erosion from similar causes.

INTRODUCTION

Kalispell, the major city in Montana's Flathead Valley, is a Salish word meaning "flat land above the lake." This flat land, called the Flathead Valley, contains the Flathead River, which meanders across the glacial valley, leaving oxbow lakes, ponds, wetlands, and a high water table.

This flat land has been carved by the meandering Flathead River for about 12,000 years, when the last huge glaciers disappeared from the basin. Stream currents, wind-driven waves, periodic floods, inundation from artificially high lake levels, and boat wakes have chewed away at the banks of this river.

Senate Joint Resolution 28 (SJ28) presented the Water Policy Interim Committee with exploring these erosion issues along the 21 river miles from state Highway 35 (east of Kalispell) to Flathead Lake.

This stretch of river is subject to repeat attempts by landowners to stabilize the riverbanks. This report explores some of the causes of erosion and a discussion of possible solutions.

Solutions may include more-aggressive bank stabilization efforts, implementing local land use laws, prohibiting certain motorized watercraft, expanding lakeshore protection measures, or even appealing for a change in the operating permit for a dam on the far end of Flathead Lake.

THE RIVER

The Flathead River is considered the headwaters of the Columbia River, one of the giant drainages in the North American continent. The river is located in northwestern Montana; The courses through or by Glacier National Park, and the cities of Columbia Falls, Kalispell, and Polson. The national park, the Bob Marshall Wilderness Area and British Columbia provide tributaries for the river. The basin is approximately 90 miles long and 200 miles wide.[1]

The river is generally considered to have three forks. The north fork—which some consider the river's main stem—emanates from the MacDonald Range in southeastern British Columbia. The middle and south forks join the main stem upstream of Columbia Falls. The south fork is obstructed by the federal Hungry Horse Dam operated by the Bureau of Reclamation.

The river empties into Flathead Lake, which is the largest U.S. freshwater lake west of the Mississippi River. The river continues its journey south out of Flathead Lake, where it joins the Clark Fork River near Paradise, Mont. The river runs 158 miles from Canada, not including the 28-mile length of Flathead Lake. The Stillwater, Whitefish, Jocko, and Swan rivers join the Flathead River.

The Flathead River watershed is described as:

[1] Northwest Power and Conservation Council, *Flathead River Subbasin Executive Summary* (2004), 5.

> ...flowing from Glacier National Park and the Livingston, Mission, Swan, and Whitefish ranges. These small tributary streams tumble downward, over ancient bedrock, boulders, and cobbles, sometimes in steep waterfalls, cutting deep valleys as they move. Downstream the rivers become less turbulent spread laterally over flatter landscapes and meander through broad glaciated valleys.[2]

The river is an alluvial river, meaning it flows through its own deposited sediment. In fact, the river is in a "constant state of sediment reworking."[3]

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This lateral spread is evidenced by seven larger connected river sloughs adjacent to the mainstem river downstream from the junction with the Stillwater River. Some sloughs are old oxbow channels; others are confluences with tributary creeks.[4]

THE FLATHEAD RIVER VALLEY

Native Americans, including the Kootenai and Pend d'Oreille (Kalispel) people, seasonally hunted the Flathead Valley and Flathead Lake for centuries. Later, the tribes established more permanent settlements in the area.

Fur traders hunted, trapped, and traded in the valley by the 1850s. Settlement remained sparse until the Great Northern Railway laid its route across the valley from Columbia Falls to Kalispell. The railway drew settlement, which led to a change in land use, as livestock grazing, the cultivation of wheat, barley, oats, and potatoes, and timber harvests powering sawmills began tapping into the area's natural resources.[5]

Modern day land use includes farms, hobby farms, light industry, parks, residential neighborhoods, retail and office buildings, timberlands, and other public lands.

