

**FUTURE FISHERIES IMPROVEMENT PROGRAM
GRANT APPLICATION**

(please fill in the highlighted areas)

I. APPLICANT INFORMATION

A. Applicant Name: Turner Enterprises, Inc.

B. Mailing Address: 901 Technology Blvd

C. City: Bozeman State: MT Zip: 59718

Telephone: (406) 556-8500 E-mail: Carter.Kruse@retranches.com

D. Contact Person: Carter Kruse

Address if different from Applicant:

City: State: Zip:

Telephone: E-mail:

E. Landowner and/or Lessee Name
(if other than Applicant):

Mailing Address:

City: State: Zip:

Telephone: E-mail:

II. PROJECT INFORMATION*

A. Project Name: North Fork Spanish Creek Fish Barrier

River, stream, or lake: North Fork Spanish, Chiquita Lake, Big Brother

Location: Township: T4S Range: R 3E Section: 1\4, Sec. 19

Latitude: Longitude: *within project (decimal degrees)*

County: Gallatin

B. Purpose of Project:

Return of Westslope Cutthroat Trout (WCT) to approximately 12 miles of historical stream habitat and 9 acres of high mountain lake habitat..

Westslope Cutthroat Trout - *Oncorhynchus clarkii lewisi* (WCT) - were first described by the Lewis and Clark Expedition in 1805 near Great Falls, Montana, and are recognized as one of 14 interior subspecies of cutthroat trout. The historical range of WCT includes Idaho, Montana, Washington, Wyoming, and Alberta, Canada. In Montana, WCT occupy the Upper Missouri and Saskatchewan River drainages east of the Continental Divide, and the Upper Columbia Basin west of the Divide. Although still widespread, WCT distribution and abundance in Montana has declined significantly in the past 100 years due to a variety of causes including introductions of nonnative fish, habitat degradation, and over-exploitation (Hanzel 1959, Liknes 1984, McIntyre and Rieman 1995, Shepard et al. 1997, Shepard et al. 2003). Reduced distribution of WCT is particularly evident in the Missouri River drainage where genetically unaltered WCT are estimated to persist in less than 5% of the habitat they once occupied, with most remaining populations restricted to isolated headwater habitats (Shepard et al. 2003; Shepard et al. 2005).

The declining status of WCT has led to its designation as a Species of Special Concern by the State of Montana, a Sensitive Species by the U.S. Forest Service (USFS), and a Special Status Species by the Bureau of Land Management (BLM). In addition, in 1997 a petition was submitted to the U.S. Fish and Wildlife Service (USFWS) to list WCT as “threatened” under the Endangered Species Act (ESA). USFWS status reviews have found that WCT are “not warranted” for ESA listing (DOI 2003); however, this finding was in litigation until 2008. Additional efforts to list WCT under ESA are inevitable.

In an effort to advance range-wide WCT conservation efforts in Montana a Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana was developed in 1999 by several federal and state resource agencies (including the BLM, Montana Fish, Wildlife & Parks [FWP], the USFS, and Yellowstone National Park [YNP]), non-governmental conservation and industry organizations, tribes, resource users, and private landowners (FWP 1999: MOU). The MOU outlined goals and objectives for WCT conservation in the Montana, which if met, would significantly reduce the need for special status designations and listing of WCT under the ESA. The MOU was revised and endorsed by signatories in 2007 (FWP 2007). As outlined in these MOU's, the primary management goal for WCT in Montana is to ensure the long-term self-sustaining persistence of the subspecies in its historical range. This goal can be achieved by maintaining, protecting, and enhancing all designated WCT “conservation” populations, and by reintroducing WCT to habitats where they have been extirpated.

C. Brief Project Description:

This proposal is part of ongoing efforts throughout Montana to restore WCT to historically occupied habitats. We propose construction of a concrete fish barrier, removal of non-native trout, and re-colonization of resulting fishless habitat with locally obtained native WCT (e.g. Wildhorse Creek, Bostwick Creek, and Elkhorn Creek [restored habitat]). This project would increase the miles of stream that support WCT in the Gallatin River drainage by over threefold. This Effort would greatly reduce the risk of extinction of WCT in the Gallatin River and its tributaries.

Project Objectives:

The proposed project would restore WCT to 17 miles of high quality stream habitat in four (North Fork, Willow Swamp, Placer, and Camp Creeks) interconnected tributaries and eight acres in two headwater high mountain lakes (Big Brother and Chiquita).

Once all existing fish are removed, FWP proposes to introduce genetically pure WCT from neighboring populations within the Gallatin River basin or nearest neighbor basins. Stream habitat within the proposed project area is capable of sustaining a large population of WCT. The involved parties anticipate the project taking up to seven years – construction of barrier to re-introduction of WCT - depending on environmental factors (weather, high stream flows, etc.). The removal of non-native trout and restocking with genetically pure westslope cutthroat trout would fall under the authority of FWP.

Activities Proposed: A conceptual design has been developed for the proposed fish barrier (Pioneer Technical Services, Bozeman, MT). Site characteristics, specifically an incised channel and construction access make the proposed site a good candidate for a fish barrier. The fish barrier would be constructed of cast in place concrete. Design elements include wing walls and a sloped apron. Water velocities and drop are the key elements to blocking upstream fish passage (see attached technical memo). After construction of the fish barrier, EPA registered piscicides (rotenone or antimycin) will be used to remove non-native trout (Brook, Rainbow, and Brown trouts). Prior to any treatments with piscicides a joint EA – USFS and Montana Fish, Wildlife & Parks - will be developed and the project vetted with the public. An initial scoping letter has been mailed to interested parties.

Methodology:

Fish barriers have been used with great success in Montana to protect existing miles of stream holding WCT. Fish barriers have also been used to expand populations into historically occupied habitat. Fish barriers require locations that have incised channels, bedrock if possible, and some protection from illegal transfers of non-native fish by intentional or unintentional saboteurs. A preliminary design and cost opinion has been completed with funding from Turner Enterprises, Inc. Ideally, construction would proceed in the late summer of 2017. After construction of the fish barrier, piscicide removals of non-native brook trout and hybridized WCT will be completed by FWP and USFS personnel. Re-colonization of fishless habitat will be from nearest neighbor WCT populations obtained from isolets in the Gallatin or Madison Drainage. Non-hybridized WCT will be identified using genetic testing of individual fish (SNPS methodology).

