Literature Review

Flood Risk Management

Portneuf River Literature Review
Flood Control Project

25 September 2015

PORTNEUF RIVER FLOOD CONTROL PROJECT

Overall Conditions and Issues

- The Portneuf River Flood Control Project (project) was authorized under the Columbia River Basin Plan by the Flood Control Act approved 17 May 1950, Public Law 516.
- The purpose of the project was to reduce flood risk to the City of Pocatello. Significant flood events occurred in 1962 and 1963 that caused significant damage to residents, agriculture, and industry. Estimated damage caused by the 1962 flood was $10 million.

Figure 1 - Flood of 1963

- The February 1962 flood peaked at 2,990 cfs and the February 1963 flood peaked at 2,470 cfs.
- After these two devastating floods, public opinion swayed to favor raising tax revenues to pay the local portion of flood control costs to protect its citizen's properties and the city's commercial and industrial assets.
- The 1962 and 1963 flood events also prompted the USACE to increase the design flood discharge from 2,200 cfs to 6,000 cfs. This changed certain design parameters of the project.
- Construction of the project occurred from July 1966 to November 1968.
- The project is along a 6.2-mile reach of the Portneuf River through the City of Pocatello. It consists of a 1.5-mile rectangular concrete channel and 4.7 miles of levee upstream and downstream of the concrete channel. The side walls of the concrete channel vary in height from 10 to 16 feet. The concrete channel width is 40 feet.
- Levee slopes are constructed at 2H:1V and armored with riprap.

- The project is designed to handle a flow of 6,000 cfs with 3 feet of freeboard on the levees and 2 feet of freeboard on the concrete channel. The estimated average exceedance interval at the time of design was 110 years (0.9-percent annual chance flood).
- A 4-foot high non-climbable fence on the channel side walls was installed during the original construction as a safety measure.
- Certain sections of the old river channel were filled with excess excavation material generated during construction activities.

Figure 2 - Concrete Channel Section

Figure 3 – Levee Section

Overall Opportunities for Improvement/Solutions

- Aerial photos taken prior to the project's construction indicate extensive meandering of the river existed before the project was constructed. Riparian vegetation and wetlands were evident along both banks.

- Significant environmental impacts, including reduction in river meandering and a subsequent reduction of fish and wildlife habitat, were incurred as a direct result of construction of this project.
- The river meanders supported extensive riparian and vegetation areas. A total of nine major meanders were removed with the project, which resulted in the loss of most of these riparian areas. The below as-constructed drawing depicts how these meanders were straightened during project implementation.

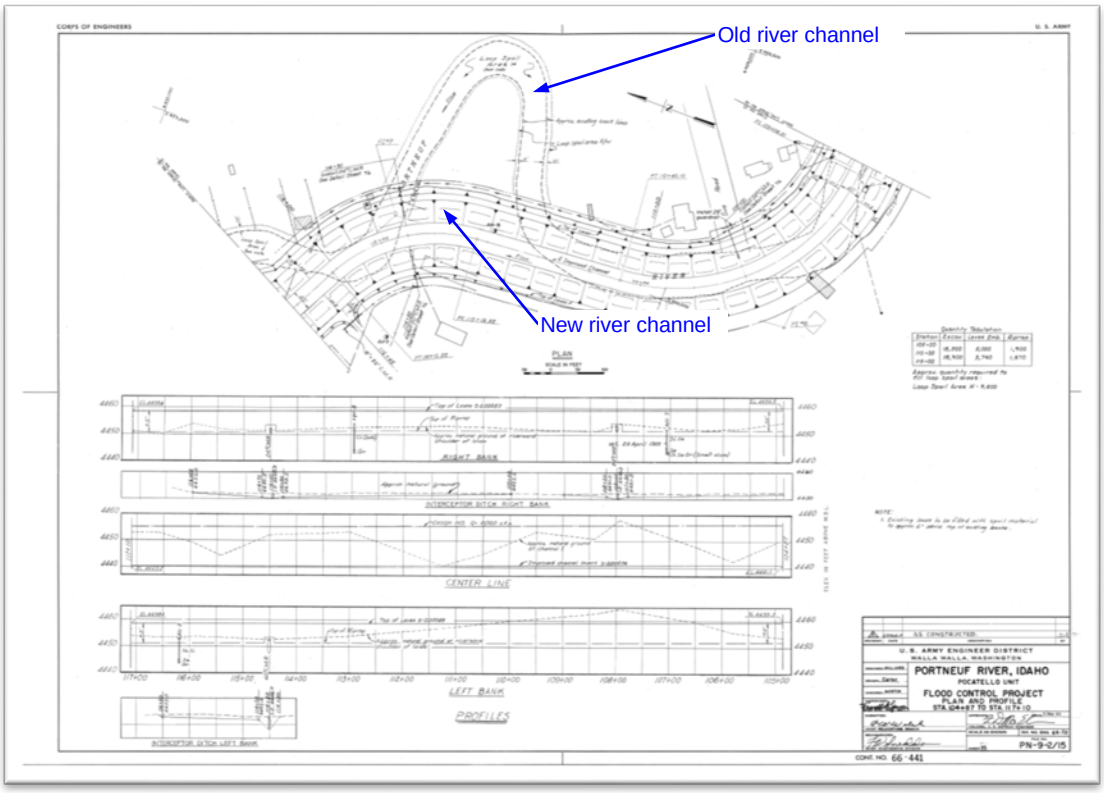


Figure 4 – River Meander

- Under current conditions, the project provides poor habitat for wildlife and fish. The degraded riparian corridor is confined to a narrow band and wetlands are absent from most of the project.
- The City of Pocatello's goal is to create a more natural and accessible river as it flows through the city. This would provide more green space and more recreational opportunities. Raymond Park has been one of the main focus areas for such a project.
- Several design concepts have been discussed and considered throughout the years that would involve modifications to the project. Some of these include:
  - Concrete channel wall modification: remove the concrete channel walls along a particular river section, and grade the earthen streambank to a flatter slope. This would create a more natural stream condition environment.
  - Restoration of river meanders: modify the channel wall or levee to allow the river to flow into the original river channel. Excavation of the original river channel would be required to accommodate this concept.

- Set-back levees: Relocate levee alignments to create a wider river corridor. Construct wetland habitat areas within this new river corridor.

Challenges

- Proposed project modifications would require engineering analysis during the planning and design phases to ensure they are feasible. A concept may prove impractical or unattainable upon further examination.
- The railroad embankment confined the river channel on the upstream end of the study reach, which disconnected river meanders and floodplain areas.
- Any project modification would require extensive USACE coordination/approval. (maybe Congressional authorization?)
- Project modifications would require additional real estate, i.e. more land would be needed. Land owned by the City of Pocatello is available in certain areas.
- The project's flood risk reduction capabilities (6,000 cfs flow conveyance with freeboard) would have to be maintained with any project modification.

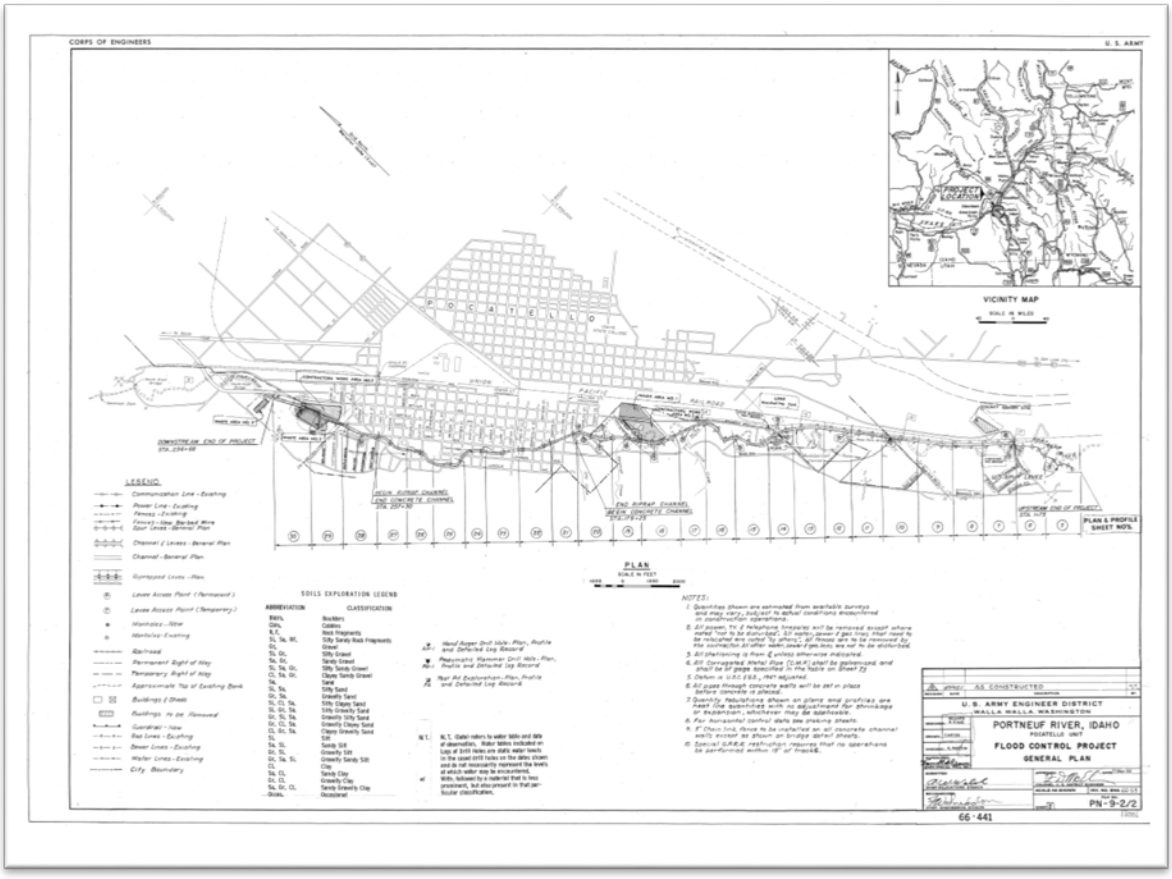


Figure 5 – Flood Control Project Site Plan (from design drawings)

