BOISE RIVER SIDE CHANNEL PROJECT AT HARRIS RANCH:
Assessment and Recommendations

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Introduction

The Boise River Side Channel Project at Harris Ranch (Project) is a proposal of the Ted Trueblood Chapter of Trout Unlimited. The project is proposed for construction to improve the aquatic ecosystem in the Boise River by reestablishing riparian habitat and creating spawning and rearing habitat for salmonid fishes with a side channel to the Boise River more than one mile in length. This project will contribute toward restoration of full support of the designated beneficial use of salmonid spawning.[1] The project proposes to provide fish passage from the Boise River to Barber Pool,[2] restoring connectivity between these areas which have been disconnected for nearly a century.

This report examines the context for the proposed project, includes an assessment of information gathered in the project area, proposes a channel design plan and offers construction recommendations.

[1] Restoration of spawning habitat is necessary if the Boise River is to be removed from the list of "impaired water bodies" under §303 of the Clean Water Act. Trout Unlimited has identified numerous sites where such restoration projects could occur.

[2] This Project originally was conceived as a side channel beginning downstream of Barber Dam and not to exceed 1/2 mile in length. Negotiations with Ada County may make it possible to divert water from Barber Pool and therefore increase the stream length, stabilize flows, enhance riparian restoration, and provide passage of fish between the Boise River and Barber Pool.

I. BACKGROUND

The Boise River Side Channel Project at Harris Ranch (Project) is a proposal of the Ted Trueblood Chapter of Trout Unlimited. The project is proposed for the lower Boise River on the East End of the city of Boise and would encompass an area from Barber Pool to Eckert Bridge, roughly one mile downstream (Exhibit A).

The Project and immediate vicinity is in transition from irrigated and nonirrigated pasture for livestock to a developed urban and suburban area. The area along the river and around the Project historically was the site of industrial activity (lumber mill) which was replaced by grazing. Some scattered relics of industry remain. The transition to an urban/suburban development is the Harris Ranch development, and the Harris family owns the side channel project area. The immediate project site is in transition from pasture to open space / natural use along the river corridor. We believe the river corridor land use is compatible with the objectives of a side channel to the Boise River, and the side channel is part of the master plan for the Harris Ranch development and the *Boise River Resource Management and Master Plan*.[3]

The General Setting

The lower Boise River watershed, Hydrologic Unit Code (HUC) 17050114, is located in southwest Idaho. The watershed drains 1290 square miles of rangelands, forests, agricultural lands, and urban areas. The lower Boise River is a 64-mile reach that flows through Ada and Canyon counties and the cities of Boise and Caldwell. Climate within the watershed is temperate to arid. The valley of the lower Boise River is broad, sloping gently to the northwest with multiple river terraces positioned laterally along its floodplain. General background and description of the area is available in the report *Lower Boise River TMDL Subbasin assessment and Total Maximum Daily Loads* (commonly known as the "TMDL") is, available from the Idaho Department of Environmental Quality

Dominant fluvial geomorphic conditions and processes in the project area are driven by a combination of geologic and human influences. Geologically the channel flows through a relatively flat valley floor area where, prior to heavy settlement and intensive land use modifications, the stable channel condition appears to have been anastomosed, or multi-threaded.

The presence of upper Boise (Anderson Ranch and Arrowrock) and lower Boise (Lucky Peak, Diversion Dam, and Barber Dam) reservoirs and dams, numerous diversions, and local flood control policies have significantly altered the flow regime and the physical and biological characteristics of the lower Boise River. The river bottom from Lucky Peak Dam to Barber Dam is composed of cobbles (64 to 256 mm) and sand (<2 mm). Gravel >2 mm to <64 mm appear underrepresented.

[3] Adopted in 1999 by the Boise City Council.

A recent study of historic Boise River (Blew et. al. 2001) conditions from the cadastral survey of 1867 was used to graphically reconstruct the Boise River and its numerous sloughs and backwater areas around this time (Exhibit B). Vegetation maps, tree sizes and densities were determined from the cadastral survey notes. In addition, maps of cultural development were produced to place the river and floodplain conditions of 1867 into its appropriate historical context.[4] The study underscores the significant changes that have occurred in the Boise valley in the past 150 years.

Similarly, a draft summary report from the US Army Corps of Engineers notes the impacts of urbanization on the Boise River:

> Subsequent changes in some of the more heavily impacting land use practices and the construction of dams, including Lucky Peak, (altering runoff characteristics within the basin) resulted in yet another shift in channel condition. A system of single thread, double thread,, and split-flow channels developed. This shift represents a partial return to the anastomosed channel type. This pattern is largely present today within the project area. Many of the formerly active threads of braided and/or anastomosed channels are still present and can be easily observed during periods of high flow and high water table conditions, or by inspection of topographic maps covering the project area.
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> The Boise River has lost natural production of spawning gravels from upstream sources due to Lucky Peak Dam. The natural processes of streambed movement of larger and smaller gravels, channel formation, and other ecological processes of a riverine environment have been interrupted in part by the presence of Lucky Peak Dam. Also, riparian habitat quality has been degraded due in part to operation of Lucky Peak as a flood control project. The river no longer experiences its natural hydrograph which included overbank flooding. Mature cottonwood stands, which are a major component of a healthy riparian ecosystem in this region, are dependent on overbank flooding which creates scouring and new, unvegetated sand bars where new cottonwoods can germinate. Typical project operations can cause water levels downstream of the dam to pulse, or drop quickly. This creates a condition where saturated banks are susceptible to sloughing, often in areas where mature cottonwoods are growing. As the banks collapse, the mature cottonwoods fall into the river. The existence and operation of the dam has also contributed to a false sense of security in the city with respect to their protection from possible flooding. This situation has contributed to development occurring within the historic natural floodplain, further degrading riparian habitat and once active side channels.