D. Length of stream or size of lake that will be treated: 17 Miles of stream and 9 lake acres

E. Project Budget:

Grant Request (Dollars): \$ \$60,000

Contribution by Applicant (Dollars): \$ **45,000** In-kind \$ **\$68,000**
(The \$68,000 In-Kind services from TEI is for permitting, biologist, and technician salaries for the length of the project)

Contribution from other Sources (Dollars): \$ **194,700** In-kind \$
 (Western Native trout Initiative, Bring Back the Natives, Trout Unlimited, USFS)

Total Project Cost: \$ 239,700

F. Attach itemized (line item) budget – see template

G. Attach specific project plans, detailed sketches, plan views, photographs, maps, evidence of landowner consent, evidence of public support and fish biologist support, and/or other information necessary to evaluate the merits of the project. If project involves water leasing or water salvage complete supplemental questionnaire (fwp.mt.gov/habitat/futurefisheries/supplement2.doc).

H. Attach land management and maintenance plans that will ensure protection of the reclaimed area.

III. PROJECT BENEFITS*

A. What species of fish will benefit from this project?:

Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*)

B. How will the project protect or enhance wild fish habitat?:

This project will have negligible effect on fish habitat. This project will have hugely positive impacts on native WCT in the Gallatin River drainage. Without this project, there is a good chance populations of WCT in the Gallatin basin will go extinct. The genetic legacy of locally adapted WCT in the Gallatin will be lost forever.

C. Will the project improve fish populations and/or fishing? To what extent?:

The project will improve fishing for native WCT in USFS wilderness streams and in two lakes in the Spanish Creek drainage.

D. Will the project increase public fishing opportunity for wild fish and, if so, how?:

No change for wild fish, change in accessibility and opportunity to catch native WCT.

E. The project agreement includes a 20-year maintenance commitment. Please discuss your ability to meet this commitment.

Montana Fish, Wildlife & Parks and Turner Enterprises are committed to protecting and restoring WCT populations. In Turner Enterprises case, the Cherry Creek restoration indicates willingness to work though all obstacles to the benefit of native WCT.

F. What was the cause of habitat degradation in the area of this project and how will the project correct the cause?:

Stocking of non-native Rainbow Trout and Brook Trout starting in the early 1900's

G. What public benefits will be realized from this project?:

For those interested the ability to catch Montana's state fish in its natal habitat. Restoring WCT to NFSC will create a more ecologically complete ecosystem. WCT have different behaviors (feeding, timing of spawning, etc.) than non-native fishes and restoration would mesh well with goals related to wilderness management. Wilderness areas are popular with the public and this project would add to the wilderness public benefit. Prevention of listing under the Endangered Species Act will also lessen impact on anglers, tax base, government regulation, and ability for the State to manage fisheries resources.

H. Will the project interfere with water or property rights of adjacent landowners? (explain):

There are no other private landowners adjacent to the project.

I. Will the project result in the development of commercial recreational use on the site?: (explain):

No

J. Is this project associated with the reclamation of past mining activity?:

No

Each approved project sponsor must enter into a written agreement with the Department specifying terms and duration of the project.

IV. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature: Mark E. Gossler Date: 5-27-16

Sponsor (if applicable): David Moser, MFWP Mac M

***Highlighted boxes will automatically expand.**

**Mail To: Montana Fish, Wildlife & Parks
Habitat Protection Bureau
PO Box 200701
Helena, MT 59620-0701**

**E-mail To: Michelle McGree
mmcgree@mt.gov
(electronic submissions MUST be signed)**

**Incomplete or late applications will be rejected and returned to applicant.
Applications may be rejected if this form is modified.**

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Both tables must be completed or the application will be returned

WORK ITEMS (ITEMIZE BY CATEGORY)	NUMBER OF UNITS	UNIT DESCRIPTION*	COST/UNIT	TOTAL COST	CONTRIBUTIONS			
					FUTURE FISHERIES REQUEST	IN-KIND SERVICES**	IN-KIND CASH	TOTAL
Personnel***								
Survey				\$ -				\$ -
Design/Eng.	1	LS	\$20,000.00	\$ 20,000.00			20,000.00	\$ 20,000.00
Engineering				\$ -				\$ -
Permitting				\$ -				\$ -
Oversight	1	LS	\$25,000.00	\$ 25,000.00			25,000.00	\$ 25,000.00
Construction	1	LS	\$194,700.00	\$ 194,700.00	60,000.00		134,700.00	\$ 194,700.00
			Sub-Total	\$ 239,700.00	\$ 60,000.00	\$ -	\$ 179,700.00	\$ 239,700.00
Travel								
Mileage				\$ -				\$ -
Per diem				\$ -				\$ -
			Sub-Total	\$ -	\$ -	\$ -	\$ -	\$ -
Construction Materials****								
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
			Sub-Total	\$ -	\$ -	\$ -	\$ -	\$ -
Equipment and Labor								
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
			Sub-Total	\$ -	\$ -	\$ -	\$ -	\$ -
Mobilization								
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
			Sub-Total	\$ -	\$ -	\$ -	\$ -	\$ -
TOTALS				\$ 239,700.00	\$ 60,000.00	\$ -	\$ 179,700.00	\$ 239,700.00

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

*Units = feet, hours, inches, etc. Please do not use lump sum.

**Can include in-kind materials. Justification for in-kind labor (e.g. hourly rates used for calculations). Describe here or in text.

Reminder: Government salaries cannot be used as in-kind match

***The Review Panel suggests that design and oversight costs associated with a proposed project not exceed 15% of the total project budget. If design and oversight costs are in excess of 15%, applications must include a minimum of two competitive bids for the cost of undertaking the project

****The Review Panel recommends a maximum fencing cost of \$1.50 per foot

MATCHING CONTRIBUTIONS (do not include requested funds)

CONTRIBUTOR	IN-KIND SERVICE*	IN-KIND CASH	TOTAL	Secured? (Y/N)
Turner Enterprises, Inc.	\$ 68,000.00	\$ 45,000.00	\$ 113,000.00	Y
Bring Back the Natives	\$ -	\$ 80,000.00	\$ 80,000.00	N
United States Forest Service	\$ -	\$ 25,000.00	\$ 25,000.00	N
Trout Unlimeted	\$ -	\$ 5,000.00	\$ 5,000.00	N
Western Native Trout Inititative	\$ -	\$ 16,700.00	\$ 16,700.00	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
TOTALS	\$ 68,000.00	\$ 171,700.00	\$ 239,700.00	

*****Applications may be submitted at anytime, but must be signed and received by the Future Fisheries Program office in Helena before December 1 and June 1 of each year to be considered for the subsequent funding period.*****