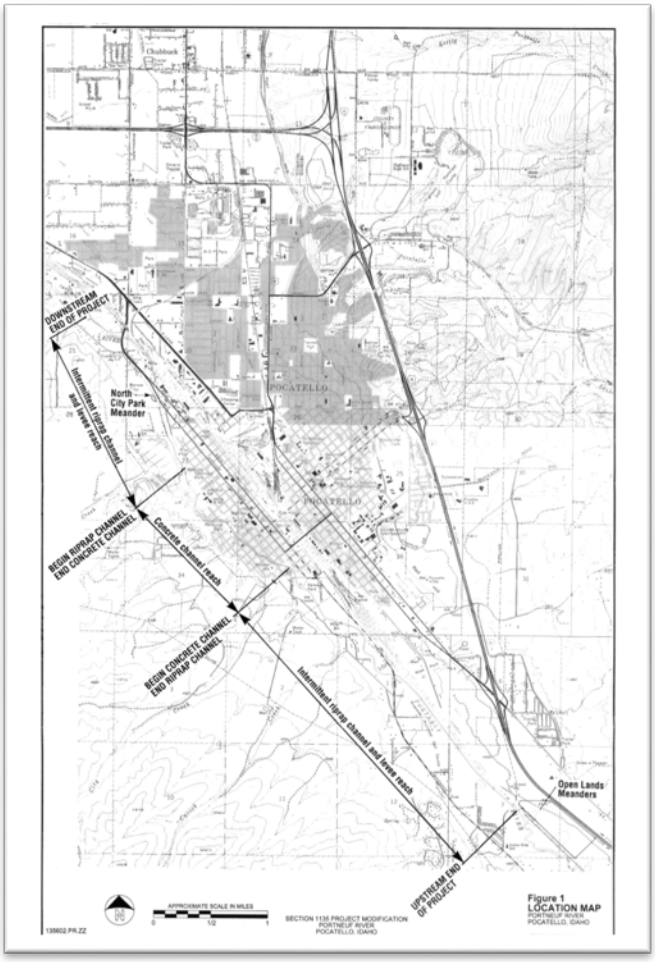


Figure 6 – Flood Control Project Site Plan (from 1135 report)

REFERENCES

- Portneuf River, Idaho, Flood Control Construction Plans, U.S. Army Engineer District, Walla Walla, 11 Feb 1969
- Portneuf River Section 1135: Channel Restoration Plan, Project Modification Report, January 1997
- MILES website, Exploring the Portneuf River, Pocatello Flooding History
- Notes from conversation with John Sigler, City of Pocatello, 23 May 2011
- Operation and Maintenance Manual, Portneuf River Flood Control Project, U.S. Army Engineer District, Walla Walla, 1968
- General Design Memorandum, Flood Control Project, Portneuf River, Idaho, Pocatello Unit, U.S. Army Engineers District, Walla Walla, 22 July 1964

Literature Review

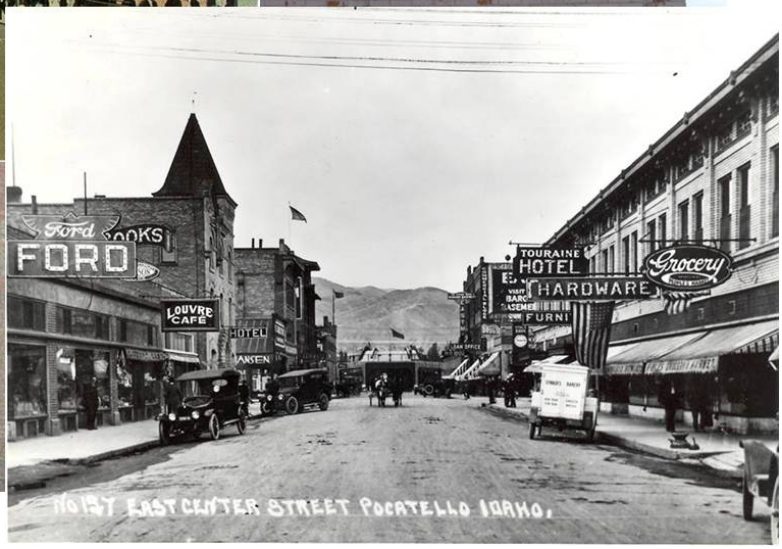
Cultural/Historic Resources

PORTNEUF RIVER – VISIONING STUDY

CULTURAL/HISTORIC RESOURCES

Born in Ontario, Canada in 1879, Frank G. Paradice, Jr. was an architect working in Pocatello from 1913 until his death in 1952. During Paradice's time in Pocatello he worked prolifically, designing many noteworthy buildings. Among them, the Bannock Hotel tower, Central Building, Valentine Building, Kasiska Building, the ISU Administration building, the Pocatello high school gymnasium, and a renovation of the high school building resulting in its current appearance. His buildings show strong thematic trends of the Renaissance Revival-style featuring terra cotta cornices, pilasters, string courses, and other ornamentation. Despite the passage of time, Paradice's designs still strongly influence the character and appeal of downtown Pocatello, and represent the single strongest design anchor for the National Register of Historic Places listed Pocatello Historic District.

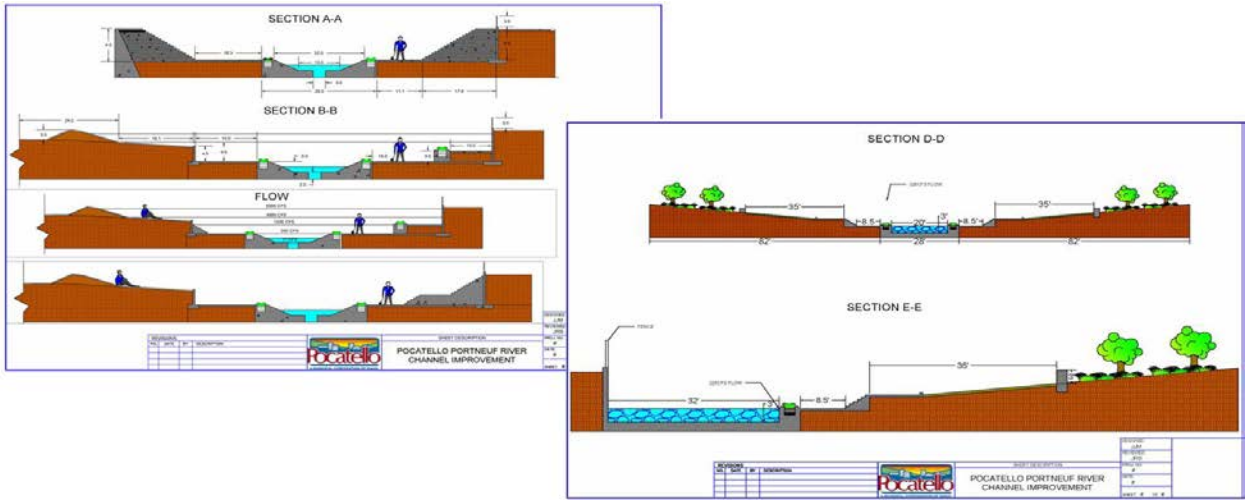
Other elements that help tie together the downtown historic district, and give it character, are the continued prevalence of awnings, and the remnant “ghost signs” that appear on the sides, fronts, and tops of buildings. Some of these signs are indicative of historic tenants of the various downtown buildings, and some have been redesigned to reflect the current tenants. These features are prominent in historic photos of downtown, and their continued existence is indicative of an appreciation and commitment to maintaining the historic character of the downtown.



Aside from the downtown, the city contains other National Register listed commercial, community and residential structures and districts, among them a trio of churches (the Trinity Episcopal Church, St. Joseph Church, and the Church of the Assumption), the Carnegie Library, the Federal Building; residential districts (ISU Neighborhood District, Lincoln-Johnson Residential District, West Side Residential District, and Old Town Residential Historic District) and individual houses (Hyde House, Rice-Packard House, Standrod House, Sullivan-Kinney House, and Hood House); and other commercial areas (The East Side Downtown and Warehouse Historic Districts). A search of listed properties on the National Parks Service's National Register indicates that Pocatello has the greatest number of listed properties in Bannock County, and one of the highest concentrations of listed structures of any community in the state of Idaho.

The city has already made strides in tying together the historic downtown with design elements that enhance the historic character of the community. In particular through the use of design elements such as brick buffered sidewalks and stylized street lamps.

The community of Pocatello has expressed an interest in renewing its connection to the Portneuf River. The city has produced designs for public spaces to facilitate this connection by creating public places that allow interaction and appreciation of the river.



One way to literally connect the community to the proposed improvements along the channel is to create street corridors that literally tie the community to these public spaces. Doing this opens the door for all sorts of community enhancement opportunities, both small and large. Working groups that bring together historic societies, students, community members and the public may provide opportunities to engage and benefit from local knowledge. Below is a list and brief description of a small fraction of these opportunities:

- Street Corridors: The city already has a start on this effort with curbside improvement. These improvements should be extended to corridors that allow a connection with the improved spaces. Incorporating historic areas of the city into these corridors will enhance and highlight the historic character of the community. Inserting design elements found downtown into these improvements will further enhance the historic character of the community.
- Educational Public Spaces: The idea of elements that tie together and enhance the historic character of the community presents the opportunity to interpret historic Pocatello. Kiosks and signage that highlight important events associated with the community could be educational, and provide another opportunity to integrate historically accurate design elements that would further enhance the improved public places.
- New Development: This historical connection between places may provide opportunities to encourage development into historic areas of Pocatello. In particular, a connection between historic downtown and the Warehouse District that includes beautification and specific design elements could encourage mixed-use development on the east side of downtown. This area seems like a real possibility for incubator type development that could retain the historic character of the area while providing spaces for start-up opportunities.

Literature Review

Existing Hydrologic and Hydraulic Conditions

Portneuf River Literature Review
Existing Hydrologic and Hydraulic Conditions

August 24, 2015

Purpose and Scope

The purpose of this report sub-section is to inventory and summarize important available information resources that will be of value in communicating existing conditions along the Portneuf River within the study reach, and to present limited field information gathered during a site visit in August 2015. Information presented here relates to a hydrologic and hydraulic perspective; information regarding other technical and resource perspectives may be found in other parts of the report. Ideally, this information will aid in identifying potential approaches for maintaining flood carrying capacity of within the existing floodplain while creating improvements to the environment that are of value to the community and the nation.

Previous Federal Studies

A number of USACE studies for the Portneuf River and tributaries near Pocatello have been undertaken by the Walla Walla District Army Engineer District (NWW) in the past. The majority of these were performed in association with what became the Pocatello Unit Flood Control Project, described below, though some were performed after completion of the project. The following lists the more important project documents located in the NWW Hydrology Section's library:

1. NWW, 1964 (22 July 1964). *General Design Memorandum, Flood Control Project, Portneuf River, Idaho, Pocatello Unit*..
2. NWW, 1968. *Detailed Project Report, Flood Control Project, Lava Hot Springs, Idaho, Portneuf River.*
3. Federal Emergency Management Agency (FEMA), 1996. *Flood Insurance Study, City of Pocatello, Idaho, Bannock County*.
4. NWW, 1970. *Flood Plain Information, Pocatello, Idaho and Vicinity, Portneuf River and Tributaries*.

Much of the information summarized in this appendix comes from the above reports, or other sources that will be identified later. In some cases, such as the U.S. Geological Survey (USGS) measurements and the frequency-discharges, the information has been updated. The more relevant hydrologic and hydraulic information is presented below.

Pocatello Unit Flood Control Project Description

A central component of the existing conditions of the Portneuf River in the study area is the flood control project constructed by the U. S. Army Corps of Engineers (USACE) on the Portneuf River within Pocatello, ID. The Flood Control Project was authorized by the Flood Control Act, Public Law No. 228, approved August 18, 1941, and as amended by the Flood Control Act of December 22, 1944. The project is located on the main stem of the Portneuf River (Figure 1). It was conceived to provide protection to the City of Pocatello in Southeast Idaho, and was constructed from July 1966 to November 1968. The projects extends along a 6.2-mile reach of the Portneuf River and consists of a 1.5-mile stretch of

rectangular concrete channel and 4.7 miles of revetted levee and channel reaches upstream and downstream of the concrete channel, and has a design capacity of 6,000 cfs.