Agriculture continues to operate in the valley, albeit mostly through smaller holdings. While the average size of a Montana farm is 2,149 acres, the average size for Flathead County is 159 acres.[6] (The median county farm size is even smaller at 30 acres.)[7]

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[2] Flathead Community of Resource Educators Watershed Education Committee, *Flathead Watershed Sourcebook*. May be accessed at http://flatheadwatershed.org.
[3] Karin Boyd, Applied Geomorphology, Inc., *Flathead River Channel Migration Zone Mapping*, 1.
[4] Montana Department of Fish, Wildlife and Parks, *Boating Survey on the Flathead River and Soughs Upstream of Flathead Lake, 2008* (2009)
[5] Flathead Community of Resource Educators Watershed Education Committee, *Flathead Watershed Sourcebook*. May be accessed at http://flatheadwatershed.org.
[6] U.S. Department of Agriculture, *2017 Census of Agriculture*.
[7] Top crops by acreage in the county are hay, spring wheat, and canola. Top livestock are cattle, chicken (layers), and hogs. U.S. Department of Agriculture, *2017 Census of Agriculture*.

The county growth plan identifies affordable housing, parks and recreation, trails, transportation, water quality, public facilities, emergency, wastewater management, mineral resource extraction, and economic development as priorities.[8]

CAUSES OF EROSION

Causes of erosion alongside the Flathead River are many. The first is the geologic nature of the place. As the county growth plan[9] noted:

> The Flathead Valley is a floodplain on a glacial scale...The dynamic nature of the Flathead River and its tributaries is evident by the numerous oxbows and sloughs that were created by the river and then abandoned as the rivers migrated. The relatively flat terrain of the valley floor also manifests itself in the sinuous nature of the rivers that wind through the valley to Flathead Lake. The meandering patter of the river is a result of bank erosion on the outside bends and subsequent deposition on the insides.

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Stream currents and wind-driven waves—which reach 3 feet in height on Flathead Lake ---are also part of the natural process.

Floods are common. For example, the 1964 flood inundated hundreds of homes and 20,000 acres under four feet of water.[10] Other major floods occurred in 1894, 1928, and 1948.[11]

The melting of snowpack during spring and summer months provides a characteristic "snowmelt hydrograph" with peak runoff between April and June. Precipitation ranges from 18 inches to 100 inches annually in the subbasin.[12]

However, this hydrograph is no longer natural. The Hungry Horse Dam upstream impounds the South Fork of the Flathead River and thus regulates 30 percent of the inflow into Flathead Lake.[13] Fewer floods have been experienced since the dam was constructed in 1953.

[8] Flathead County Commission, *Flathead County Growth Policy* (2007), 156.
[9] Flathead County Commission, *Flathead County Growth Policy* (2007), 15-16.
[10] Flathead Community of Resource Educators Watershed Education Committee, *Flathead Watershed Sourcebook*. May be accessed at http://flatheadwatershed.org.
[11] Karin Boyd, Applied Geomorphology, Inc., *Flathead River Channel Migration Zone Mapping*, 30.
[12] Northwest Power and Conservation Council, *Flathead River Subbasin Executive Summary* (2004), 6-7.
[13] Flathead Community of Resource Educators Watershed Education Committee, *Flathead Watershed Sourcebook*. May be accessed at http://flatheadwatershed.org.

Flathead Lake's surface elevation is regulated by Seli'š Ksanka Qlispe' Dam (formerly known as Kerr Dam), which lies approximately 5 miles below Flathead Lake, where the Flathead River resumes its course and serves as an outlet for the lake.

The Qlispe' Dam generates electrical power and regulates the top 10 feet of Flathead Lake. The dam's federal licensing requires the lake level to be dropped to low pool elevation by April 15, refilled 7 feet by May 30, and raised to full pool by June 15. This pool, which is 10 feet higher than before the dam was constructed in 1930, is held until Labor Day.[14] This inundation causes erosion, as native vegetation cannot take root while submerged for nearly three months of the year.

This heightened pool does provide recreational opportunities along the area of study. These boat wakes also increase the rate of erosion. Scientific studies have quantified the relationship between boat size and speed and the power of a wake. As one study on the Sacramento Delta in California pointed out:

> Boat size shows a positive correlation with wave energy, meaning as a boat gets larger the energy in its wake increases...Typically, as speed increases the boat planes and there is progressively less of [the] hull in the water, decreasing potential displacement and producing a less energetic wake.[15]

General boat traffic has increased over time on the lower Flathead River, owing much to the heightened pool of Flathead Lake, which provides access to the river that otherwise wouldn't be accessible.

