APPENDIX E.3.3

SIDE CHANNEL ENHANCEMENT INVESTIGATION

ENVIRON

MEMORANDUM

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To: **Jeremy Pratt**

CC: **Jean Baldrige and Woody Trihey – ENTRIX**
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From: Greg Reub – ENVIRON

Date: **7-8-08**

Re: Enloe Hydroelectric Project – Review Draft – Side Channel Enhancement Investigation

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This technical memo provides an overview of the background, methods, results and conclusions from an investigation concerning the development of a side channel enhancement project in the Similkameen or Okanogan Rivers. The objective of this effort is to advance the existing understanding of channel enhancement feasibility and conceptual design.

BACKGROUND

A side channel enhancement project was proposed in the Enloe Draft Hydroelectric License Application (DLA) (Okanogan County PUD 2007) as a prevention, mitigation and enhancement (PM&E) measure to mitigate for potential impacts from the Project on aquatic resources. Several comments were provided on the DLA regarding this proposal with a request to provide more information on the feasibility and design of the enhancement measure.

In summary, the side channel enhancement proposal in the DLA involved using an unidentified existing or abandoned side channel to improve habitat for salmonid species. Elevated summer temperature is probably the greatest limiting factor for salmonids in the system thus limiting the amount of rearing habitat to a very small area. The side cannel enhancement project would be designed to address these limiting factors by providing cool water suitable for rearing salmonids. Cool water would be obtained from a shallow well and plumbed through perforated pipe buried in gravel substrate (manifold system). Water would be pumped through the PVC pipe during critical warm water periods thus providing upwelling of the cooler water. A “low-technology” structure (e.g., boulders or log(s) would be anchored at the head of the channel to allow water to enter the side channel during all flow conditions (low flow channel) while deflecting the larger flood flows back into the main channel

METHODS

The methods involved in the examination the channel enhancement involved four basic steps including: 1.) development of criteria for site selection, 2.) selection of potential

sites, 3.) a field visit to each of the sites with a team of professionals to collect information in a standard manner across the sites and 4. evaluation and summary of information.

The professionals involved in method development and site evaluation included:

John Arterburn – Anadromous Fish Biologist – Colville Tribes
Keith Kistler – Biologist – Restoration Specialist – Colville Tribes
Greg Reub – Fisheries Biologist – ENVIRON
Woody Trihey – Restoration Engineer – ENTRIX
Dan Boettger – Director Regulatory and Environmental Affairs – Okanogan County PUD
Nick Christoph – Biologist – Okanogan County PUD

Development of criteria for site evaluation

Initial site evaluation parameters were developed and sent to the participating professionals for comment and discussion at a meeting prior to the field visit. These parameters were discussed prior to examination of the potential enhancement sites and certain parameters were added and others combined. The following were the initial parameters that were thought to be important in the evaluation.

- Potential to affect existing habitat
- Channel geomorphology
- Channel length and width
- Head of channel relative to high/low flow conditions
- Potential for use by fish species and life stages
- Channel connection to main stem
- Availability of surface and ground water (e.g. wells nearby)
- Accessibility, ownership, etc.
- Distance to electricity
- Security
- Streambed materials that could affect manifold system

These parameters were then condensed (combined) and used as criteria to evaluate the potential of a site to accommodate a channel enhancement project. The criteria provided a standard evaluation across all sites and assessment of those sites relative to each other. The criteria were useful in a preliminary or fatal-flaw level evaluation. The criteria and evaluation were provided to advance our understanding of the potential feasibility and possible conceptual designs for a channel enhancement project.

Criteria

<u>Potential to Adversely Affect Existing Habitat</u>**:** This criterion was considered the most critical. If there was a moderate to high likelihood of a site to adversely affect existing habitat, it was not considered in the initial site selection for a field visit. Therefore this criterion evaluated potential to affect existing habitat within sites that were already screened as “not likely to significantly affect”. There is limited functional (and marginally functional) salmonid habitat in the Similkameen or Okanogan Rivers. Any project that has the potential to significantly and negatively affect such habitat should not be considered. On the contrary, only those sites that could provide complimentary and

beneficial contribution in relation to existing habitat were considered, such as expanding rearing habitat availability in areas where spawning habitat is currently abundant.