Study Area Hydrology

Basin Description The Portneuf River basin contains approximately 1,290 square miles, covering most of Bannock County and parts of neighboring Bingham, Caribou, and Power Counties. The Blackfoot River basin borders it to the north and east, the Bear River basin is to the south, and the Bannock Mountain Range is to the west. The Basin is shown on Map1.

The river rises in the northern tip of the basin, flows due south for about 30 miles, and then travels northwesterly for about 50 miles to its confluence with the Snake River at the American Falls Reservoir. March Creek, the principal tributary, enters the Portneuf River from the south, has a flat slope of about 4.5 ft per mile, and drains about 30 percent of the total basin. Upstream of Pocatello, elevation ranges from about 9,280 to 4,440 ft with a mean basin elevation of 5,850ft.

Climate The climate of the basin is characterized by moderate to low precipitation and humidity, relatively windy springs, warm summers, and cool to cold winters. Normal annual precipitation in the Portneuf River Basin above Pocatello ranges from less than 12 inches to more than 22 inches and for the drainage area average 15.8 inches. Seasonal precipitation variations are quite small, with July, August, and September somewhat drier than other months. Rainfall intensities are generally low although high intensities sometimes occur during summer and fall thunderstorms. In the winter months, a large part of the precipitation occurs as snowfall. Average annual snowfall varies from about 35 inches in lower valleys to nearly 100 inches in the mountains.

The mean monthly temperatures recorded at Pocatello vary from 26 ^{O} F in January to 73 ^{O} F in July. Temperature high and low extremes were recorded at 106 ^{O} F in July and –24 ^{O} F in January. The mean annual high temperature is 59 ^{O} F and the mean annual low temperature is 33 ^{O} F.

Stream Flow Characteristics The U.S. Geological Survey (USGS 13075500) operates a river gaging station in the City of Pocatello. The longest record of stream flows for the Portneuf River is at Pocatello where an incomplete record was kept for the periods 1897-1899 and 1911-1917, and continuous records maintained since 1917. The gage is located on the left bank of the Portneuf River, immediately above the Fremont Street Bridge. The current average annual flow during the period of record is 295 cfs. The record instantaneous peak flow, 2,990cfs occurred on February 14, 1962. The current lowest daily mean flow 0.23cfs occurred on July 19, 1979 (USGS, 2105).

The original Portneuf River flood frequencies were computed for winter rain floods and spring snowmelt floods, and a composite curve was developed from these two event types. Table 1 briefly summarizes values from the three frequency curves developed at that time (NWW, 1964).

Figure 2 illustrates current USACE Portneuf river flood frequency curves (NWW, 2012).

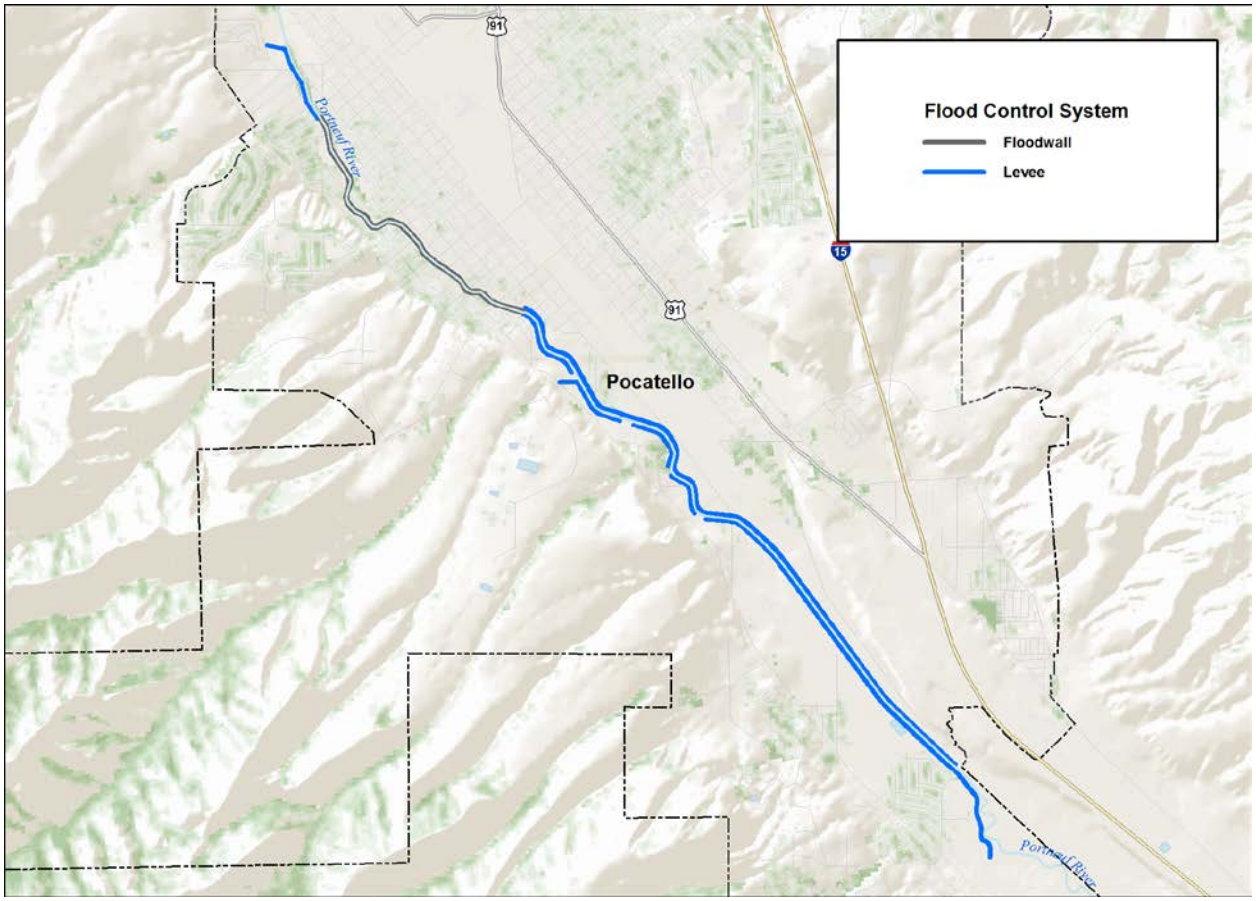
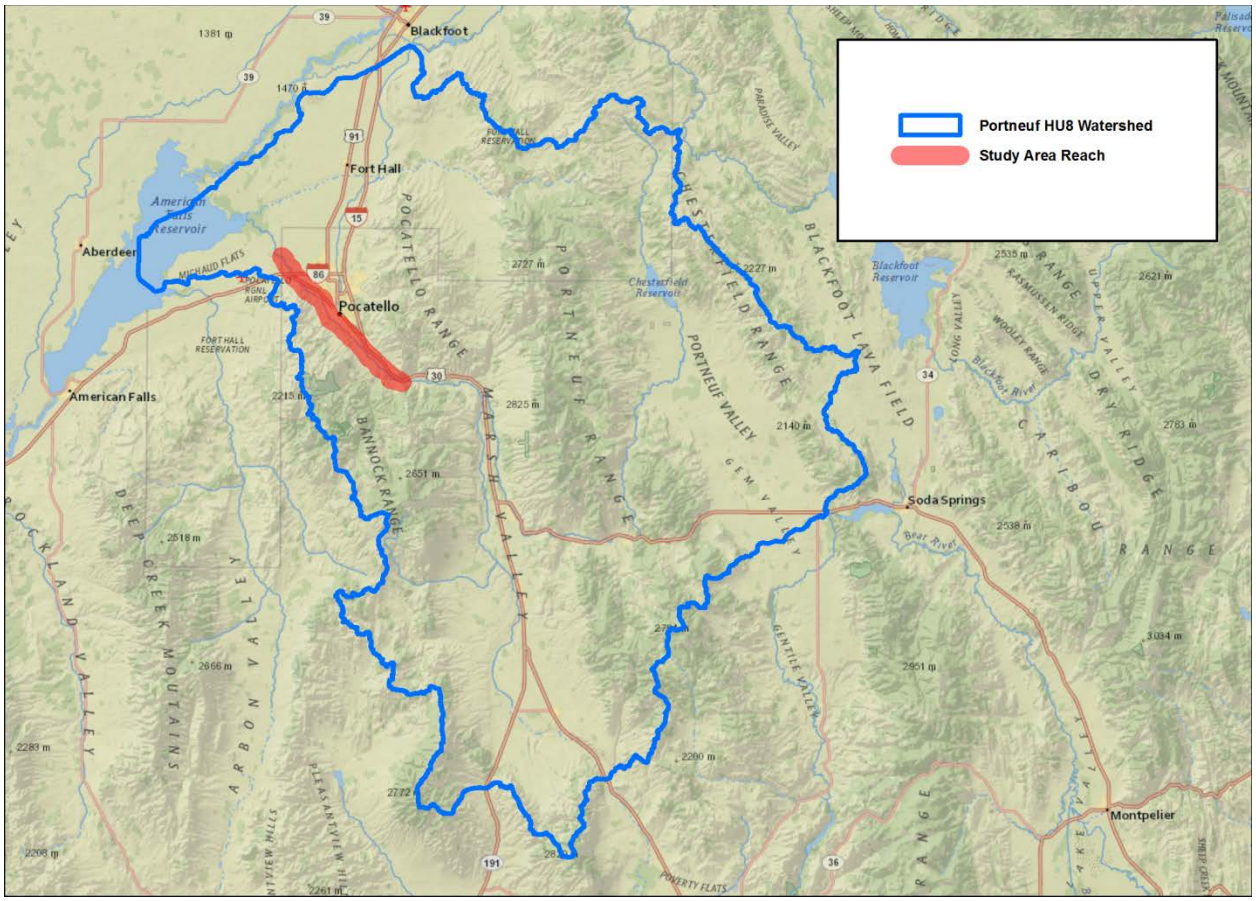


Figure 1. USACE Flood Control Project, Pocatello Unit.



Map 1. Portneuf River Watershed.

The runoff pattern of the Portneuf River at Pocatello is generally one of rising springtime flows, typically peaking from April to June, and receding to low flows by July. Flood peaks are generated by spring snowmelt, sometimes augmented by rainfall, and also by rain on frozen ground in the winter months. The highest three flood flows experienced at Pocatello when the GDM was prepared all occurred in February. Winter floods are of comparatively-lower duration and lesser-volume than spring snowmelt events, but are capable of generating higher peaks (NWW, 1964).

Flood Frequency Revisions Portneuf River flood frequencies were computed for winter rain floods and spring snowmelt floods and a composite curve was developed from these two curves for the General Design Memorandum (GDM). Table1 briefly summarizes values from the three frequency curves developed (NWW, 1964).