A Boise River assessment[5] commissioned by the Boise City Parks and Recreation Department was completed in 1999 and notes the following:

> Some reaches of channel have been straightened by human activities. Other reaches have, or have the potential to be, straightened by natural channel avulsions. Flatter gradient reaches where levees have been installed, or where side channels have been obstructed, are vulnerable to channel bed aggradation when sediment loads are heavy. Excessive sediment deposition

[4] Historical Conditions of the Boise River Prior To Large-Scale Watershed Urbanization and Development. David Blew, Idaho Department Of Water Resources (Presenter). Coauthors: Katy Koval, Idaho Department Of Water Resources; Mike Ciscell, Idaho Department Of Water Resources; Roger Blew, S.M. Stoller Corporation.
[5] BOISE RIVER CHANNEL ASSESSMENT: CITY OF BOISE, ADA COUNTY, IDAHO. Prepared For City Of Boise Parks and Recreation Department, Boise, Idaho. Agua Tierra Environmental Consulting, Inc (Atec), Olympia, Washington. 1999.

within the channel or between the levees displaces floodwaters and creates more frequent out-of-channel flood events.

In cases where sediment supply is not heavy aggradation might not occur. However, if side-channels are obstructed flood conveyance capacity is lost and more frequent out-of-channel flood events will occur. These conditions prevail on the Boise River within the project area. Three major dams and the Barber Dam have largely controlled sediment loads above the project area. Dam regulation of flood flows has reduced the frequency of flow through many of the side channels. Many of these channels have been partially obstructed by development or thick vegetation. At some point in time a flood will eventually occur that exceeds the capacity of the dams. In this instance remnants of the former side channels will be the first places to flood and may be the locations of channel changes.

At the Project site riverbed conditions indicate cobble sizes dominate, and gravels are underrepresented. River management does not allow for gravel recruitment.[6] Seasonal fluctuations in river elevation upstream of the Barber Irrigation Diversion[7] resulting from flow management and operation of the diversion have resulted in roughly 1/2 mile of the north bank of the Boise River being largely denuded of vegetation (Exhibits C, D and E). The lack of riparian function contributes additional bank erosion to the Boise River on a seasonal basis as water elevations change and wave action erodes sand and sediment from the exposed bank.

The TMDL reports that "In general, the portion of the Boise River near the city has an armored substrate that consists primarily of large cobbles. Of the cobbles, pebbles, and gravel present, more than 60% were embedded in the 25% to 49% range during a 1987 survey (Asbridge and Bjornn, 1988). Embeddedness exceeding 32% is generally considered to indicate impaired habitat. Most pea gravels in Loggers Creek were also embedded in the 25% to 49% range during the same study, limiting the value of the substrate salmonid spawning." Lack of recruitment of gravels is generally attributed to storage in the reservoirs upstream in the watershed.

Boise River Fish Habitat Conditions

The 1999 TMDL assessment includes a succinct profile of the Boise River fishery:

> Fish populations in the Boise River include rainbow trout, brown trout, mountain whitefish, sculpin, redside shiner, sucker, and chub. The fish are not evenly distributed throughout the river, and some species are more successful in sustaining their populations than others. The Boise River experiences intense angling pressure. Currently, natural reproduction of both wild and hatchery trout stocks is insufficient to sustain populations. As a result, the IDFG must stock between 50

[6] The TMDL states in part, "The river bottom from Lucky Peak Dam to Barber Dam is composed of cobble-size (64 to 256 mm) material and sand-size (<2 mm) sediment. During high flows sand-size sediment builds up behind Diversion Dam. After the irrigation season (mid-October) the gates at the base of Diversion Dam are opened and the sediment is washed downstream. Sediment is retained behind Barber Dam and is flushed downstream only during high flows. Gravel recruitment below Lucky Peak Dam is limited by the presence of the dams thus, the river below Barber Dam is said to be sediment starved." In fact, Barber Dam continues to flush sediment downstream through the powerhouse, depositing sand in a back eddy and blocking the north channel of the Boise River immediately downstream during low flow releases.

[7] The Barber Irrigation Diversion is approximately 1/2 mile downstream of Barber Dam and diverts water into the Ridenbaugh Canal.

and 60 thousand hatchery, catchable sized rainbow trout and thousands of brown trout fingerlings annually.

Lack of full support of salmonid spawning in the Boise River is due to absence of appropriate fish habitat components and the underlying physical and ecological functions and processes that create and support good habitat for salmonid fishes.