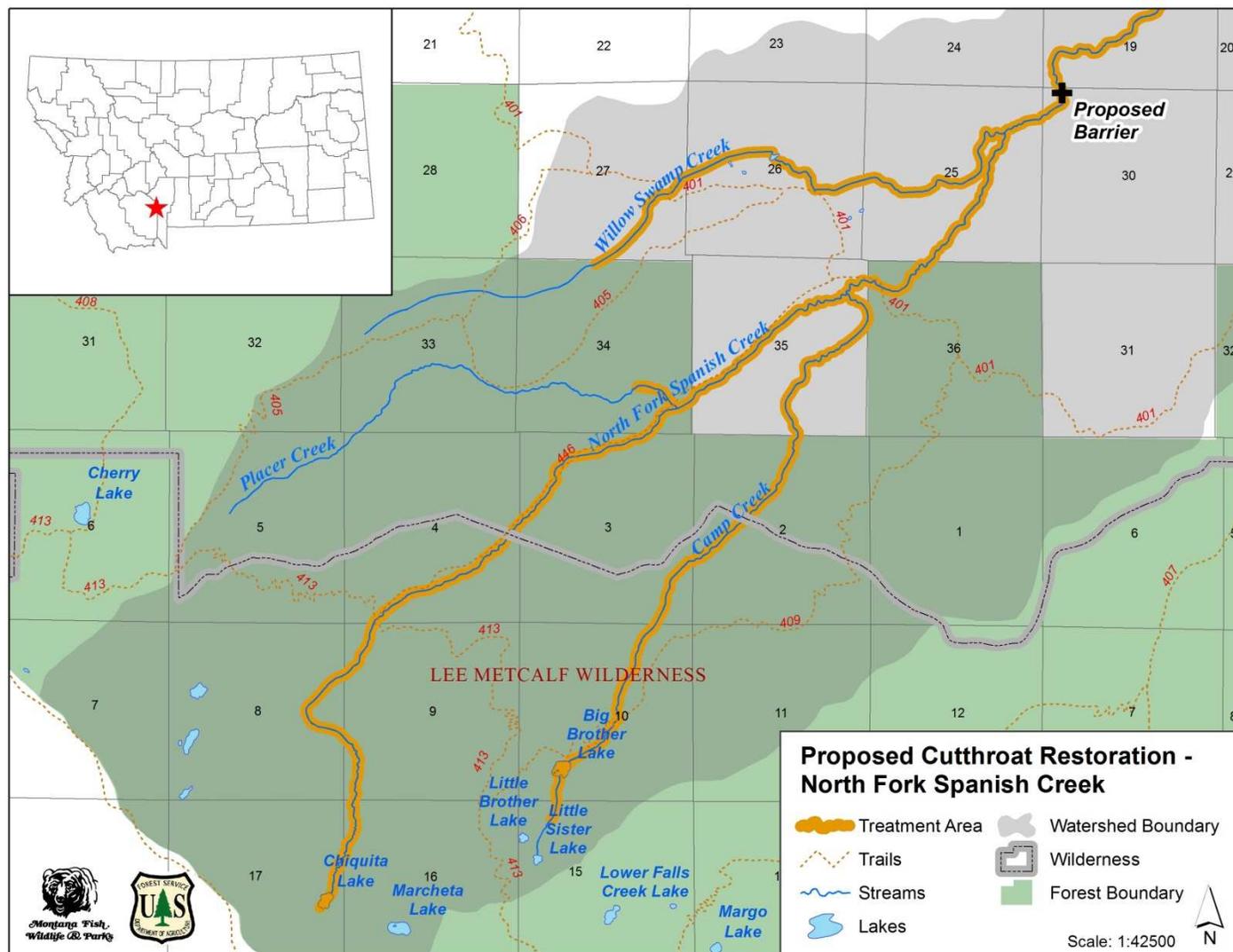


Figure 1. Project area and general location within Montana.



Memo

To: Mr. Carter Kruse, TEI
From: Pioneer Technical Services, Inc.
Date: 1/19/2012
Re: North Fork Spanish Creek Fish Barrier Site Evaluation

Objective

As part of the native cutthroat trout restoration efforts, a fish barrier on the North Fork, Spanish Creek in Gallatin County, Montana, is being considered by Turner Enterprises Inc (TEI). The barrier would serve to create a permanent barrier to upstream fish travel. As a preliminary step in the project, a field reconnaissance was conducted to evaluate the potential barrier site and collect data to develop a conceptual/preliminary site feasibility estimate. This memorandum documents the field reconnaissance activities and presents the site data, preliminary calculations and a site feasibility discussion.

The fish barrier design concept used in this analysis is based on NOAA Fisheries guidelines and are summarized here:

- Minimum weir height relative to the maximum apron height equals 3.5 ft;
- Minimum downstream apron length shall be 16 feet;
- Minimum downstream apron slope shall be 16H:1V; and
- The downstream apron crest elevation is elevated above the downstream design water surface elevation.

Field Reconnaissance

A field reconnaissance was conducted on October 13, 2011, by George Austiguy (Pioneer Technical Services, Inc.) and Even Faulk (TEI). The reach evaluated included approximately 200 lineal feet of the North Fork Spanish Creek (NFSC), located at approximately 4.5 miles upstream from the confluence with South Fork Spanish Creek, (SW 1\4, Sec. 19, T4S, R 3E see Figure 1).

Hydrology

As part of the investigation and analysis, flood frequency estimates were conducted for NFSC using the USGS Regression methods for un-gaged watersheds. Figure 1 shows the watershed area and basin characteristic parameter values. The results of the flood frequency analysis are summarized in the following table. Detailed calculation results are provided in Attachment A.

Recurrence Interval (yrs)	NFSC Flow at Project Site (cfs)
2	157
5	285
10	370
25	466
50	528
100	587
500	782

The fish barrier structures were evaluated to exclude fish up to the 50-year event (Q = 528 cfs).

Site Description, Data Collection and Conceptual Design

The stream reach in the study area is predominantly a boulder-cobble, with some bedrock, step-pool system with an inset channel and low flood plain bounded on both sides by terrace landforms. Large woody debris is present in the stream corridor. Photos 1 thru 4 show the site characteristics.