A Department of Fish, Wildlife and Parks study found boat traffic on the lower Flathead River has increased at least sixfold since 1992. And because the last boat traffic study was conducted in 2015, this figure is likely to be even higher.[16]

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Newer "wake boats," which are designed to move slowly through the water, creating a large wave for people to surf on, have been identified as particularly adding to erosion. As a state boat survey noted "landowners along the river believe that boat wakes impact stream banks by increasing the rate of bank erosion beyond what is caused by stream currents and wind waves."[17] However, further study is necessary to determine how much erosion may be attributable to what kinds of boats.

Local land use may also affect the rate of erosion. The creation of impermeable surfaces like parking lots and roads can concentrate and accelerate runoff, especially in a large precipitation event. Livestock grazing may degrade stream banks, destroy soil structure, and increase the likelihood of soil being

[14] Northwest Power and Conservation Council, *Flathead River Subbasin Executive Summary* (2004), 7.
[15] Robert Shuster, Douglas J. Sherman, Mark S. Lorang, Jean T. Ellis, and Frank Hopf, "Erosive Potential of Recreational Boat Wakes," *Journal of Coastal Research, Special Issue No. 95* (2020)
[16] Testimony of Amber Steed, Montana Department of Fish, Wildlife and Parks, to WPIC, Oct. 13, 2022.
[17] Montana Department of Fish, Wildlife and Parks, *Boating Survey on the Flathead River and Soughs Upstream of Flathead Lake, 2008* (2009), 2.

suspended in water.[18] Forestry practices, such as logging to make way for land use development and agricultural operations, can cause impacts to valley waterways, including an increase in sediments, increased peak flows, and loss of channel stability.[19]

Erosion control structures themselves may accelerate erosion, as waters scour away and around bank armor, such as rock, rip rap, and cement, referred to as "scallop erosion." A 2009 study of the river's migration noted that failure at the toe of the bank armor can lead to "scalloping."[20]

MEASURING EROSION

Identifiable types of erosion along the studied stretch of the Flathead River include:[21]

- Long, fluvial erosion of bank lines
- Severe local erosion, creating a scallop-shaped gouge in the bank
- Sever scallop erosion of armored bank
- Meander scroll feature affected by the new course of the river
- Undercut banks and topple failure of upper bank
- Gravitational failure of saturated banks
- Boat wakes, storm waves, wind-generated waves

Over time, the effect of erosion on the river's bank line is often dramatic.

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A 2009 study of this river channel measured the meander or migration of the river due to erosion. The erosion hazard area measured observed migration rates between 1956-2009. The migration rate for this lower reach of the Flathead River varies between approximately 1 to 4 feet per year.[22] This migration rate may be used to estimate future migration and for the delineation of erosion hazard area buffer zones.[23]

Erosion may be measured in other ways, such as by the efforts of landowners to protect their property and river banks to halt or slow the rate of erosion. State law under the 1975 Montana Streambed Protection Act requires Montana's conservation districts to authorize any "physical alteration or modification that results in a change in the state of a natural, perennial-flowing stream or river, its bed,

[18] http://crops.extension.iastate.edu
[19] Northwest Power and Conservation Council, *Flathead River Subbasin Executive Summary* (2004), 9.
[20] Karin Boyd, Applied Geomorphology, Inc., *Flathead River Channel Migration Zone Mapping*, 15.
[21] Karin Boyd, Applied Geomorphology, Inc., *Flathead River Channel Migration Zone Mapping*, 15-18.
[22] Karin Boyd, Applied Geomorphology, Inc., *Flathead River Channel Migration Zone Mapping*, 40.
[23] Karin Boyd, Applied Geomorphology, Inc., *Flathead River Channel Migration Zone Mapping*, 47.

or its immediate banks."[24] This authorization from conservation district supervisors is known as a 310 permit.[25]

A 310 permit is required for erosion control projects. Erosion control projects—also called bank stabilization—generally fall into one of two categories: armor and channel structures or bioengineered projects.[26]

An armored erosion control project[27] includes:[28]

- riprap
- cement and block mattresses
- jetties, barbs, vanes, weirs
- dikes, levees, gabions, retaining walls

Bioengineered methods include:

- planted vegetation
- root wads, tree revetments
- coir logs and wattles
- matting, fabric

Both categories of erosion control projects have their benefits and shortcomings. For example, bank armor is a familiar method, but is expensive and complex. It also has no ecological benefit and may cause adverse effects upstream or downstream of the project. Costs of bank armor are variable, depending upon the depth of the river. One conservation district expert estimated a cost of a 300-foot increment of riprap at $100,000 to $300,000.[29]