The 1999 Boise River *Master Plan* provides a status of the fishery, fish habitat and recreational fishing along the river through the city of Boise:

> The quality of existing fish habitat is highest in the upstream portions of the lower Boise River within the city of Boise. Fish densities and diversity are highest based on sample sites upstream of Broadway Bridge. Habitat conditions generally are best above Veterans Park. Below Lander Street, species diversity and monitored fish densities are lower than upstream reaches. Snag removal, for safety of tubers and other river users, presents a dilemma because the best fish habitat is above the Americana Bridge and it could be improved by leaving many snags. The river above Americana Bridge is also the most heavily used by river recreationists.
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> The Idaho Department of Fish and Game stocked approximately 40,000 catchable hatchery rainbow trout between Barber Park and Glenwood Bridge during 1999. Trout are stocked at flows between 1,800 and 200 cfs, usually from spring into December, depending on winter temperatures. Nearly 40 percent of fishing effort occurs above Broadway Bridge to Barber Park. Another 40 percent occurs between Glenwood Bridge and Veterans Park. Above Broadway Bridge, nearly 85 percent of fish caught are released by anglers, while harvest rates are higher downstream. Roughly 50 percent of the anglers above Broadway Bridge fish with flies or artificial lures, with the other 50 percent made up of anglers fishing with bait. Below Veterans Park, nearly 75 percent of anglers fish with bait.
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> In 1994, fisheries managers estimated there were 70,000 hours of fishing effort between Barber Park and Glenwood Bridge, up from an estimated 50,000 hours of effort in 1987. The average trip length in 1994 was estimated at 1.4 hours. This information is from the Idaho Department of Fish and Game. The fishery is valued at about $1.175 million based on an average value of $23.50 for an angler trip, using U.S. Fish and Wildlife Service data.
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> Tributary streams to the Boise River in the study area are significantly altered and degraded. Most have been channelized or placed in culverts, such as Cottonwood Creek, thereby losing connectivity between the river and tributary streams which provide habitat for aquatic species.

Following development of the TMDL, Idaho DEQ provided additional comments to the Environmental Protection Agency (EPA) on fish habitat issues in the Boise River:

> "There is a lack of access to off channel rearing sites, due to a regulated flow regime (no floods allowed) coupled with encroachment on the historic floodplain by development. In channel habitat is adversely affected by annual channel maintenance through a population center. This involves removal of large woody debris which presents a hazard to recreationists and threatens a predictable channel. Though beneficial to other uses, these actions reduce the quality of salmonid habitat."[8]

[8] Idaho Division of Environmental Quality. *A Synopsis of Current Understanding of Total Suspended Solids, Substrate Conditions and Salmonid Spawning in the Lower Boise River.* Attached to DEQ letter of September 28, 1999.

Water temperature is also an important habitat need for salmonids. We reviewed published information on water temperatures at Eckert Road. USGS measured and reported daily mean water temperature at Eckert Road between July 18 and September 5, 1996. The daily means ranged from about 14.3 deg. C (57.7 deg. F) on July 18, to about 16.8 deg. C (62.2 deg. F) on September 4. For comparison, the IDEQ WQ Standard for coldwater biota is "(22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C."[9]

Fish and fish habitat studies of the Boise River are few. Asbridge and Bjornn (1988)[10] studied the Boise River in 1986 and 1987 and completed a habitat classification survey, made physical habitat measurements, and conducted salmonid relative abundance estimates. The study concluded the river lacks suitable spawning and rearing habitat. Aside from this limiting factor, the river through town supports trout and whitefish populations with adequate water temperatures.

Similarly, the Boise River *Master Plan* found that "Tributary streams to the Boise River in the study area are significantly altered and degraded. Most have been channelized or placed in culverts, such as Cottonwood Creek, thereby losing connectivity between the river and tributary streams which provide habitat for aquatic species. Habitat studies of the Boise River have recommended restoration of side channels as one priority for addressing fisheries needs. Currently, Loggers Creek is the only Boise River side channel producing trout."

We reviewed Boise River studies conducted by the USGS in the 1990s and found very good habitat conditions near Eckert Bridge, just downstream from the proposed side channel. One study[11] concluded that instream habitat conditions tended to decline in a downstream direction, but riparian habitat conditions did not follow this trend. The upstream end of the study area coincides with the proposed side channel project, placing the project in the area of where habitat conditions and the aquatic community (fishes and macroinvertebrates) appear in the best conditions in the Lower Boise River. For example, substrate conditions at the Eckert Bridge area shows sand and silt making up 18 percent of the river bottom, while the Boise River near Middleton and Parma both sampled nearly 50 percent of the stream bed made up of sand and silt.

Macroinvertebrate data collected at several sites along the Boise River indicated the Eckert Bridget area scored the best in an index of biotic integrity. Similarly, a second study[12] contains data indicating the most optimum water temperatures for salmonid species are in the Eckert Bridge area.

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[9] USGS. 1998. Water-Quality Conditions of the Lower Boise River, Ada and Canyon Counties, Idaho, May 1994 Through February 1997. Water-Resources Investigations Report 98-4111.