A coarse, cross-section survey of the site was conducted using tape measures and a survey level. Elevations are based on an arbitrary local datum. This data should be considered as an approximation of the site ground surface and is not a substitute for a detailed site survey, which should be done prior to conducting detailed design work. Three cross-sections were measured. One cross-section was located at the proposed barrier location, one section was located approximately 48 feet upstream of the proposed barrier site and one section was located approximately 66 feet downstream of the proposed barrier section. Based on the assumption that a barrier would be designed to deny fish up to a flow event with a 50- year recurrence interval, a preliminary barrier design section is plotted on Figure 2. The design concept is to construct a concrete weir across the channel. The weir height will be 5.5 feet higher than the downstream water surface elevation during the 50-year flow. Figure 3 shows a preliminary/conceptual profile the barrier design for Site 1. The design is based on NOAA guidelines and an estimate of the 50-year downstream water surface elevation at the site. The 50 year water surface elevation estimate was calculated using a simple HECRAS model based on the 3 cross-sections. A more accurate (i.e based on a detailed topographic\bathymetric survey) gradually-varied flow model should be used to calculate design water surface elevations during detailed design. Calculation summaries are provided in Attachment A.

Discussion

The NFSC site is a feasible location for a fish barrier. The structure at this location would be a moderately large structure with a span of approximately 85 feet and a height of approximately 13 feet above the existing channel invert elevation. Based on surficial observations, the subsurface conditions are expected to be a composite of large boulders, cobble\gravel infill and potentially some bedrock. This combination of large boulders, cobbles, gravels and bedrock could potentially make the subgrade preparation more difficult when compared with a uniform sand and gravel alluvium subgrade or a site with competent bedrock.

During construction, the stream flow would need to be diverted around the work area. Re-routing the channel along the north terrace would likely be the most feasible diversion plan as the north terrace is lower than the south terrace.

The general site location is easily accessible via the existing, NFSC gravel road. Getting down to the barrier construction area, from the road will require temporary access improvements. Based on site observations accessing the barrier construction area may be more feasible from the upstream reach where the river corridor has a wider flood plain (See Photo 5). The road directly above the proposed barrier site is confined between a bedrock outcrop and the river, therefore a staging area will need to be located either upstream or downstream of the barrier location. Table 1 summarizes the site characteristics.

Site observations indicate woody debris is a consistent component of the stream channel morphology. Therefore some annual maintenance should be anticipated to remove any accumulated woody debris from the structure.

Cost Opinion

An order of magnitude cost opinion was developed for each site evaluated. The construction cost estimates are based on a time and materials basis and incorporate unit costs from previously constructed barriers. A more accurate construction cost opinion, based on a detailed design should be conducted to develop a project budget. Table 2 presents the cost opinion.

PHOTOS

Anaconda

307 E. Park St., Suite 421
Anaconda, MT 59711
Phone 406 563-9371
Fax 406 563-9372

Butte

63 ½ W. Broadway St.
Butte, MT 59701
Phone 406 782-5177
Fax: 406 782-5866

Billings

1925 Grand Ave., Suite 100
Billings, MT 59102
Phone 406 545-4805
Fax 406 545-4658

Helena

201 E. Broadway St., Suite C
Helena, MT 59601
Phone 406 457-8252
Fax 406 442-1158

Missoula

820 E. Broadway St.
Missoula, MT 59802
Phone 406-203-0704
Fax 406 203-0691



Photo 1: Proposed Site Looking Down From Road (South Side)



Photo 2: Looking Downstream from Proposed Site



Photo 3: Looking Upstream from Proposed Site

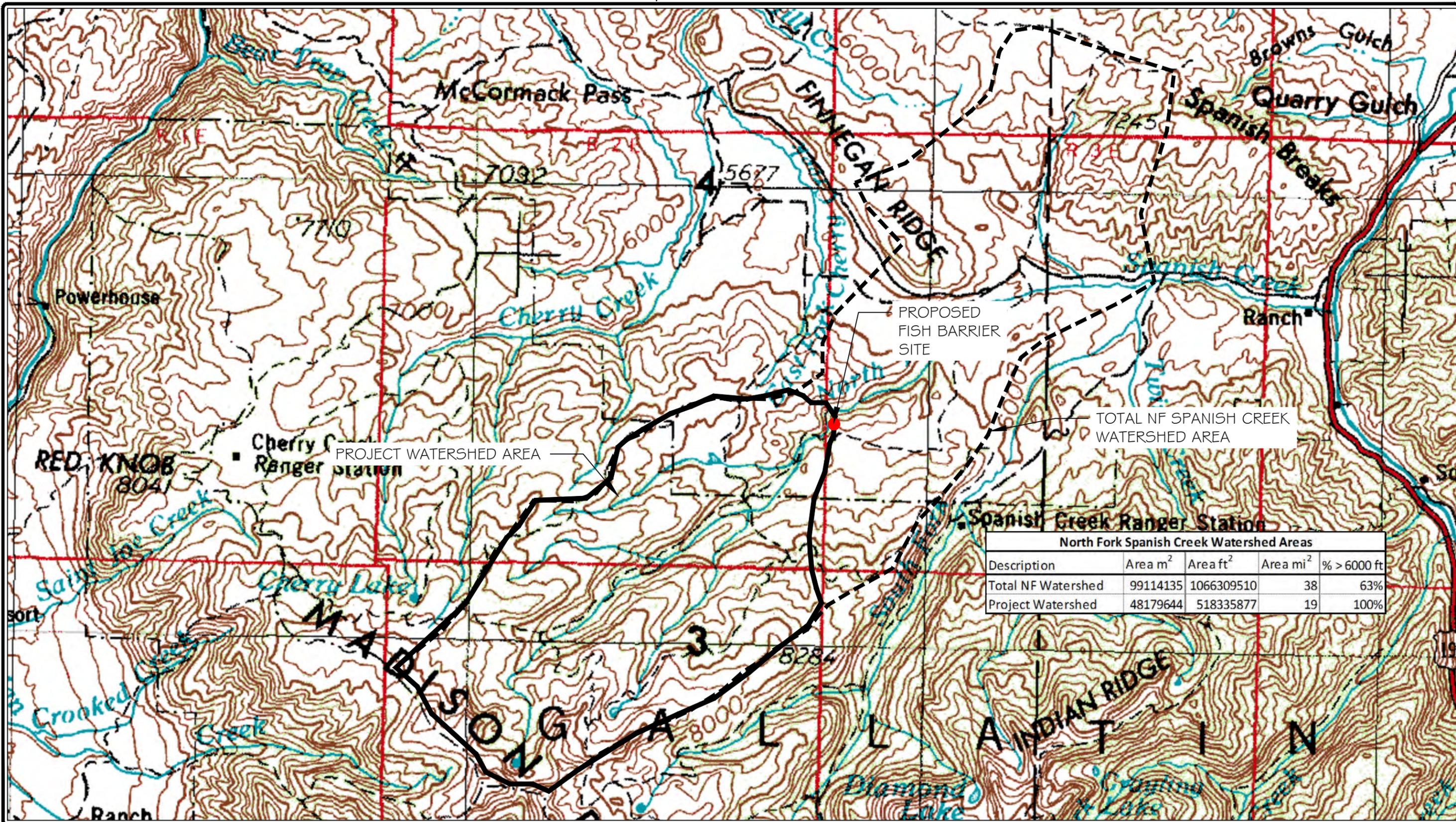


Photo 4: Proposed Site Looking Downstream



Photo 5: Upstream Potential Construction Access to Project Site.