Table 1. 1964 GDM Probability-Discharges, Portneuf River at Pocatello, ID.

Exceedance Probability Percent (%)	Discharge (cfs)		
	Winter Rain	Spring Snowmelt	Composite
50	390	680	770
20	670	990	1,180
10	1,100	1,240	1,600
5	1,800	1,500	2,230
2	3,400	1,930	3,650
1	5,400	2,320	5,500

In 2012, the probability-discharge relationship was updated to capture the additional peak discharges that had been measured since the 1964 flood-frequency analysis. The updated analysis used a Log-Pierson Type III analysis, following the procedures outlined in Bulletin 17B (Interagency Committee on Water Data, 1981), and again developed relationships for winter rain events, spring snow melt events and a composite of the two. Table 2 summarizes the updated values from the three frequency curves developed, while Figure 2 shows the updated Portneuf River flood frequency curves(NWW, 2012).

Table 2. Updated Probability-Discharges, Portneuf River at Pocatello, ID (NWW, 2012)

Exceedance Probability Percent (%)	Discharge (cfs), with Expected Probability		
	Winter Rain	Spring Snowmelt	Composite
50	467	733	790
20	667	1,093	1,200
10	806	1,374	1,520
5	1,169	1,680	1,900
2	1,776	2,137	2,550
1	2,567	2,531	3,300

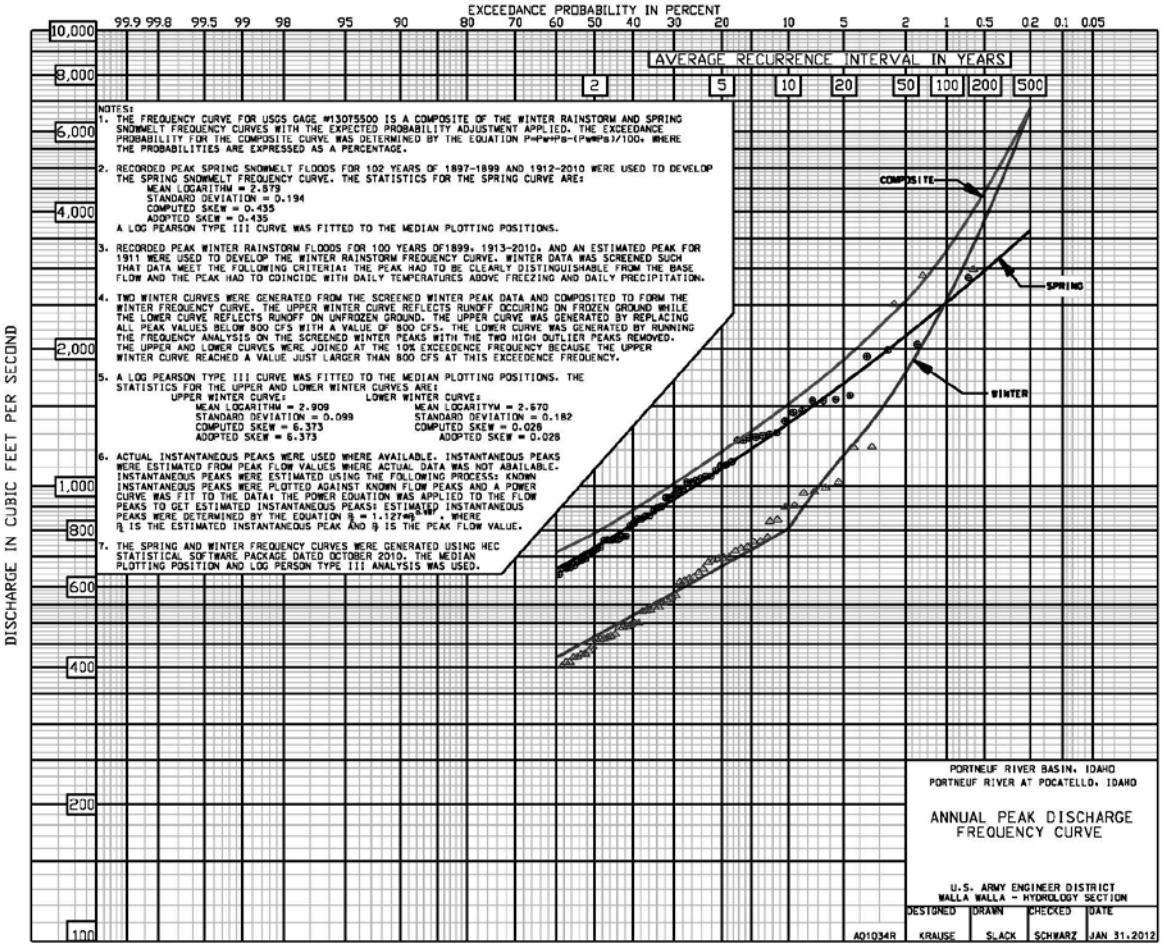


Figure 2. Portneuf River at Pocatello, ID Updated Frequency-Discharge Curves (NWW, 2012).

Flood frequency curve comparison figures were created to better illustrate changes seen in peak flows, following evaluation of additional years of record for the Portneuf River (Figures 3, 4, 5). Clearly, the biggest change came from the winter storm events evaluation.

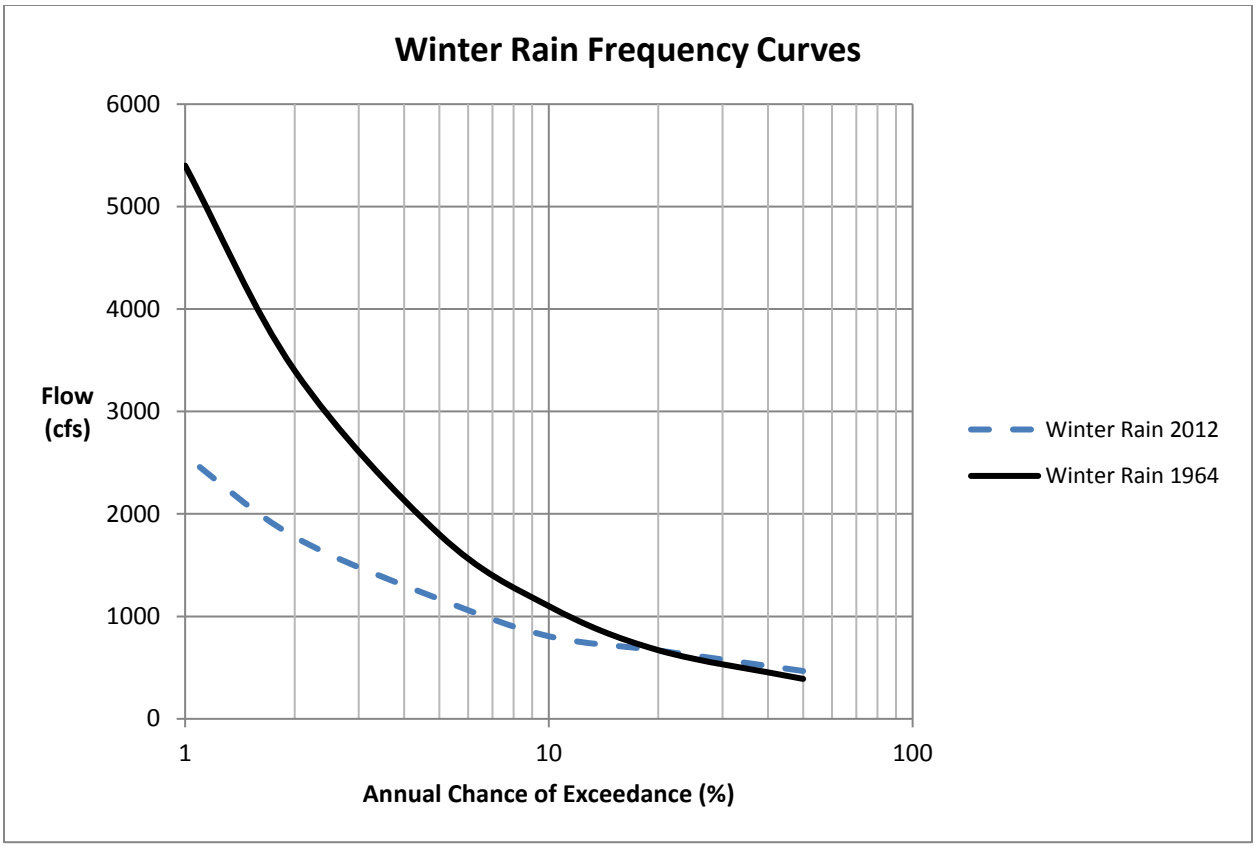


Figure 3. Winter Event Comparison.

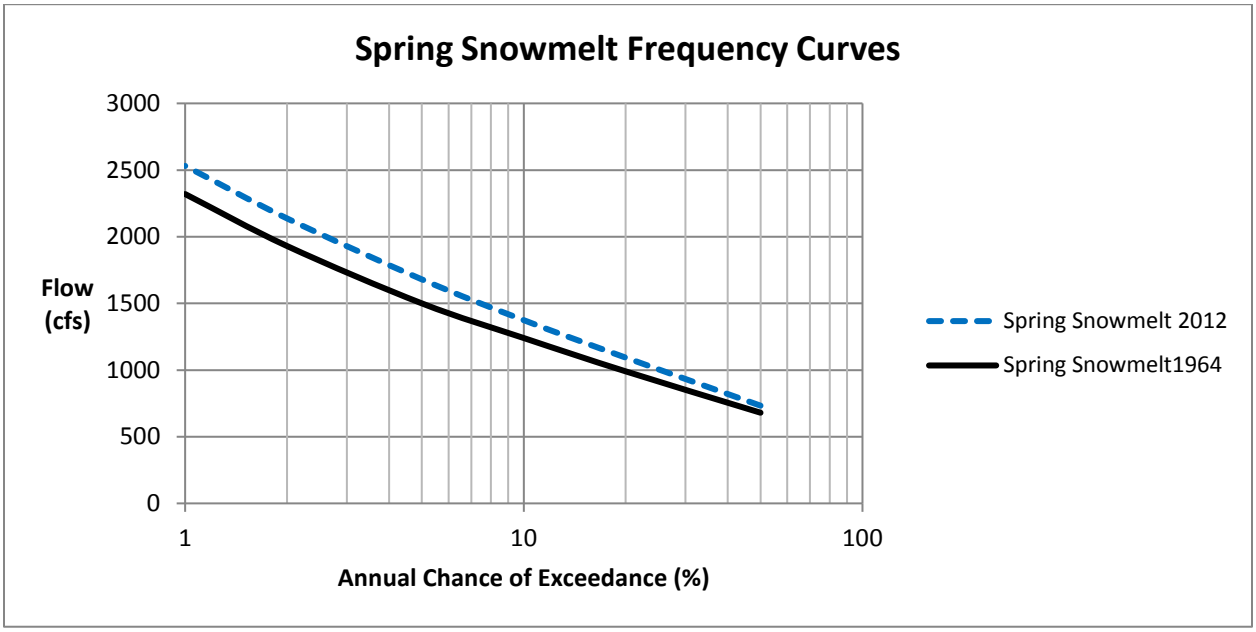


Figure 4. Spring Event Comparison.