[10] Asbridge, G., and T.C.Bjornn. 1988. Survey of potential and available salmonid habitat in the Boise River. Idaho Department of Fish and Game Job Completion Report, Project F-71-R-12, Subproject III, Job No. 3. Idaho Cooperative Fish and Wildlife Research Unit. University of Idaho, Moscow, Idaho, 71 p.

[11] Mullins, W.H., 1999, Biological Assessment of the Lower Boise River, October 1995 Through January 1998, Ada and Canyon Counties, Idaho: U.S. Geological Survey Water-Resources Investigations Report 98–4178, 37 p.

[12] Mullins, W.H., 1998, Water-quality conditions of the lower Boise River, Ada and Canyon Counties, Idaho, May 1994 through February 1997: U.S. Geological Survey Water-Resources Investigations Report 98–4111, 32 p

Electrofishing and creel survey data from Idaho Department of Fish and Game[13] also indicate fish populations upstream of Broadway Bridge (three miles downstream of the project site) include the highest densities in the Lower Boise River. Samples indicate this reach has the largest densities of catchable age fish and highest diversity of species. The creel survey conducted in 1994 and 1995 also indicate that more than 85 percent of the fish caught by anglers upstream of Broadway Bridge are released, a figure much higher than the other reaches of the Lower Boise River that were surveyed. Therefore, the area with the highest fish densities and most diverse species present is also the area least impacted by anglers.

A side channel at this location can reasonably be expected to capitalize on the relatively good conditions in this reach of the Boise River, and the additional spawning and rearing habitat should produce immediate benefits to the fishery once constructed.

Habitat Restoration Recommendations

Recommendations from the Asbridge and Bjornn (1988) study include:

- Begin a habitat improvement program in the Boise River to increase the amount of summer and winter rearing habitat.
- Concentrate spawning habitat improvements in Loggers Creek and side channels of the Boise River.
- Work to protect and enhance existing riparian vegetation and improve areas with little or no riparian vegetation.

The city's Boise River *Master Plan* recommends*:*

- Boise Parks and Recreation Department should take opportunities as they arise to work with other organizations to improve fish habitat in the City.
- Participate with the Idaho Department of Fish and Game and conservation organizations in habitat improvement projects to mitigate for removal of debris and snags, i.e., connecting and rehabilitating side channels; constructing fish habitat as the opportunities arise.

The TMDL effort for the lower Boise River has struggled to address fish habitat loss in the Boise River since much of the structure and function of habitat are affected by factors such as modification and flow alteration, which in turn may adversely affect beneficial uses.[14] Ignoring the issue will mean the Boise River will remain on the §303(d) list. We are encouraged that DEQ is on record stating, "DEQ anticipates that

[13] Allen, D.B., S. Yundt and B.J. Flatter. 1999. Federal Aid in Fish Restoration, Job Performance Report, Project F-71-R-20, Regional Fishing Management Investigations, Idaho Department of Fish and Game.

[14] Section 2.2 of the *Lower Boise River TMDL Subbasin assessment and Total Maximum Daily Loads* states the dilemma: "There are no water quality standards, habitat or flow, nor are they suitable for estimation of load capacity or load allocations. Because of these practical limitations, TMDLs will not be developed to address habitat modification or flow alteration . . . In the Boise River, actions taken to address suspended sediment will also improve habitat conditions. In addition, DEQ anticipates that these other causes of impairment will be addressed in the implementation plan developed for this TMDL."

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The condition of habitat in the Lower Boise River functions at less than optimum compared to streams in natural condition. The lack of side channels now compared to their historic presence underscores how the Harris Ranch property provides an important opportunity. The project site represents the last remaining large area with the greatest potential for significant side channel development. A further advantage of this project is its location in the reach of the Lower Boise River that monitoring information indicates contains the best habitat and fish populations under current conditions.

II. DEVELOPMENT OF STREAM DESIGN

Salmonid Fish Information

Salmonid spawning and rearing would be an important objective of the Project. Regional information on brown trout and rainbow trout was reviewed.[15] Generally brown trout spawn from October through December. Depending on the temperature, the eggs hatch in 2 to 4 months. Rainbow trout spawn from March through June; however, hatchery strains have been developed that will spawn any month of the year. Depending on the temperature, the eggs hatch in 4 to 7 weeks

We also gathered fish species-specific profile information (Exhibit F).

Site Characterization: Groundwater

Five groundwater test holes were drilled in January 2002, and CH2M Hill personnel monitored groundwater elevations since then to record temporal and spatial changes in the groundwater elevation through the Project site. Over time, the site observations were also recorded, such as weather conditions and river flows. (Exhibit G).

Measurements were made at each well beginning in February 2002, before irrigation and flood control releases in the spring. Measurements were made during summer 2002 as well as in October 2002 following irrigation season. The monitoring is continuing in 2003.

Generally, distance to groundwater decreased when river flows increased in spring, and depth to groundwater remained relatively shallow through the summer during irrigation releases. These changes were especially pronounced for the three test wells near the stream. Groundwater depths receded in October 2002. The rise in groundwater elevations is influenced both from increased river flows and by an increase in river elevation when stoplogs are placed in the Ridenbaugh Canal diversion which backs up water several hundred yards upstream. Because river flows are timed with the placement and removal of the stoplogs, it is difficult to determine if one action has a larger effect than the other does on groundwater levels measured near the river.