FIGURES



North Fork Spanish Creek Watershed Areas				
Description	Area m ²	Area ft ²	Area mi ²	% > 6000 ft
Total NF Watershed	99114135	1066309510	38	63%
Project Watershed	48179644	518335877	19	100%

DISPLAYED AS:
 COORD SYS/ZONE: Montana State Plane
 DATUM: NAD83
 UNITS: Meters
 SOURCE: NRIS

SCALE IN FEET

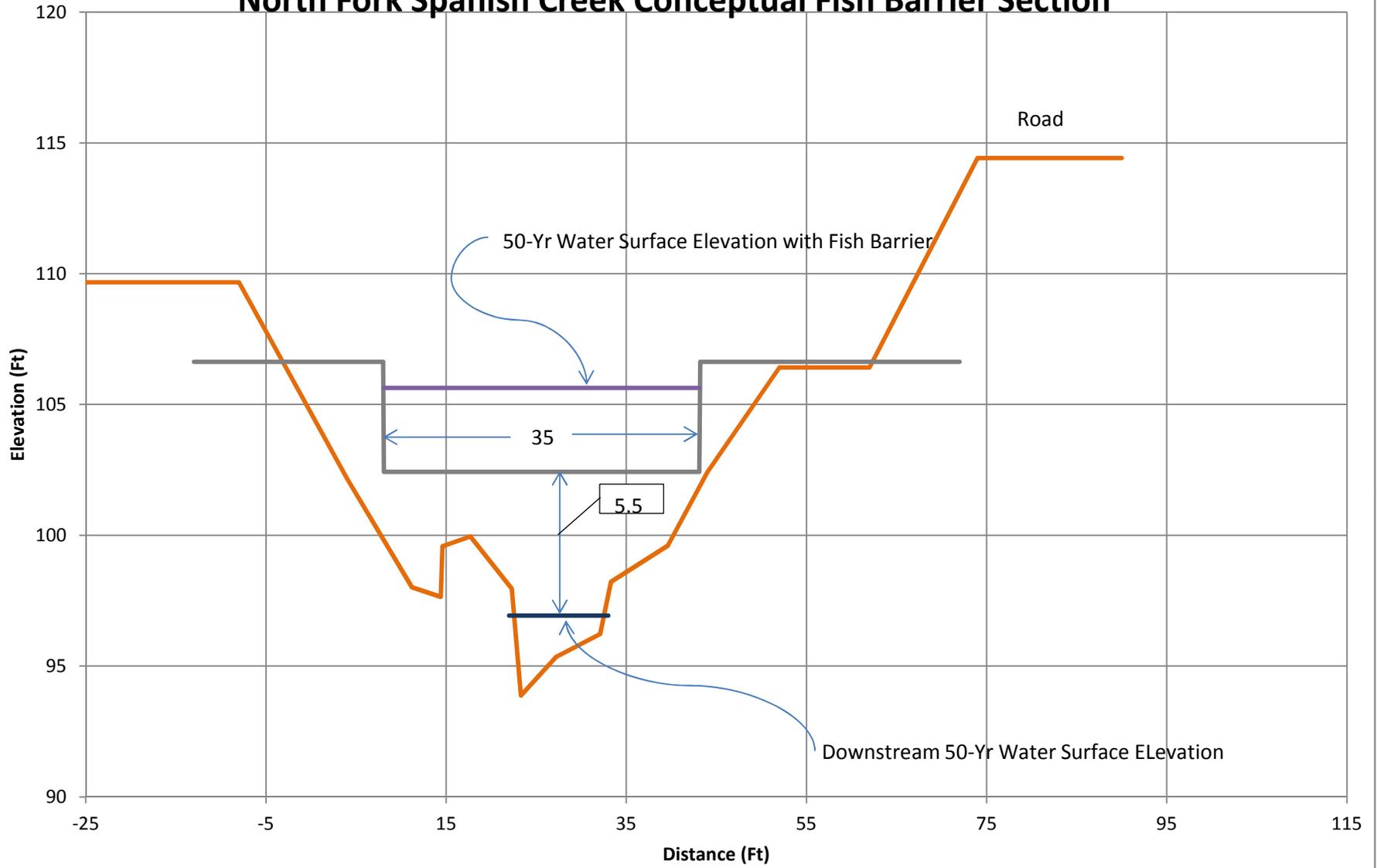
0 1000 2000

FIGURE 1
 North Fork Spanish Creek
 Proposed Fish Barrier
 Watershed Area
 Gallatin County, MT