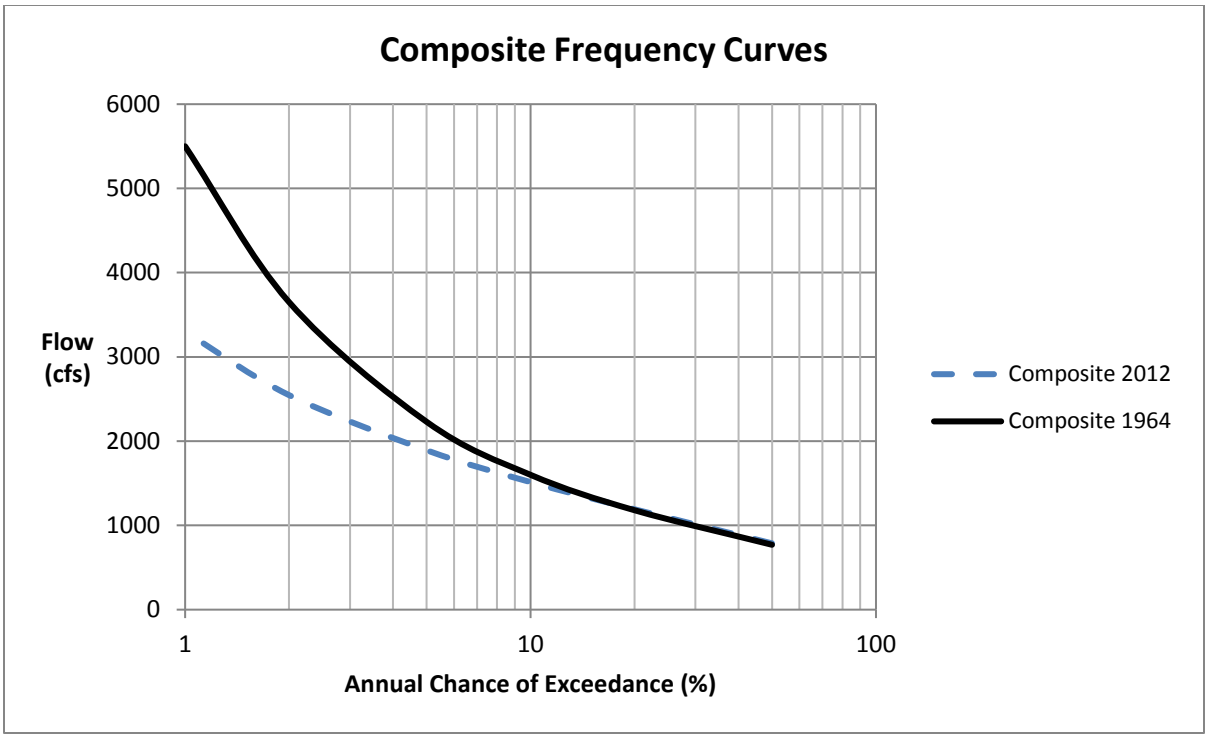


Figure 5. Composite Event Comparison.

Other Relevant Hydrologic Information The 1996 Flood Insurance Study (FIS) (FEMA) provides hydrologic information regarding the significant tributaries that enter the Portneuf River within the vicinity of Pocatello. These tributaries are the Trail Creek, City Creek, Pocatello Creek, Cusick Creek and Johnny Creek. The FIS also mentions that ice jams are a potential source of flooding in Pocatello (FEMA, 1996).

The 1970 floodplain study (NWW) provides hydrologic information regarding the significant tributaries that enter the Portneuf River upstream of Pocatello. These tributaries include Fort Hall Mine Creek, Mink Creek, Gibson Jack Creek, and Johnny Creek (NWW, 1970).

A cursory review of the 1968 DPM for Lava Hot Springs includes some discussion of the travertine deposits that control the bed of the Portneuf, a phenomenon that extends to the Pocatello area (NWW, 1968).

Additional relevant current hydrologic information is also available from the Idaho Department of Environmental Quality (IDEQ). In particular, the *Portneuf River TMDL Revision and Addendum* (IDEQ, 2010), which was recommended by numerous sources as pertinent to the study. The focus of the document is water quality, but it provides a good summary of the basin hydrology, and how it has changed recently, as well as significant information regarding sediment, one of the primary water pollutants discussed in the report. One of the more compelling illustrations of the report presents the decadal hydrographs, starting with 1910, of the Portneuf River at Pocatello (Figure 1.1 of the report). That figure shows a wide range in those decadal hydrographs, particularly in the spring runoff peaks (over a two-fold magnitude

difference) as well as peak timing. Of particular note is that the most recent decade is also the driest of the century presented (IDEQ, 2010). The current decade is expected to be even drier (Communication, 2015).

Flows of the Portneuf River are regulated upstream of Pocatello by Portneuf Dam, with a capacity of 23,965 acre-feet, and the smaller Chesterfield Dam, with 685 acre-feet capacity (USGS, 2015), and by smaller reservoirs and diversions (IDEQ, 2010). The TMDL report includes a general description of the basin geology, and describes the topsoils as predominantly very erodible loess. Section 2.5 of the report discusses data gaps, as well (IDEQ, 2010).

Sediment

The Portneuf River within what is now the concrete channel was observed to be turbid during fisheries studies at the site in 1967. A second river station about 2 miles downstream of the lower end of the project area was also observed to be turbid year round. Both observations appear to reflect the effects of sediment loading to the river that continues to occur throughout much of the drainage. Sediment loading to the lower Portneuf exceeds the flushing capabilities of the river, resulting in river bottom sedimentation due to low stream flows. Low velocities in the reach immediately above the Pocatello Unit project carries suspended sediment and flooding debris, which would generally be carried on through the project if reaching it. Side drainage in the project can deposit cobbles, gravel, and other sediment into the improved channel (NWW, 1967).

As mentioned previously, the 2010 TMDL document (IDEQ) contains considerable information regarding sediment within the Portneuf River near Pocatello. Of note is Table 2.1 from that report, which summarizes water quality status for numerous water bodies at three points in time – 1996, 1998, and the current period (i.e., 2010). A cursory review of the table suggests that there are periods of higher suspended sediment levels and accelerated bank erosion at numerous sites within the Pocatello area.

Hydraulics

A description of the Pocatello Unit Flood Control Project is summarized, below, from NWW, 1964.

Channel Description The project channel on the Portneuf River through Pocatello, ID, consists of three sections. At the upstream end of the project, an excavated channel starts at station 13+95 about 140 feet above the Cheyenne Avenue bridge southeast of Pocatello, and the downstream portion ends at station 179+65 above Halliday Street. The concrete channel is 7,635 feet long. It begins just upstream from Halliday Street at station 179+65 where it has a trapezoidal shape that matches the unlined channel upstream. This trapezoidal shape extends downstream five feet and then transitions into a 40-foot wide rectangular shape at station 180+00. The 40-foot rectangular channel extends 7,562.5 feet downstream to the exit transition where the bottom width is increased from 40 feet at station 255+62.5 to 55 feet at station 256+00. The concrete channel ends at station 256+00 by utilizing wing walls placed normal to the channel centerline.

Downstream, an excavated channel connects with the concrete channel at station 256+00, and ends at station 346+65. Both excavated channels are bounded by levees and riprap on channel sides. Riprap is placed to prevent bank erosion, including channel bends above and below bridges and at channel transitions. Excavated channels are trapezoidal in cross section with side slopes of 1 foot vertical to 2 feet horizontal.

Flow Conditions The earth channel is designed to carry the project design flow of 6,000 cfs with 3 feet of freeboard. The concrete channel is designed to carry the same design flow at subcritical velocities to station 239+00, at supercritical velocities from station 239+00 to the stilling basin at station 252+60, where a hydraulic jump will occur, and at subcritical velocities from the stilling basin to the end of the concrete reach.

The original 1964 GDM (NWW) for the Pocatello Unit Project on the Portneuf River carries a tabulation list of representative hydraulic data for project design flow for earth and concrete channel reaches at selected locations as follows (Table 3):

Table 3. Pocatello Unit Hydraulic Design Parameters (NWW, 1964).

Stations (ft)	Invert		Mean Sectional Velocities (ft/sec)	Depth (ft)
	Slope (ft/ft)	Width (ft)		
Earth Channel				
15+45 – 38+85	0.00184	40	7.1 - 7.4	21.8 – 12.5
39+35 – 52+87	0.00184	45	5.9 - 6.5	14.0 – 12.8
53+37 – 93+00	0.000750	50	5.4 – 5.5	14.3 – 14.0
93+50 – 127+10	0.00120	40	6.2 – 7.1	14.1 – 12.8
128+10 – 165+20	0.000694	60	5.1 – 5.4	13.0 – 13.6
165+70 – 179+65	0.000694	50	5.7 – 5.8	13.4 – 13.6
Concrete Channel				
256+00 – 262+76	0.00126	55	5.5 – 5.7	13.0 – 13.2
263+76 – 275+74	0.00126	60	4.8 – 5.1	13.4 – 14.1

Representative hydraulic data for the 6,000cfs design flow as estimated for bridges across the river are shown as in Table 4 (NWW, 1964):

Table 4. Hydraulic Parameters at Bridges (NWW, 1964).

Bridge	Station	Width (ft)	Design Water Surface (ft) (NGVD29)	Mean Velocity for Design Flow (ft/s)
Cheyenne Avenue	15+30	70	4464.7	7.8
Cottonwood foot	271+25	61	4431.9	7.2
Highway 30	304+69	90	4430.6	5.7
Highway 30	326+25	90	4430.0	5.2

For the 6,000cfs design flow, water would be expected to overbank at the two Highway 30 bridges; the bridge at station 304+69 would carry 5,800 cfs with only 200 cfs overbank, while the bridge at station 326+25 would carry only 3,800 cfs, with 2,200cfs overbank.

HEC-RAS Model

A relatively current HEC-RAS model was built for the concrete hydraulic design channel in 2009, and is available for use in the current study. Hydraulic results from the model for the concrete channel are shown in Table 5:

Table 5. HEC-RAS Model Output (NWW, 2009).