Distance to groundwater elevation from ground surface (feet)
(Three groundwater wells near river)

Date	Upstream near-river TH-3	Middle near-river TH-2	Downstream near-river TH-1
02/17/02	8.48	3.97	1.90
02/25/02	8.43	3.97	1.85
03/11/02	8.43	4.02	1.85

[15] Simpson, James and Richard Wallace. 1978. Fishes of Idaho. The University Press of Idaho, Moscow, ID.

03/24/02	8.48	4.02	1.90
04/04/02	7.63	1.62	1.15
04/14/02	6.63	0.72	-0.10
07/07/02	6.23	0.72	-0.10
10/13/02	8.33	3.22	1.20
03/30/03	8.03	2.42	1.30
05/27/03	6.28	0.62	-0.10

One groundwater well, TH-3, is located near the Boise River, but it actually recorded the furthest depth to groundwater. This well is located near the northern channel of the Boise River that is dry during low flow months. We can make no firm conclusions why the depth to groundwater exceeds that of other sites, but it appears to be an area where land elevation is actually higher compared to the other sites, thus the water depths do not vary as much compared to the other test wells.

For the two test wells set back from the river by 200 feet or more, we observed similar changes in water levels through the seasons. Because water elevations appear to rise in March and to drop at one well during the summer irrigation season, we postulate some effect occurring from groundwater migration from the foothills to the north.

Distance to groundwater elevation from ground surface (feet)
(Two groundwater wells away from river)

Date	Upstream off-river TH-A	Downstream off-river TH-B
02/17/02	3.48	4.07
02/25/02	3.43	4.12
03/11/02	2.93	4.12
03/24/02	3.08	4.07
04/04/02	3.43	3.52
04/14/02	3.08	2.37
07/07/02	5.23	2.77
10/13/02	4.23	3.22
03/30/03	2.43	3.37
05/27/03	3.78	2.12

Site Characterization: Soils

Notes from the drill log of the five groundwater test holes provide the following soil profile and soil depth information:

- TH-A (upstream, off river): Cobble/gravel at 8 feet, water at 8.5 feet, well to 10 feet
- TH-B (downstream off river): Gravel at 4 feet to 9 feet, water at 9'2", well at 10 feet
- TH-3 (upstream on river): Silt & sand to 3 feet, gravel to 10 feet, water at 4 feet

- TH-2 (middle, on river): Silt & sand to 4 feet, gravel to 10 feet, water at 2 feet
- TH-1 (downstream on river): gravel from surface, water at 8 feet

The above information indicates that stream channel excavation to four feet of depth can be effective in reaching historic river bottom constituents. The lower 200 yards of the proposed channel along the Boise River serves as a seasonal backwater to the Boise River when there are high river flows. TH-1 is located in this backwater area.

Site Characterization: Wetlands

We obtained a data layer of the delineated wetlands from Resources Systems Inc. for the area east of Eckert Road upstream to Barber Dam. Resource Systems completed the wetlands survey in 1996. The backwater area and immediate vicinity are delineated wetlands. This information has some bearing on the stream alignment and was discussed with the Army Corps of Engineers in a site visit on May 2, 2003.

Two other identified wetlands are just east of the power line corridor, northwest of an artesian well and excavated trench (Exhibits H and I).

Project Proposal and Planning Narrative

The Ted Trueblood Chapter originally proposed the project to create a new side channel of the Boise River to provide trout spawning, rearing, and over-wintering fish habitat, all of which are limiting to the river fishery. The original concept was to divert water from the northern channel around the island downstream of the Barber Dam tailrace. The side channel would parallel the Boise River for about 1/2 mile and then return to the Boise River just upstream of Eckert Bridge. The side channel would be located within a planned 35-acre riverfront park, with the riverside area maintained in a natural condition.

Discussion of the project concept began in the late 1990s with meetings between TU and Harris Ranch. Harris Ranch has endorsed the side channel, incorporating it into its master planning and development efforts.[16] Over time more agencies and other partners were approached, including the City of Boise and Idaho Department of Fish and Game.

The Ted Trueblood Chapter was awarded an Embrace-A-Stream grant from the national Trout Unlimited organization in April 2000 for this project. The Boise City Council approved a grant from the City of Boise in April 2001. The National Fish and Wildlife Foundation awarded the project a grant in July 2001.

Initial meetings were held with a large number of interested and affected parties in September 2000. Issues identified at these early meetings included public access, fishing regulations, permits, water rights, and funding needs.

[16] Harris Ranch continues to support the Project despite the Master Plan for development being abandoned in May 2003.

TU and Harris Ranch met with the Nampa-Meridian Irrigation District (NMID) in Nampa on September 11, 2000. At this meeting the District identified issues of concern due to the fact that the side channel would route water around the irrigation diversion for the Ridenbaugh Canal. The District requested specific information on the amount of water that would be in the side channel and whether there will be water loss in the stream reach and how this side channel will affect their diversion of water. They requested the design provide for emergency access to the north bank of the river and the District's diversion works. Finally, the District suggested that the side channel could return to the Boise River upstream of the irrigation diversion so that there be no flow depletion from the Boise River.