[24] Section 75-7-103, MCA.
[25] Section 75-7-112, MCA.
[26] Testimony of Samantha Tappendeck, Flathead Conservation District, to WPIC, January 2022.
[27] State law prohibits a past form of erosion control—the dumping of car bodies into the river (Section 75-7-106, MCA).
[28] Riprap is a layer of rock or similar material on an embankment slope; block mattresses are concrete blocks joined by polypropylene ropes; barbs are low rock structures that extend into the stream on the outside of a river bend; vanes are linear structures that extend from a streambank into the channel in an upstream direction; a weir is a low dam across a river; a gabion is a cage filled with rocks; a tree revetment are when trees are cabled together and anchored to a stream bank; a coir log is a natural fiber product; wattle is a woven bunch of sticks or branches.
[29] Testimony of Hailey Graf, Conservation Resource Development Division (Department of Natural Resources and Conservation), to WPIC, Oct. 13, 2021.

Bioengineered projects provide ecological value, may be simpler to install and require less maintenance. But these solutions take time to become established and may not be effective during a flood. A mixture of methods may be preferable.[30]

A count of 310 permits issued for erosion control projects on the lower Flathead River since 1976 shows 435 permits for bank stabilization projects.[31] This is roughly equivalent to the installation of an erosion control project every other river mile every year—a clear indication that landowners are actively combatting erosion.

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Riverbank erosion in Montana is not limited to the Flathead River.

Various conservation district supervisors, mainly along the mainstem of the Missouri River, testified to similar issues of erosion. They noted sediment has increased at wastewater treatment plans. They lay particular blame on boating, as these may also accelerate wind-driven waves. They suggested that conservation districts may take their own actions, such as altering lake levels (as in the case of Lake Helena to reduce ice scouring) or even proposed land use regulations. But they also cautioned that creating no-wake zones may just force boat users elsewhere, potentially causing other problems.[32]

The WPIC planned a tour of two erosion control projects in and near the Helena Valley in July 2022.

The committee may also contemplate further scientific inquiry into the exact causes of erosion on the lower Flathead River. The Flathead Conservation District and the Flathead River Commission launched a scientific study this summer. This study is anticipated to be completed by October 2022.

LIST OF SOLUTIONS

Policy solutions to help mitigation erosion along the lower Flathead River are somewhat limited. Policy will not be able to control exception flood or storm events, or alter the meanderings of an alluvial river on a "flat land."

The first solution may reside with landowners, who decide or are forced to take matters into their own hands and install armored or bioengineered methods of erosion control.

Policy options include:

- Expand education and outreach efforts on causes and effects of erosion.

[30] Testimony of Samantha Tappendeck, Flathead Conservation District, to WPIC, January 2022.
[31] Flathead Conservation District, database of 310 permits issued (1976-2021)
[32] Testimony of Tenlee Atchison, Lewis and Clark Conservation District; Karl Christians, Missouri River Conservation District Counil; Jeff Ryan, Lewis and Clark Conservation District; and Mark Siderius, Flathead Conservation District to WPIC, March 15, 2022.

- Develop a landowner incentive program for installation of certain bank stabilization methods
- Establish a no-wake zone for certain types of boating. This could be imposed by either the Montana Legislature or the Fish and Wildlife Commission.
- Designate the lower Flathead River as lake shore, effectively creating a no-wake zone for all sections of river less than 200 feet from shore.
- Create land use regulations through the Flathead County Commission or the Flathead Conservation District to reduce accelerated runoff into the affected watershed.
- Appeal to federal authorities to revise Qlipse' Dam operational requirements, perhaps reducing the summertime lake pool elevation.

As of June 23, the committee had not made a recommendation related to SJ28.

APPENDIX A:
WATER POLICY INTERIM COMMITTEE MEMBERS

Before the close of each legislative session, the House and Senate leadership appoint lawmakers to interim committees. The members of the Water Policy Interim Committee, like most other interim committees, serve one 20-month term. Members who are reelected to the Legislature, subject to overall term limits and if appointed, may serve again on an interim committee. This information is included in order to comply with 2-15-155, MCA.

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Appendix B: SJ28