River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
211+60	PF 1	6000	4433.7	4443.96	4442.62	4447.28	0.001276	14.63	410.2	40.01	0.81
216+00	PF 1	6000	4433.3	4442.2	4442.2	4446.62	0.001926	16.86	355.92	40.01	1
216+50	PF 1	6000	4432.6	4440.11	4441.52	4446.31	0.003185	19.99	300.1	40.01	1.29
218+00	PF 1	6000	4432.2	4439.92	4441.12	4445.79	0.002935	19.45	308.48	40.01	1.23
220+40	PF 1	6000	4431.5	4439.24	4440.42	4445.08	0.002904	19.38	309.57	40.01	1.23
222+70	PF 1	6000	4430.8	4438.58	4439.7	4444.36	0.002866	19.3	310.95	40.01	1.22
239+62 Custer St.	PF 1	6000	4425.88	4433.7	4434.78	4439.42	0.00282	19.19	312.67	40.01	1.21
240+12 Custer St.	PF 1	6000	4425.74	4433.78	4434.66	4439.19	0.002602	18.67	321.3	40.01	1.16
240+66 Custer St.	PF 1	6000	4425.58	4433.65	4434.5	4439.02	0.002572	18.6	322.55	40.01	1.15
241+16 Custer St.	PF 1	6000	4425.43	4434.12	4434.35	4438.75	0.002069	17.27	347.35	40.01	1.03
241+27 Nr. Custer St.	PF 1	6000	4425.4	4434.12	4434.3	4438.72	0.002044	17.2	348.79	40.01	1.03
242+00 Nr. Custe	PF 1	6000	4422	4433.58		4436.19	0.000901	12.95	463.18	40.01	0.67
255+83 Begin Tra	PF 1	6000	4421.1	4431.93		4434.91	0.001091	13.85	433.21	40.01	0.74
257+30 End Concr	PF 1	6000	4421	4433.28		4434.17	0.000259	7.57	792.26	89.1	0.45
257+29 Start Rip	PF 1	6000	4421	4433.28		4434.17	0.001879	7.57	792.22	89.1	0.45
270+00 Nr. MAple	PF 1	6000	4418.6	4430.89	4426.38	4431.78	0.001873	7.56	793.18	89.14	0.45

Note: Blue shaded color reflects hydraulics transitions.

The concrete channel water surface profile with 6,000 cfs through it shows that a hydraulic jump would occur between stations 216+00 and 241+27. Subcritical flows would be expected at stations 211+60 and 241+27, respectively, above and below the segment where super critical regimes are formed. The transition in flows concurs with the theoretical results found in the 1964 Portneuf River GDM (NWW) described in this report. The water surface profile plot shown below (Figure 6) illustrates critical flow transition phenomena.

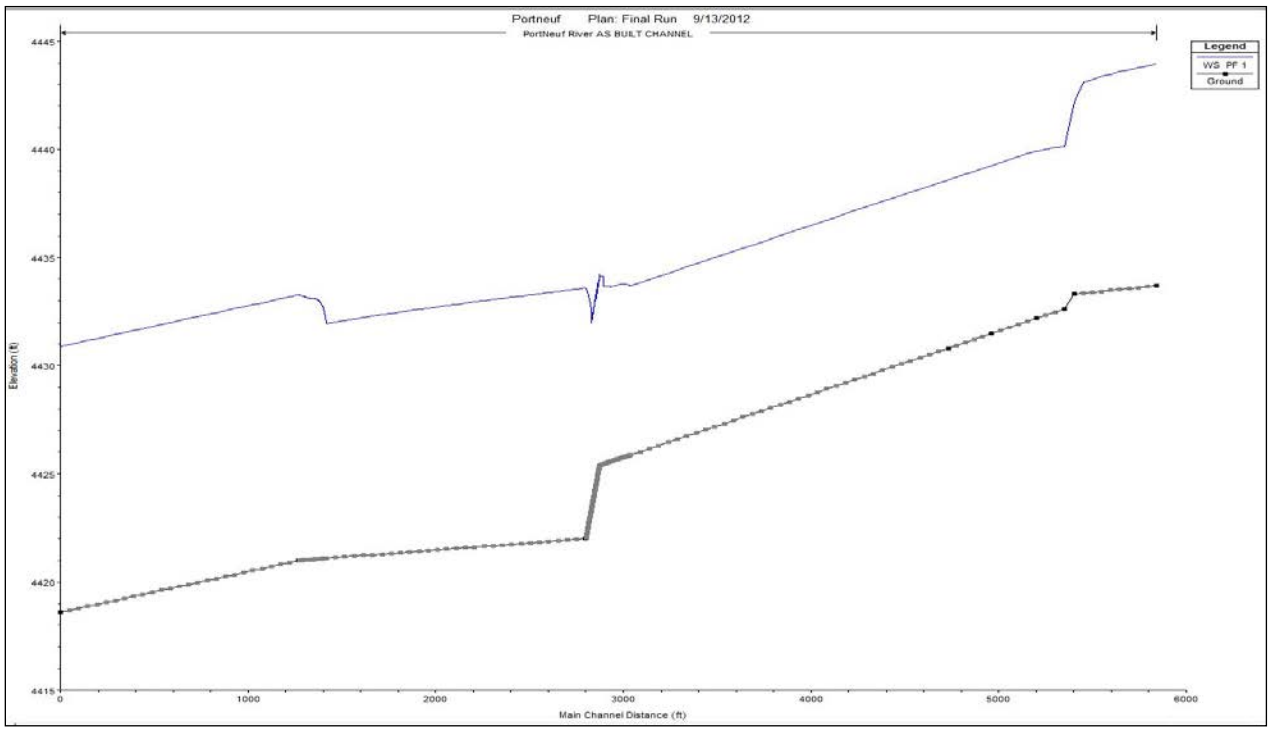


Figure 6. HEC-RAS 6,000 cfs Profile (NWW, 2009).

The 2009 HEC-RAS model indicates velocities that are greater than the velocities listed in the 1964 GDM (NWW). Concrete channel velocities range between 13.85 and 7.6 ft/sec during and after the hydraulic jump, compared to GDM values of 5.7 – 4.8 ft/sec.

Current Conditions Description

Key existing conditions associated with ecosystem values is also described in the June 1996 *Portneuf River Restoration Environmental Assessment Report* (CH2M Hill, 1996a), and indicate that construction of the concrete channel associated with the flood control project eliminated a major portion of the fish and wildlife habitat. Also, the flood control project levees, channel revetment, and concrete channel further reduced the river meanders, which impact habitats. Landowners have also altered and eliminated a number of meanders in the landscape. Limits to the riparian zone tend to prevent woody vegetation from expanding. Water supply would continue to be cut off from the meanders, adversely impacting associated wetland areas and riparian zones (CH2M Hill, 1996a).

Furthermore, recommendations were made in the June 1996 *Portneuf River Flood Control Project Modification Report* (CH2M Hill, 1996b), described in two locations, *North City Park* and *Open Lands Meanders*, located adjacent to the Portneuf River flood control project that have the potential for environmental improvement. Both areas at the time (1996) were unimproved lands that contain remnants of old river meanders. *North City Park* is at the downstream end of the project, while the *Open Lands Meanders* are located at the upstream end of the project (CH2M Hill, 1996b).

The meanders at *North City Park* have no flowing water but are vegetated with trees and bushes. The *Open Lands Meanders* include several ancient river meanders that lie along the right bank of the river. An existing railroad embankment prevents water flow to the meanders. The areas identified are shown on Map 2.

General Environment

The *Managing Idaho's Landscape for Ecosystem Services* (MILES, 2015) web pages include a great deal of information that may be of value for subsequent phases of this study. The *Pocatello* tab provides access to substantial resources on the Lower Portneuf River Watershed, along with the *Resources* tab. The *Explore the Portneuf* tab includes useful visualizations, such as the flooding history timeline and 1959 and 2013 Pocatello aerial imagery comparisons. The latter of these visualization tools is particularly useful in conveying the substantial changes in planform geometry associated with the flood control project, for example. The *Research* tab, as its name implies, provides links to research presentations on the Portneuf River.

Finally, the City of Pocatello and Bannock County have a number of online resources available that may be of use in subsequent phases of this study. Of particular interest, in terms of hydrologic and hydraulic applications, are the 1) City of Pocatello Comprehensive Plan -

2015 Update: Link to Plan sections: http://ourvalleyourvision.pocatello.us/, and its Maps appendix: http://ourvalleyourvision.pocatello.us/documents/ovov/24%20APPENDIX%20A%20MAPS%20Jan%202015.pdf The city has other online resources available, though several of these were not online during the time this review was assembled.

The Bannock County Comprehesive Plan (http://www.bannockcountyplanning.us/uploads/1/4/1/8/14185210/comp_plan.pdf) also includes information on the county that may be of subsequent value.

Conceptual plans for removal and replacement of the concrete channel were developed by an Idaho State University (ISU) design team. These are available at: http://pgf.seffect.com/sites/pgf.seffect.com/files/Channel%20Removal%20Alternative%20Analysis.pdf

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Literature Review

Land Use

Portneuf River Literature Review
Land Use

August 24, 2015

1) Planning Efforts

2008 – Bannock County Comprehensive Plan 2008

Bannock Transportation Plan Organization

- 2012 Portneuf Valley Bicycle Master Plan
- 2008 Portneuf Greenway Trail System Plan
- 2035 Metropolitan Transportation Plan

2015 – City of Pocatello Comprehensive Plan

2014 – Old Town Pocatello Revitalization Plan

Idaho State University MILES Project

2) Housing

Conditions and Issues

- The Portneuf River stretches north to south through the City and once was the core of a downtown neighborhood where housing and commerce flourished as part of the Original Townsite. In the last 45 years or so housing stock and businesses have aged and some citizens have voiced concern that the area, especially, adjacent the river have become somewhat blighted. Much of this was brought on by the community's decision in the late 1960's to have the U.S. Army Corp of Engineers (ACOE) install a flood control project. While the resulting concrete channel and earthen berm levees have minimized flood danger, they removed an important part of the community fabric. The area includes one of only two census tracts which lost housing units from 2000 to 2010.
- Care must be taken to ensure that any revitalization does not displace affordable housing from the area as home values rise.
- While Pocatello's older neighborhoods that are adjacent to the concrete channel are very walkable due to their grid layout, they suffer from a perceived lack of safety, as crime rates in this area are above most other City neighborhoods
- Following channelization of the River Corridor in the late 1960s, much of the City's low –moderate income housing was built next to the concrete channel, making use of inexpensive flat land that was already a platted grid style neighborhood with good access to the downtown shopping district. To date it

retains reasonable access to public transportation, neighborhood groceries, and the original Pocatello downtown shopping district (which now struggles to maintain its commercial presence).

Opportunities for Improvement /Solutions

- Neighborhood enhancements that result in increased pedestrian activity in this blighted area would decrease area crime, and increase the value of the riverfront neighborhoods and the community at large.
- There is a need to ensure that as the City implements projects to improve the livability of the River Corridor along the concrete channel (e.g. by removing sections of the concrete channel), that access to affordable housing isn't lost from this neighborhood.

3) Transportation (Auto and Bike)

Conditions and Issues

- At present, the area's goals (outlined in BTPO's 2035 Metropolitan Transportation Plan, 2003 Bicycle Plan, 2008 Pedestrian Plan, and 2009 Portneuf Greenway Master Plan) for sidewalk, bicycle and transit facility improvements are integrated into some but not all plans for housing development, street improvements for motor vehicles, and commercial development. A lack of publicly owned space along the Portneuf River has resulted in a piecemeal installation of non-motorized transportation facilities along the River Corridor, despite strong demand. Additionally, the roadways near the River Corridor were built in the early 1900's and are very narrow making bicycling difficult.
- In 2011 Pocatello Regional Transit (PRT) updated its fixed transit routes to better serve neighborhoods in the City core. However, more planning is needed to address bus routing concerns near the river.
- The Portneuf River is the largest natural barrier to bicycle travel.