PIONEER
 TECHNICAL SERVICES, INC.
 63-1/2 WEST BROADWAY
 BUTTE, MONTANA 59701
 (406) 782-5177

DATE: 12-09-2011

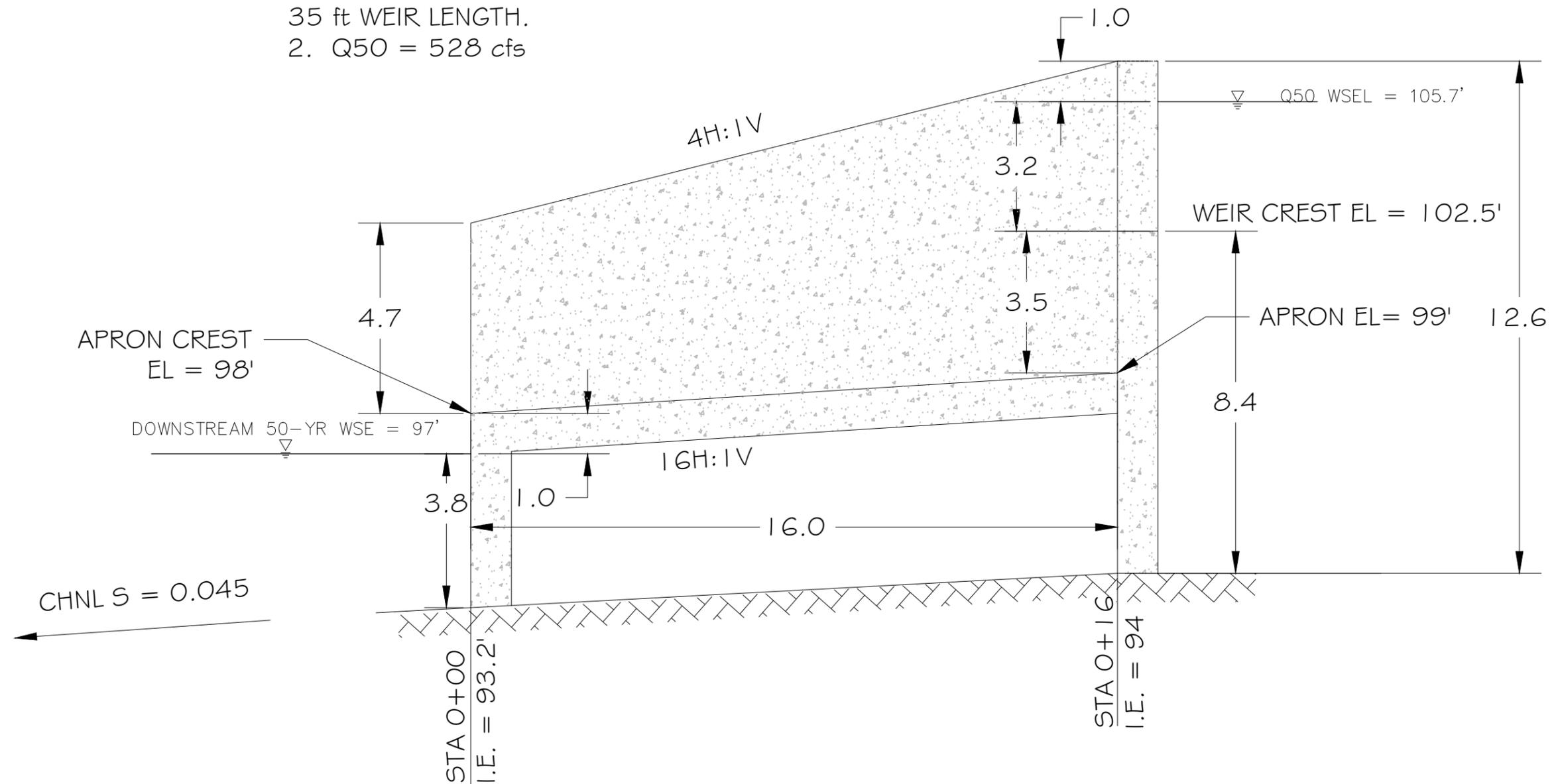
Figure 2 North Fork Spanish Creek Conceptual Fish Barrier Section



Existing X Section FB Existing 50 Yr WSEL Prop 50 Yr WSEL

NORTH FORK SPANISH CREEK CONCEPTUAL FISH BARRIER PROFILE

- NOTES:
 1. Q50 WSEL BASED ON
 35 ft WEIR LENGTH.
 2. Q50 = 528 cfs



DISPLAYED AS:
 COORD SYS/ZONE: Local
 DATUM: Local
 UNITS: Ft
 SOURCE: PTS

SCALE IN FEET
 0 1.5 3

FIGURE 3 North Fork Spanish Creek
 Fish Barrier
 Evaluation
 Conceptual Design

PIONEER
 TECHNICAL SERVICES, INC.
 1215 Apples Way
 Belgrade, Montana 59714
 (406) 388-8578

DATE: 01-01-12

TABLES

Table 1
North Fork Spanish Creek
Site Summary Table

Design Flow	528 cfs	50-year Flow
Approximate Structure Length	85 ft	Includes 10 ft key in on both sides
Approximate Structure Height Above Existing Channel Invert	12.6 ft	
Cast in Place Concrete Volume	152 cy	
Lateral Boundary Conditions	South: Terrace\Road Potential Bedrock North: Terrace \Potential Bedrock	
Upstream Boundary Conditions	Channel/Floodplain	
Downstream Boundary Conditions	Channel	
Channel Bed	Large Boulders, Cobbles - Gravels - Potensial bedrock	
Access	Good to the general site, temporary access construction required to access the work area	
Water Management	Flows Can Be Routed Around Site	
Potential Issues	Large Boulders- could be difficult to move	
	Woody Debris - Maintanance Required	

Table 2

Project: NFSC Fish Barrier Feasibility Evaluation

Date: 1/4/2012

Subject: Order of Magnitude Cost Opinion

Site	Desc	Unit	Quantity	Unit Cost	Total Cost	Notes
1	Construction, Includes 10% contingency	LS	1	\$ 194,700	\$ 194,700	Includes all work, materials and expenses for mobilization, water management, structure construction and reclamation. Concrete vol estimate assumes 3' keyin below channel bottom
1	Design	LS	1	\$ 20,000	\$ 20,000	Includes survey, hydraulic analysis, and design
1	Construction Oversight	LS	1	\$ 25,000	\$ 25,000	Includes contractor procurment support, construction management and inspections
	Site Total				\$ 239,700	

ATTACHMENT A

Montana Flood-Frequency and Basin-Characteristic Data

Estimate Flood Discharges at Ungaged Sites in Montana -- (continued)

Summary of Estimation Parameters Selected:

Name for this estimation:	Default
Region:	Upper Yellowstone
Estimation method:	Weighted estimate based on Basin and Climatic Characteristics and Active-channel width
Drainage area in square miles:	19
Percent basin above 6,000 feet:	100
Width of active channel in feet:	17

Flood Discharge Estimation:

(In the Flood Discharge table, RI is the Recurrence Interval, in years; STD ERR is the Standard Error; and 90% PRED. INTERVAL is the 90% Prediction Interval, in cubic feet per second)

METHOD: Regression on basin characteristics

Flood frequency estimates for

Default

Upper Yellowstone-Central Mountain Region: A = 19.00 E6 = 100.

RI	DISCHARGE (cfs)	STD ERR OF PREDICTION(%)	90% PRED. INTERVAL	
2	106.	94.5	28.2	400.
5	189.	72.2	64.4	554.
10	258.	62.8	99.1	673.
25	362.	56.5	150.9	866.
50	448.	55.2	190.1	1050.
100	540.	56.1	226.5	1290.
200	638.	58.7	258.6	1580.
500	782.	64.4	294.3	2080.