Numerous site visits occurred over time, including a meeting on March 31, 2001, with TU, Harris Ranch, Quadrant Consulting, University of Idaho, City of Boise, Idaho Fish and Game and Idaho Parks and Recreation. At this site visit investigators examined the then dry northern channel and whether a point of diversion could occur further upstream near the tailrace of the Barber Dam hydropower facilities. A basalt rock outcrop was observed at water surface, which could complicate the excavation efforts (Exhibit J).

Quadrant Consulting produced poster-sized aerial photographs showing land elevation contour lines and conceptual routes for the side channel. These materials were used during the site visit.

An April 15, 2001 site visit and meeting occurred with TU, Quadrant Consulting, CHI Energy Inc., and the NMID. By this date the river flows had increased from 240 cfs to more than 800 cfs, the stop logs were in place at the NMID Ridenbaugh Canal Diversion (which is about 40 yards upstream of Eckert Bridge), and water was flowing through the northern channel. The drawings were showed to the CHI and NMID representatives (Exhibit K).

A December 18, 2001, site visit was made by TU, Quadrant Consulting and CH2M Hill. The purpose was to determine location of groundwater monitoring wells. Locations for five wells were selected, staked, and recorded on a GPS unit by Quadrant Consulting (Exhibits L and M). We also walked the dry northern channel (flows were again at the lower winter level (150 cfs). It was discussed whether the northern channel was dry due to changes in channel currents and eddies created by the wing wall in the Barber Dam tail race.[17]

[17] A dry northern channel did not comport with recollections of TU members from the early 1990s and the effects of the dam reconstruction in the 1980s and high water in the late 1990s may have rearranged channel morphology which now blocks water from the northern channel at low flows. Nonetheless, potential diversion sites were scoped.

Groundwater wells were drilled in January 2002 by Haz-Tech Drilling under the supervision of CH2M Hill. In late February 2002 the project area was surveyed with more than five dozen survey points collected by Quadrant Consulting.

A February 18, 2002, site visit to the side channel project site revealed significant challenges for diverting water from the Boise River into a side channel.[18] The original assumption had been that a diversion of water could be made from the northern channel around the island just downstream of the Barber Dam tailrace. We determined that the northern channel dry during winter flows (240 cfs or less) and any attempt to open the upstream end of the channel would require significant removal of streambed materials, which could potentially redeposit and block the channel due to flow patterns in the tailrace.[19]

The issue of diverting water into a side channel therefore emerged as the key question surrounding whether a side channel was feasible. This question became the main issue needing resolution before undertaking any other planning and design work for the side channel. If no feasible option could be identified, the project would need to be abandoned and the funds remaining from the $50,000 raised would need to be refunded or allocated to another project.

Based on these site visits and investigation, two possible options emerged for diverting water into a side channel:

1. ***Divert water immediately downstream of Barber Dam tailrace.*** This option would require excavation of a trench to a depth sufficient for gravity flow of water at the low flow elevation. Significant excavation for the side channel would have to occur for much of the length of the channel. The diversion could be open or could be a buried pipe. A conceptualization of diversion works should be identified and cost estimates developed.

2. ***Divert water from Barber Pool.*** This option would entail the construction of diversion works to draw water from the Barber Pool upstream of the Dam. The length of the side channel would extend upstream to the diversion and would likely route around the earthen embankment extending approximately 1,100 feet north of the Barber Dam powerhouse. Diverting water at this point would affect more landowners and interests, and any water routed through the diversion would not be available to generate power at Barber Dam. As with the first option, a conceptualization of diversion works would need to be identified and cost estimates developed. In addition, the elevation drop from the Barber Pool elevation to the elevation of the side channel may present engineering and design complexities.

[18] This site visit included TU members, Quadrant Consulting, Idaho Fish and Game, and Philip Williams and Associates.

[19] It would be possible to divert water into a side channel during the April – October period when the stoplogs are placed in the Ridenbaugh Diversion. A point of diversion could be constructed in the dry and used seasonally. Less excavation for the channel would be required.

For several months in 2002 and early 2003, we continued to monitor the groundwater elevations in the wells and researched the feasibility of diverting water from Barber Pool. TU worked with Ben Johnson Associates (energy market consultants) to understand the impacts of diverting water from Barber Pool and the degree of impact on electricity generation from Barber Dam. Quadrant Consulting provided information and analysis on Boise River flows that was made available to Ben Johnson Associates. Initial contacts were made with the hydropower operator (CHI Energy, Inc.) and the dam owner (Ada County).

In August 2002 TU met with an Ada County Commissioner to discuss the concept of diverting water from Barber Pool and determining if an adjustment in the royalty paid by CHI Energy to Ada County could help address the energy revenue impacts. An indication of willingness to explore the option of sharing revenue impacts between the two parties led to Ben Johnson Associates conducting a study for Ada County Commission review. Meetings were held in December 2002 and March 2003 (two members had changed in the 2002 election) to follow up on the issues. The Ada County Commission offered conceptual support for the project in April 2003.