Opportunities for Improvement /Solutions

- New trail developments should allow for pedestrian and cyclist use.

4) Recreation & Access

Conditions and Issues

- Increased access to the River for recreation and "connectivity" of trails along the River are key interests for many stakeholders.
- The idea of a "greenway" bordering the concrete channel is a central topic, yet it remains a concern for many homeowners whose private property, and privacy, would be impacted by any significant alteration of the channel and trail usage.

- Viewpoints vary on how a greenway might be constructed and how continuous trails and access might be through the city. There is acceptance by many that complete access won't be possible
- In terms of access to the River for the purposes of recreation, school representatives articulated the interest in their students using the River as part of their curriculum. ISU Students and other community members also indicated a desire to use the River for swimming, kayaking, and float trips.
- Results showed from surveys completed by ISU that 93% of stakeholders see the Portneuf River as an important place to walk and run for recreation.
- Results from that same survey showed that only 32% were satisfied with the river as a place to walk and run for recreation.
- The vision of the Portneuf Greenway Master Plan is to create a trail system. These corridors will link the Portneuf River to Old Town Pocatello, Idaho State University, public lands, and the hills which surround the valley. The primary goal of this plan is to link the community to the river and public lands.

  River Corridor-Trail
  The River Corridor contains 20.5 planned miles of trail. The corridor's ten sections all run near or next to the Portneuf River. The corridor is the backbone of the trail system. The planned corridor starts in northwest Pocatello near where US 30 crosses the Portneuf River and ends in the south at the Portneuf Gap. In many places along the corridor, trails are built or planned for trail on both sides of the river. These dual trails will require four to five additional bridges which would total eight or nine bridges on the entire corridor.

  The most significant gap in the River Corridor is from Carson Street, where the existing trail ends, to Halliday Street where the Pre-History Trail begins. The section is currently served with on-street bicycle lanes and sidewalk connections through a densely developed older neighborhood. The river in this section is channelized and when the channel was built, homes were allowed to be constructed near or next to the new channel. There are limited opportunities to create a separated trail along the river. Some advocate for removal of the concrete channel and restoration of the river in this area; however, this would require numerous property acquisitions and a massive investment of public funds.

- BTPO's 2008 Pedestrian Plan defines a neighborhood's **walkability** as the "ability to walk from your home to shopping, restaurants, and recreation destinations." When Pocatello's target area for low- to moderate income housing is compared with the City's walkability index, it shows that most of the targeted areas are at least somewhat walkable (and within the River Corridor all of the targeted areas are at least somewhat walkable). There is a need to ensure that as the City implements projects to improve the livability of the River Corridor along the concrete channel (e.g. by removing sections of the concrete channel), that access to affordable housing isn't lost from this walkable neighborhood.

Opportunities for Improvement /Solutions

- Increased flow to support floating and fishing.
- Access points along the channel to allow community members to climb in and out of the channel.
- Modifications to the channel to provide more public access to the river
- The greenway may not always be directly on the river or might not be fully connected, but there could be ways to create pathways connecting sections.
- Consider creative designs for a greenway in the channel, such as covering the channel in parts or placing a “hanging” path over the river to avoid property infringement.

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Literature Review

Water Quality, Riparian and Wetland Habitat, Fish and Wildlife

Portneuf River Literature Review
Water Quality, Riparian and Wetland Habitat, Fish and Wildlife

March 14, 2016

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Overview

The Portneuf River drains approximately 1,360 square miles (870,400 acres) and is about 100 miles long (IASCD 2001). Land use in the Portneuf River drainage includes rangeland (63% of the total watershed), irrigated and fertilized cropland (23%), forest cover, (13%), and urban areas (1%) (Resh 2008).

Within the entire Portneuf watershed, landowners have straightened and removed dozens of miles of the river since the 1800s. Several miles of the lower Portneuf River in Pocatello, ID have been straightened and the banks armored. A concrete-walled channel approximately 1.5 miles long was constructed within the city as part of a U.S. Army Corps of Engineers flood damage reduction project completed in 1968 (IDEQ 2010). This channelization followed previous channelizing work by the railroad throughout the southern portion of the valley.

Prior to development of the area and the modification of the river channel, spring peak flows routinely inundated the floodplain. Uncontrolled spring runoff established and maintained flood channels throughout the riparian area and floodplain and contributed to the complex set of factors that make a riverine ecosystem function properly. Following construction of walls, levees, and bank armoring, the floodplain was no longer accessible to floodwaters. This altered the natural characteristics and habitat value of the river corridor within the Portneuf Valley. Channelization increases flooding downstream, increases stream erosion, decrease the ability of a stream to clean itself of polluted water, and removes habitat for fish, birds, beaver, and other wildlife.

Water Quality

Water quality in the Portneuf River is often poor. In 1972 wastes from processing phosphate ore, suspended solids and nutrients from tilled cropland, and organic wastes from cattle and municipal sewage contributed to the polluted nature of the river (Minshall and Andrews, 1973). In 2008 there were 30 water quality limited assessment units in the Portneuf River subbasin (IDEQ, 2010). Pollutants include *E. coli*/fecal coliform, temperature, dissolved oxygen, phosphorus, nitrogen, and sediment. In

addition, oil and grease has been a problem in the past (IDEQ, 2010). Above Batiste Road there is a sediment problem (and associated high levels of nutrients and bacteria); 2) below Bastiste there is a phosphorous problem due to influx of groundwater with extremely high phosphorous loads from Simplot and FMC. Exposure to elemental phosphorus and other contaminants at the levels found at the former FMC plant is dangerous to people, animals, and the environment. The former FMC phosphorus processing plant is located mostly on the Fort Hall Reservation near Pocatello, Idaho, and is within the Eastern Michaud Flats Superfund Site. FMC manufactured elemental phosphorus from 1940 until December 2001. While FMC was in operation, elemental phosphorus from spills and leaks during production, storage, and handling contaminated the property and polluted the water below which, in turn, has also polluted the Portneuf River. Elemental phosphorus now can be found down to 85 feet below the surface on FMC property. Elemental phosphorus can explode and burn uncontrollably when it is exposed to air. In addition, slag (a byproduct of processing phosphate ore), used as fill and stored in mountain-sized piles on site, emits dangerous gamma radiation.

A goal for the Portneuf River is to improve water quality and someday meet primary and secondary contact recreation beneficial uses. Primary contact recreation includes activities such as swimming. Secondary contact recreation includes activities like wading and fishing.

Water quality, species richness, and substrate conditions are also influenced by recreation activities on the fringes of Pocatello (Cornell 2013). A sub-watershed with a higher level of recreation was shown to have more fine sediment; lower macroinvertebrate species richness, abundance, and biomass; higher dissolved organic carbon and higher total phosphorus (Cornell 2013).

Irrigation has reduced the river flow as much as 70% during summer compared to unregulated flow (Marcarelli et. al. 2010). The river and its tributaries also receive irrigation return flows and non-point source discharges which can be laden with bacteria, excessive nutrients and sediment (IASCD 2005; IDEQ 2010). High nutrient levels in the lower Portneuf River can lead to excessive aquatic plant growth (IDEQ 2010). Often dissolved oxygen levels are not adequate for cold-water aquatic organisms. Water temperatures are likely higher than historic conditions. Stormwater runoff carrying oil and grease, high nutrients, bacteria and sediment has also been a problem in developed areas (IDEQ 1999).

The correct range of water temperature is essential to fish and other aquatic species. The type of aquatic community (warm-water, cool-water, or cold-water) is highly influenced by water temperature. Irrigation return flow, riparian vegetation alteration, channel alteration, and flow alteration can all affect water temperature. Water temperature in the lower Portneuf River in Pocatello during summer is often too high for cold-water fish. A thermal barrier to upstream fish passage can occur (IDEQ 2010).

Dissolved oxygen is required by aquatic organisms. Dissolved oxygen levels of at least six parts per million (ppm or mg/L) are optimal for cold-water fish. When dissolved oxygen levels are below six ppm, fish and other aquatic organisms can be stressed or die. Several factors impact the amount of dissolved oxygen in the water. Colder water has the potential to contain more dissolved oxygen than warmer water. Flow, nutrient loading, aquatic vegetation, and channel alteration also affect the dissolved oxygen level. As water temperature increases late in the afternoon, water is not able to hold as much dissolved oxygen. When the sun sets, photosynthesis which has been contributing to increased dissolved oxygen levels during daylight switches to plant respiration which consumes dissolved oxygen. Dissolved oxygen levels can drop below optimum levels for cold-water species. Elemental phosphorus can exacerbate this process by allowing more algae and bacteria than normal to grow in the river. The excess algae and bacteria leads to a higher respiration level which consumes more dissolved oxygen.

Excess fine sediment can have negative effects on aquatic organisms. High fine sediment levels are a problem in the Portneuf River (IDEQ 1999). Many fish species can endure high suspended sediment levels for a short time, such as during spring runoff, but longer periods of exposure can be harmful. Sediment is one of the highest water quality pollutants (EPA 2009) and is the leading cause of benthic stress in Idaho (Rowe et al. 2003).

Nutrients are also bound to sediment. Excess nutrients can contribute to poor water quality. Phosphorus is typically bound to sediment which can be a major source of this nutrient available to rooted aquatic plants. Much of the excess sediment in the Portneuf River is derived from non-point sources such as range and crop land (IDEQ 2010). High levels of fine sediment also enter the Portneuf within the concrete channel from stormwater runoff. Water with high levels of nutrients can have a lower concentration of dissolved oxygen due to the amount of oxygen required for organic matter decomposition and other chemical reactions.

Riparian and Wetland Habitat

Construction of the flood damage reduction channel resulted in the loss of approximately four miles of natural river channel and associated wetlands by removing natural meandering and more than 100 acres of riparian habitat (USACE 1992, as cited in IDEQ 2010). Also note loss of miles of channel and associated wetlands from UPRR straightening in the Portneuf Valley.

A healthy riparian corridor would … Discuss what a healthy riparian area would look like (perhaps see Boise river for examples), even without cottonwoods. Discuss impacts of riparian veg on maintaining perennial flow. Discuss benefits of debris within the stream channel.

Reach 1. natural river that has been straightened in some areas by the railroad. Not many trees here. Still some floodplain connection.

Reach 2 levee area. Some trees. No floodplain connection.

Reach 3 Concrete channel.

Reach 4 limited channelization. Healthy canopy, despite loss of cottonwoods due to flow regime alteration. Note the healthy population of black willows in the downstream reach (4).

Fish and Wildlife

Fish, aquatic insects, and other aquatic organisms are widely used to evaluate the ecological health of rivers (Zaroban et al. 1999, Resh 2008). These organisms are good indicators of aquatic habitat quality because they require many variables representing different spatial and temporal scales that are directly linked to their habitat requirements (Jungwirth et al. 2000). Even though trout exist in the Portneuf River, the upper river had aquatic insect indices reflective of poor conditions (IDEQ 2010).