METHOD: Regression on active channel width

Flood frequency estimates for

Default

Upper Yellowstone-Central Mountain Region: WAC = 17.00

RI	DISCHARGE (cfs)	STD ERR OF PREDICTION(%)	90% PRED. INTERVAL	
2	183.	70.9	63.2	532.
5	397.	67.1	143.3	1100.
10	596.	68.9	210.5	1690.
25	913.	74.4	301.6	2770.
50	1200.	80.5	369.4	3910.
100	1540.	87.5	436.0	5410.
200	1920.	95.6	499.7	7370.
500	2520.	107.8	580.4	10900.

METHOD: Combined methods 1 and 2

Flood frequency estimates for

Default

Region 7

RI	DISCHARGE (cfs)	STD ERR OF PREDICTION(%)	90% PRED. INTERVAL	
2	157.	66.5	57.6	430.
5	285.	57.1	117.9	689.
10	370.	54.3	159.2	861.
25	466.	53.3	203.4	1070.
50	528.	54.0	227.8	1220.
100	587.	55.8	247.5	1390.
200	646.	58.7	261.8	1590.
500	782.	64.4	294.3	2080.

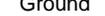
Montana Flood-Frequency and Basin-Characteristic Data

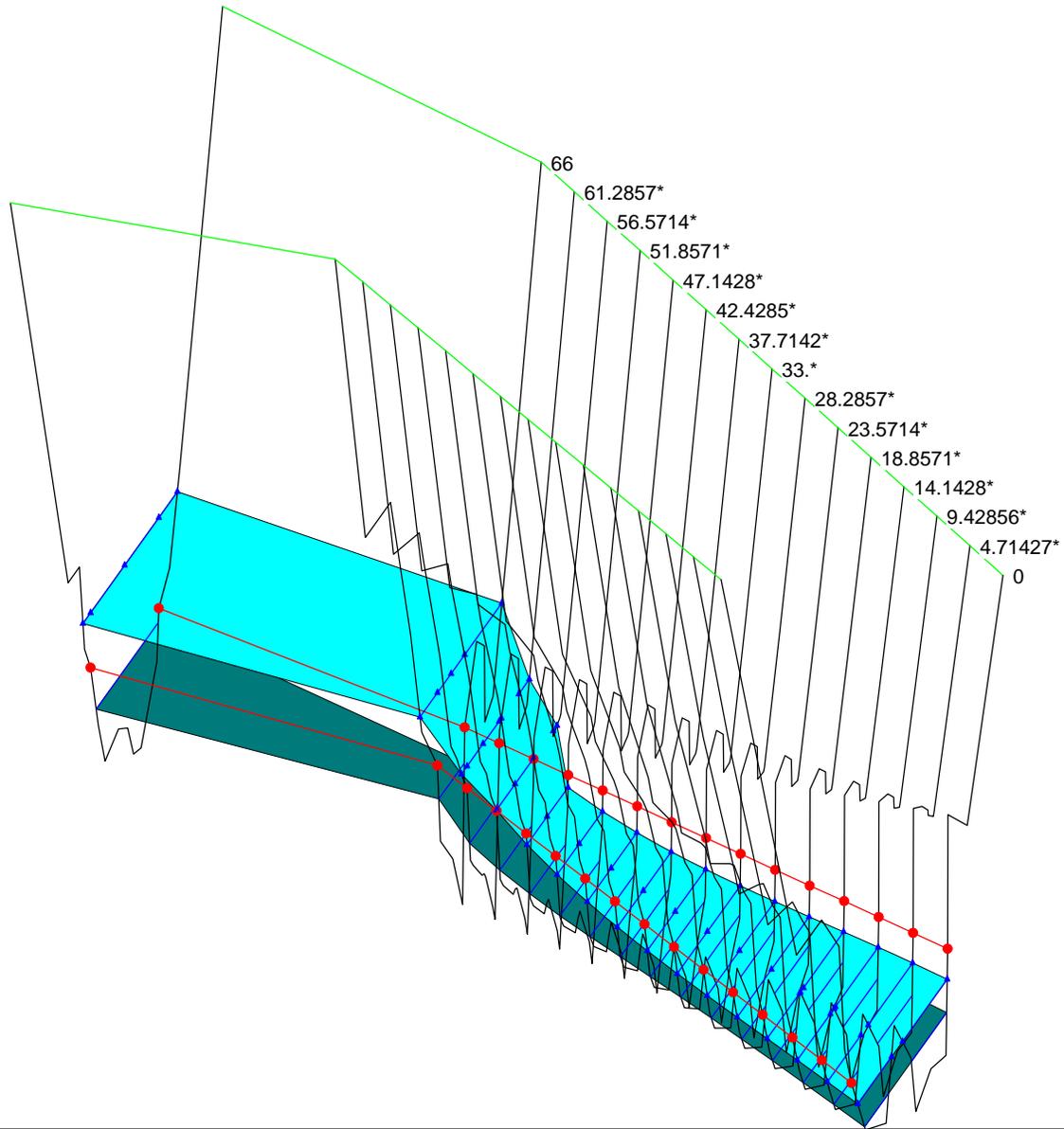
Retrieved on: 2011.12.30 13:42:19

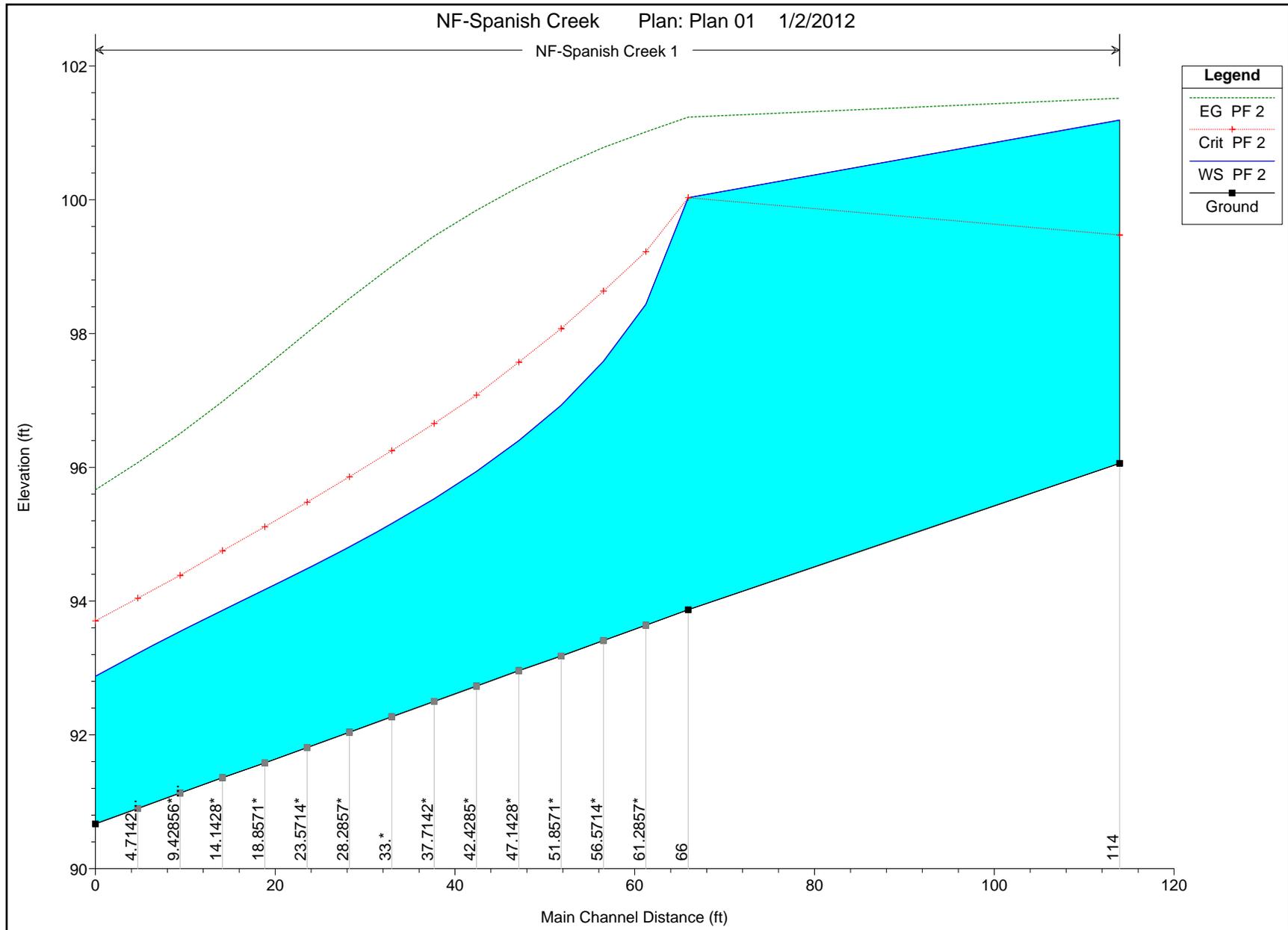
[Department of the Interior, U.S. Geological Survey](#)

[Privacy Statement](#) // [Disclaimer](#) // [Accessibility](#) // [FOIA](#)

NF-Spanish Creek Plan: Plan 01 1/2/2012

Legend	
	WS PF 1
	WS PF 2
	Ground
	Bank Sta
	Ground





HEC-RAS Plan: Plan 01 River: NF-Spanish Creek Reach: 1 Profile: PF 2

Reach	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
1	114	PF 2	528.00	96.06	101.19	99.47	101.52	0.002087	4.68	121.92	37.61	0.41
1	66	PF 2	528.00	93.87	100.03	100.03	101.24	0.010995	9.39	72.15	32.57	0.78
1	61.2857*	PF 2	528.00	93.64	98.44	99.22	101.01	0.030208	13.00	43.23	20.21	1.30
1	56.5714*	PF 2	528.00	93.41	97.59	98.63	100.78	0.045220	14.35	36.90	16.45	1.60
1	51.8571*	PF 2	528.00	93.18	96.93	98.07	100.50	0.057659	15.17	34.80	16.38	1.83