Concurrently, the Idaho Department of Fish and Game, which endorses the Project, expressed desire to secure its direct participation in stream design and construction of the channel by ensuring that public access to the riverside area be secured.[20] Discussions commenced in spring 2003 on the mechanisms of land conveyance from the Harris family to the Land Trust of the Treasure Valley to include the public access needs for the Idaho Fish and Game.

Site visits occurred in April and May 2003 to more completely describe the existing conditions at the side channel site. A site meeting with the Army Corps of Engineers May 2, 2003, resulted in determining a stream alignment that would minimize the impact to delineated wetlands. More than 950 data points were surveyed by Philip Williams and Associates and University of Idaho personnel to define the existing topography, with special emphasis on the area selected for the proposed alignment during a land survey May 16, 2003 (Exhibit N). From this information a plan and channel alignment was developed which incorporates input from TU, Idaho Department of Fish and Game, Quadrant Consulting, CH2MHill, and Philip Williams and Associates and is discussed in the final section of this report.

[20] Harris Ranch will provide real property and/or easements for an extension of a paved public greenbelt path between Eckert Road and Barber Dam. This provision may be to a non-profit corporation, e.g. a land trust (Land Trust of the Treasure Valley), will be 15 acres kept in a preservation of open space with a stream that would go through (Boise City Planning & Zoning Commission Minutes of October 21, 2002, CUP02-55/Harris Ranch).

III. STREAM DESIGN RECOMMENDATIONS

Site visits and meetings with various parties have led to identifying issues and options for the point of diversion into the channel, the general alignment of the channel between its beginning and end, and the location where the channel will return to the Boise River.

Upstream Diversion Point
Factors affecting the upstream end of the channel (the point of diversion), have been mentioned previously. The original side channel proposal envisioned a 1/2-mile long channel with a point of diversion at from the northern channel of the Boise River several hundred yards downstream of Barber Dam. Because the northern channel is dry in low flow conditions and there were no long term solutions for restoring and maintaining flow to the channel, this point of diversion appears not feasible for constructing a side channel with year-round flow.

Diverting water from the Boise River near the tailrace of Barber Dam would make for a 3/4-mile long channel. Locating a water intake diversion at Barber Pool, for a more than one-mile long channel, is the other option. While it appears possible to excavate a channel with gravity flow from the tailrace of Barber Dam, site survey information indicates a large difference in water surface elevation at low flow and the elevations of adjacent land where a channel would be excavated. Basalt outcrops and existing springs present in the area may also affect feasibility and cost.

While the Barber Pool option would result in a longer channel, approximately 6,000 feet total length, it could avoid the deep excavation associated with the 4,500-foot long channel starting at the Barber Dam tailrace. We therefore estimated the amount of fill that would have to be excavated for a stream channel for both options (Exhibit O). Diverting water from Barber Pool to a side channel would result in a stream that is 33 percent longer than from a river diversion downstream of the dam, but it would require approximately 50 percent or less of the excavation required of the river tailrace option. A Barber Pool point of diversion will also allow the side channel to have greater elevation drop over the 6,000 foot long reach, which will provide more opportunity for habitat features to be incorporated into the stream including spawning riffles in some areas. We recommend the Barber Pool diversion also for the potential that fish passage can be restored to the Pool from the Boise River, bypassing both Barber Dam and the Ridenbaugh Canal diversion.

If construction of an outlet from Barber Pool is delayed for many years, it is still advisable to proceed with the initial phase of construction of the side channel using the water sources from the artesian well and the excavated trench near Barber Dam.[21]

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[21] An additional option for providing the full 10 cfs flow in the side channel would be to construct a river diversion that would operate during the time the river elevation is high, which occurs during irrigation season and flood releases from Lucky Peak Dam. This option could be pursued if there are long-term

These sources will be able to provide water for vegetative recovery of the stream banks following initial excavation and reduce the potential for accelerated bank erosion along the 3,000 feet of side channel once a 10 cfs flow is diverted into it. Experience with Loggers Creek excavation as well as recommendations from other river corridor restoration literature support this approach.

Downstream Re-entry Point

The NMID suggested that the side channel return to the Boise River upstream of their Ridenbaugh Canal diversion structure so that there is no change in the amount of water passing over the diversion. We suspect that the NMID's interest is to maintain the maximum amount of water in the main channel to help with the diversion of their water for which they have water rights at that site.

The most accessible side channel habitat that meets the objectives for enhanced spawning and rearing habitat for the lower Boise River would have a re-entry point downstream of the diversion. Otherwise, fish downstream of the diversion would require a fish ladder over the diversion to access the mouth of the side channel.

A fish ladder would have to be built on the Ridenbaugh Diversion, which would increase the costs of the side channel project and not increase flows in the main channel. The ladder would have to be designed to ensure a certain amount of water would pass over the diversion at a wide range of flow levels,[22] and these flows would likely impact the head behind the diversion. The NMID suggestion, therefore, may actually have more impact to the Ridenbaugh diversion than a separate side channel, although neither would have a significant impact on the flows at the diversion.