Eleven native fish species and four non-native fish species reside in the Portneuf River (Feldman and Peterson). Table 1 lists these species. Poor water quality and altered river characteristics likely limit the total number of fish present in the river within Pocatello.

No Endangered Species Act-listed aquatic species are currently found in the Portneuf River. Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*), has been recognized by a number of agencies. They are listed as sensitive or imperiled by the U.S. Forest Service, the U.S. Bureau of Land Management, and the Idaho Department of Fish and Game (IDEQ 2010, Appendix F-Biological Assessment).

Table 1. Fish Species in the Portneuf River (Feldman and Peterson).

Native Species	**Scientific Name**
Utah Sucker	*Catostomus ardens*
Bluehead Sucker	*Catostomus discobolus*
Mountain Sucker	*Catostomus platyrhynchus*
Mottled Sculpin	*Cottus bairdii*
Paiute Sculpin	*Cottus beldingii*
Utah Chub	*Gila atraria*
Longnose Dace	*Rhinichthys cataractae*
Speckled Dace	*Rhinichthys osculus*
Redside Shiner	*Richardsonius baleatus*
Cutthroat Trout	*Oncorhynchus clarkii*
Mountain Whitefish	*Prosopium williamsoni*
Non-Native Species	**Scientific Name**
Common Carp	*Cyprinus carpio*
Rainbow Trout	*Oncorhynchus mykiss*
Brown Trout	*Salmo trutta*
Brook Trout	*Salvelinus fontinalis*

Five native species of amphibians have been recorded in the Lower Portneuf Drainage, three of which are still known to occur there. Relatively few recent records of amphibians exist for Pocatello. Most of the recent records (except for tiger salamanders) are from the Mink Creek area.

- Barred Tiger Salamanders (*Ambystoma mavortium*) appear to be persisting throughout the drainage, with fewer numbers of locations reported before and after 1968 (40 vs. 26).
- Western Toads (*Anaxyrus boreas*) no longer appear to occur in the Lower Portneuf Drainage (7 records, all from before 1968), which is a similar trend for most of Southeastern Idaho. This disappearance is probably due to disease.
- Great Basin Spadefoots (*Spea intermontana*) have only been recorded from 2 sites in the Lower Portneuf Drainage. The last record is from 1983 at a site which no longer is a wetland. Changes in irrigation practices and the loss of wetlands from flood control practices probably have resulted in the loss of appropriate breeding habitat.
- Boreal Chorus Frogs (*Pseudacris maculata*) still persist in the Mink Creek area south of Pocatello, but appear to have declined or disappeared from the Portneuf Valley in the Lower Portneuf Drainage (25 pre 1968 records vs 17 post 1968 records).
- Northern Leopard Frogs (*Lithobates pipiens*) have apparently disappeared from the Lower Portneuf Drainage (14 records, all from before 1968), but are known to persist further up river and to the north in the Fort Hall Bottoms. Habitat loss and disease are the probable causes of their decline.

Three species of lizards have been recorded for the Lower Portneuf Drainage, two of which still occur.

- Pygmy Short-horned Lizards (*Phrynosoma douglassii*) apparently no longer occur in the Lower Portneuf Drainage. They are known from only 2 records, both from before 1968. It probably disappeared from the Pocatello area as urban development resulted in the loss of appropriate habitat.
- Sagebrush Lizards (*Sceloporus graciosus*) persist in the drainage, but apparently at fewer locations (24 pre 1968 records vs. 6 post 1968 records), probably due to development and loss of habitat.
- Western Skinks (*Plestiodon skiltonianus*) also persist, but apparently at fewer locations (12 records total with only 1 since 1968), probably due to urban development and loss of habitat.

Nine species of snakes have been recorded from the Lower Portneuf Drainage, seven of which are known to still occur there.

- Northern Rubber Boas (*Charina bottae*) persist in the drainage and are probably more common than indicated (17 records) because they are difficult to sample due to their secretive nature.
- Racers (*Coluber constrictor*) are the most frequently recorded snake species (42 records) with more occurrences after 1968 than before.

- Striped Whipsnakes (*Coluber taeniatus*) show relatively few records (7), the last occurring in 1998. The apparent decrease or possible disappearance of this species in the drainage is probably related to loss of habitat due to development.
- Ringnecked Snakes (*Diadophis punctatus*) are rare (6 records), but continue to persist.
- Desert Night Snakes (*Hypsiglena chlorophaea*) are rare (5 records) with their occurrence only documented in 2 areas of the drainage. Most of the records are from the Ross Park area during the 1960s, an area that has experienced considerable development and habitat fragmentation.
- Gophersnakes (*Pituophis catenifer*) are relatively common (15 records) with the majority of occurrences since 1968. This is a species that does relatively well in human modified areas.
- Terrestrial Gartersnakes (*Thamnophis elegans*) are also relatively common (19 records) with the majority of occurrences since 1968. This is a species that does well in human modified areas.
- Common Gartersnakes (*Thamnophis sirtalis*) appear to have been rare in the Lower Portneuf Drainage and to no longer be present (3 records, all from before 1968). Their decline is likely due to the disappearance of Northern Leopard Frogs which are a very important part of their diet.
- Western Rattlesnakes (*Crotalus oreganus*) appear to be decreasing (22 records before 1968 vs. 6 records after 1968). Rattlesnake populations generally decline or disappear in areas with high human densities.

Beaver (Data and estimates provided by Mr. Mike Settel, personal communication 2016).

The number of beavers that existed in the Portneuf drainage in the years 1824-1834 was significant; 4,000 to 8,000 beaver. This estimate is based on the percentage of 1-2% gradient streams in the basin, trapping reports from the Hudson's Bay Company and estimates, from other trapping brigades.

Today, the story is different. Now a large percentage of beaver are transitory. Stationary beaver now occupy less than 0.1% of suitable habitat. There are essentially four primary areas which are likely to contain beaver in the Portneuf River basin today:

1- The main channel of the Portneuf and Marsh Creeks below Chesterfield
2- Numerous tributaries and streams on private lands
3- Tributaries on public lands, at higher elevations
4- The Portneuf River downstream of Pocatello to American Falls Reservoir

Group 1 beaver, main stem of the Portneuf River, has a limited beaver population, most likely migratory juveniles. This population is estimated to be 5 to 50 beavers between I-84 and Chesterfield Reservoir.

Group 2 beaver, private land, are populated by migrating beaver and are trapped and eliminated nearly as soon as they are discovered. This population is estimated to be 1 to 10 beaver.

Group 3 beaver, public lands, are found primarily in four, 2nd order streams: Mink, Rapid, Pebble, and Toponce. The number of beaver on all of these reaches is estimated to be 7-20. Under current trapping regulations, these likely will not stabilize to a significantly larger number.

Group 4 beaver, between I-84 and American Falls Reservoir, are stationary and migratory. Based upon anecdotal reports from tribal and other community members, there is likely a stable pool of migratory juveniles moving up the Portneuf from the bottoms. This population is indeterminant, but is estimated to be 5-20 beavers per year, with a static population of approximately 10-60. Both groups are reduced due to trapping, migration out of the basin, and other mortality factors.

Thus, for the entire drainage, American Falls up to Chesterfield Dam, there are estimated at:

Group 1	5-50
Group 2	1-10
Group 3	7-20
Group 4	10-60

TOTAL: 23-140, with the majority of those occurring on Tribal Lands. If tribal lands are excluded, the estimate is 11-90 individuals.

Birds

During late winter there are about 4-8 species in Sacajawea Park area, but in May through August there are 14-16 species. There are very few ground nesting species because of the presence of ferrel cats and other predators such as fox, coyote, mink, raccoon, and fox squirrels (Charles Trost, personal communication 2016). Birds are seldom seen in the concrete channel, except in the winter when the lower section freezes over. Then mallards visit the area to reach flowing water. Diversity is typically greater in the Edson Fichter area because of the pond and willows along the river, with 15-20 species common in the summer. A list of commonly observed birds is presented in Table 2.

Table 2. Common Birds near the lower Portneuf River, as observed by Charles Trost.

Common Name	Scientific Name
American Crow	*Corvus brachyrhynchos*
American Goldfinch	*Carduelis tristis*
American Robin	*Turdus migratorius*
Barn Swallow	*Hirundo rustica*
Belted Kingfisher	*Ceryle alcyon*
Black-billed Magpie	*Pica pica*
Black-capped Chickadee	*Poecile atricapillus*
Brewer's Blackbird	*Euphagus cyanocephalus*
California Gull	*Larus californicus*
Canada Goose	*Branta canadensis*
Dark-eyed Junco	*Junco hyemalis*
Eurasian Collared Dove	*Streptopelia decaocto*
European Starling	*Sturnus vulgaris*
House Finch	*Carpodacus mexicanus*
House Sparrow	*Passer domesticus*
House Wren	*Troglodytes aedon*
Killdeer	*Charadrius vociferus*
Mallard Duck	*Anas platyrhynchos*
Mourning Dove	*Zenaida macroura*
Northern Flicker	*Colaptes auratus*
Ring-billed Gull	*Larus delawarensis*
Rock Pigeon	*Columba livia*
Sharp-shinned Hawk	*Accipiter striatus*
Swainson's Hawk	*Buteo swainsoni*
Yellow-rumped Warbler	*Dendroica coronata*

Invasive New Zealand mudsnails are found in the Portneuf River and have the potential to alter the natural riverine ecosystem (Heinrich and Baxter 2015). Heinrich and Baxter (2015) found densities greater than 1 million individuals per m^2. However, they also found aquatic insect densities were higher in areas where mudsnail densities were high.

Environmental Improvement Opportunities

While aquatic and terrestrial habitat along the Portneuf River in Pocatello is generally poor, there are some areas with healthy riparian trees (e.g. Reach 4). Conservation and protection of riparian and wetland habitat is of high priority. Riparian trees provide many benefits to fish and wildlife. All native trees along the river should be retained and more planted where space is available. However, retaining trees in leveed reaches can compete with the Corps' policy of establishing a vegetation free zone on the levee crown and slopes down to the levee toe, plus an additional 15 feet beyond the toe (Engineer Manual (EM) 1110-2-1913 *Design and Construction of Levees,* dated 03 April 2000; and Engineering Technical Letter (ETL) 1110-2-583, *Engineering and Design:*

Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, dated 30 April 2014).

If additional land becomes available, the floodplain and channel meanders could be reestablished in Reaches 1, 2, and 4. This would help restore woody riparian vegetation, improve fish and wildlife habitat, and reduce sediment and excess nutrients in the river.

To decrease input of degraded stormwater from the city to the river, oil/water separators could be installed within the city in all feasible locations to reduce the amount of oil and grease that make their way into the river.

Constructed wetlands, restored floodplains, or retention swales upstream from Pocatello could reduce the input of sediment and excess nutrients to the river.

Within the concrete channel, shallow water combined with low flows creates a passage barrier to fish. A low-flow channel could be constructed within the channel to provide deeper water. A meandering low-flow channel could also provide refuge from high velocities when flows are high.

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