1	47.1428*	PF 2	528.00	92.96	96.40	97.57	100.19	0.068744	15.63	33.78	18.04	2.01
1	42.4285*	PF 2	528.00	92.73	95.94	97.08	99.84	0.078907	15.86	33.30	19.75	2.15
1	37.7142*	PF 2	528.00	92.50	95.53	96.66	99.46	0.087585	15.90	33.20	21.49	2.25
1	33.*	PF 2	528.00	92.27	95.16	96.25	99.01	0.093185	15.74	33.55	23.26	2.31
1	28.2857*	PF 2	528.00	92.04	94.81	95.86	98.52	0.096478	15.46	34.15	25.05	2.33
1	23.5714*	PF 2	528.00	91.81	94.49	95.48	98.01	0.097231	15.07	35.03	26.86	2.33
1	18.8571*	PF 2	528.00	91.58	94.17	95.11	97.49	0.096107	14.63	36.10	28.68	2.30
1	14.1428*	PF 2	528.00	91.36	93.86	94.75	96.98	0.092907	14.17	37.25	30.19	2.25
1	9.42856*	PF 2	528.00	91.13	93.55	94.39	96.50	0.087375	13.80	38.25	30.73	2.18
1	4.71427*	PF 2	528.00	90.90	93.22	94.04	96.07	0.083704	13.55	38.97	31.10	2.13
1	0	PF 2	528.00	90.67	92.88	93.71	95.66	0.081449	13.40	39.41	31.25	2.10

Project: NF Spanish Creek
Weir Hydraulic Calculations

Cd, Weir Coeff = 2.7
 Discharge Eqn $Q = C_d w h^{3/2}$

STAGE	Elevation	Width	Q (cfs)
0	102.5	35	0
0.1	102.6	35	2.988
0.2	102.7	35	8.452
0.3	102.8	35	15.528
0.4	102.9	35	23.907
0.5	103	35	33.411
0.6	103.1	35	43.920
0.7	103.2	35	55.345
0.8	103.3	35	67.619
0.9	103.4	35	80.686
1	103.5	35	94.500
1.1	103.6	35	109.024
1.2	103.7	35	124.223
1.3	103.8	35	140.071
1.4	103.9	35	156.539
1.5	104	35	173.608
1.6	104.1	35	191.255
1.7	104.2	35	209.462
1.8	104.3	35	228.213
1.9	104.4	35	247.493
2	104.5	35	267.286
2.1	104.6	35	287.581
2.2	104.7	35	308.366
2.3	104.8	35	329.628
2.4	104.9	35	351.357
2.5	105	35	373.544
2.6	105.1	35	396.179
2.7	105.2	35	419.254
2.8	105.3	35	442.760
2.9	105.4	35	466.690
3	105.5	35	491.036
3.1	105.6	35	515.792
3.2	105.7	35	540.950
3.3	105.8	35	566.504
3.4	105.9	35	592.448
3.5	106	35	618.777