We reviewed more than 20 years of monthly average flows on the lower Boise River and calculated flows at the Barber Dam and the Ridenbaugh Diversion (Exhibit P). We found a 10 cfs flow in a side channel would on average have less than a 1 percent impact on flows (0.28 percent in May; 0.88 percent September). Over the 23-year record studied, for the 138 months with significant irrigation flows (April through September, or six months each year), a 10 cfs diversion exceeds one percent of river flow about 11.5 percent of the time. This case occurred usually in September, and only once in 23 years during the month of August. Average flows in the Boise River in the spring and summer months are in the 2,000 cfs - 3,000 cfs range April through July, 1,600 cfs average in August, and 1,100 in September. Average diversion into the Ridenbaugh canal is between 450 cfs - 500 cfs through August, and then the average diversion in September appears to be 350 cfs. It is in this context of much larger flows that a 10 cfs flow in a side channel has such a small impact.

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impediments to a side channel diversion from Barber Pool. Such an option should be pursued only if there were adequate surplus funds for this second diversion and if the construction costs are reasonable.

[22] Average monthly flows during irrigation season range from 400 cfs (September 1992) to 6,148 cfs in May 1998. Flows in June 1997 peaked at more than 8,000 cfs for a few days. Thus a fish ladder over the diversion would have to be based on design criteria that can operate at a significant range of flows.

Based on the monthly average flow data, it appears a 10 cfs flow in a side channel that bypasses the Ridenbaugh Diversion would have a less than 1 percent impact on river flow. Therefore it would be very difficult to measure any affect on the ability to divert water into the Ridenbaugh Canal.

Additional Considerations
Additional considerations for alignment of the side channel include the delineated wetlands and the alignment immediately upstream of where the channel returns to the Boise River.

We reviewed the mapping of the wetlands along the river near Eckert Bridge as well as photographs of the area during high water. It appears the wetland area is influenced by groundwater migrating from the raised river elevation from the Ridenbaugh Diversion during irrigation season. In addition, at high flows the river elevations increase upstream of Eckert Bridge due to a backwater effect of the river width being constrained at the bridge. The wetland area is also low in elevation and providing important wetland habitat. During high flows it is a backwater to the Boise River. Therefore, we developed a stream alignment that skirts the wetland just to the north (Exhibit Q).

The point at which the side channel joins the Boise River is influenced by several factors. Spring Creek, an intermittent stream, enters the Boise River in that vicinity. There is also a telephone pole near the confluence point. The side channel and the intermittent flows from Spring Creek could be joined prior to their entering the Boise River, and additional excavation could direct flows around the telephone pole. (Exhibits R and S).

Our conceptual drawings also include a stream profile (Exhibit T). The land elevations along the stream channel alignment change only slightly in the upstream reaches, while the area of greater change is near the confluence with the Boise River. The stream profile includes more gradient in the upper sections and a lower gradient stream in the downstream section. The typical cross sections describe the approximate channel shape and dimensions (Exhibit U).

Recommendations

- Acquire 10-cfs flow into side channel from Barber Pool[23] and manage for steady flows to promote riparian vegetation growth, shading for stream and bank stability while minimizing impacts on other water uses.

[23] The basis for a steady 10 cfs flow is to promote riparian growth because it cannot be achieved in the river due to significant fluctuation of river elevation. The 10 cfs quantity is also based on the following: 1) recommendations from Idaho Fish and Game are to limit side channel flows in winter to 10 cfs (Bob Martin, IDFG, May 2002); 2) 10 cfs minimizes impacts to hydropower generation. *(The Value of Hydropower Generation at Barber Dam.* Ben Johnson Associates, October 2002); 3) the need to reduce impact to river flow and ability of the Nampa & Meridian Irrigation District to divert water into the Ridenbaugh Canal (in response to issue raised in meeting with NMID in September 2000).

- Construct and restore approximately 5,100 - 6,000 feet of side channel, depending on the wavelength and amplitude of meanders based on stream design.

- Align the side channel to skirt the north end of the wetlands near Eckert Bridge.

- Construct in two phases. The first phase should start with the downstream end (downstream of the Ridenbaugh Canal diversion and upstream of Eckert Bridge) and connecting at the upstream end to an existing trench and artesian well that can provide minimal flows into the stream channel to irrigate riparian vegetation and stabilize banks.

- Create a channel connection to Barber Pool from the side channel as the second phase to the project.

- Provide high quality pools primarily for overwinter habitat and several segments of optimal spawning habitat. Aim to achieve 15-30 percent of channel length to include suitable spawning gravels, with the remainder designed for rearing habitat.

- Create and restore approximately 102,000 – 120,000 square feet of riparian area (depending on stream length and assuming 20 sq. feet of riparian area per linear foot of stream).

- Implement Best Management Practices as part of the stream restoration work. Follow NRCS conservation practices including the following standards that were downloaded from the Idaho NRCS website: Riparian Herbaceous Cover (390), Heavy Use Area Protection (561), Restoration and Management of Declining Habitats (643), Fence (382), Stream Habitat Improvement and Management (395), Streambank and Shoreline Protection (580), and Critical Area Planting (342).