Channel Geomorphology: This criterion included the potential to use a site based on the channel shape (width or length), geomorphology (substrate, gradient, etc.), and ability to retain water and appropriate substrate. This affects the practicability of creating and maintaining a project and was a measure of potential success from a functional perspective. A site should have an apparent close connection with ground water levels and the ability to maintain substrate suitable for spawning, rearing and invertebrate production (i.e. gravel).

Channel Protection: This criterion included the ability to protect the site in relation to local and seasonal hydrology and hydraulics, especially high flow. This included either the position of the head of the channel in relation to the mainstem and/or the ability to place a low technology structure at the head of the channel to keep out high flows from flooding and damaging the site.

Water Availability: This criterion included the practicability of obtaining cooler ground water for use in the cannel. If the channel is large, and would potentially require some surface water to provide good results, the criteria would include accessibility to surface water also.

Other Considerations: This criterion was a "catch all category". If there was a consideration that could affect the use of a potential site not described above, it is reflected in this criterion and explained in the score. The considerations included potential use by fish and life stages, predation and other mortality concerns, accessibility and ownership, distance to facilities like electricity and security.

Selection of potential sites

Site selection was primarily provided by John Arterburn of the Colville Confederated Tribes (CCT). John is extremely familiar with the Similkameen and Okanogan Rivers and habitat parameters that are important to salmonids in the river basin. John provided an initial list, prior to going into the field. The objective of the site selection was two-fold. First, the sites should have some potential to provide enhanced habitat for anadromous salmonids. Second, we wanted a good cross-section of challenges and conditions that would actually be presented in a real channel enhancement project for the parameters we listed as being important (e.g. channel size, location, availability of water, etc.). Aerial photographs of the initial areas were produced for field reference and to look for other potential sites. A pre-field meeting was held to discuss other potential sites and discuss how the parameters and criteria discussed above were used to select the sites. The original site list was slightly modified after discussion.

Field visit and information collection

Each site was visited in the field on April 1, 2008. The team first went to a channel that was considered one of the better channels for spawning and rearing habitat for anadromous salmonids in the systems. This helped "calibrate" the teams' judgment of the parameters at the other sites. Each candidate site was walked for its entire length and the parameters discussed in terms of what was feasible from constructability, maintenance, and a spawning and/or rearing habitat perspective. Information was collected in a standard manner across the sites and recorded in a notebook. Photographs were taken at various locations along the channel.

Evaluation and summarization of the information.
A matrix was developed utilizing the criteria developed for site evaluation. We evaluated each site and a score from 1-5 was given was given to each category with a 1 being poor and 5 being excellent. The reason for assigning scores for each site was to establish a priority between the sites and the rational for these scores is explained in the site description results. The draft memo was sent to each of the team members for review and adjustment of the scores. Results and conclusions were then provided in this memorandum.

RESULTS

Six sites were selected, visited in the field and evaluated in this memorandum. The site location data are provided in Table 1.

Table 1. Site location information.

SITE	LAT DD	LONG DD	LATITUDE	LONGITUDE
Site 1	48.92168641050	-119.44019889100	48° 55' 18.071" N	119° 26' 24.716" W
Site 2	48.92120649820	-119.43958738600	48° 55' 16.343" N	119° 26' 22.515" W
Site 3	48.91742610040	-119.42352947100	48° 55' 02.743" N	119° 25' 24.706" W
Site 4	48.89314809340	-119.43207040200	48° 53' 35.333" N	119° 25' 55.453" W
Site 5	48.43108666650	-119.47042304100	48° 25' 51.912" N	119° 28' 13.523" W
Site 6	48.49328508060	-119.48421298100	48° 29' 35.826" N	119° 29' 03.167" W

Site Descriptions and Results
Each site is described in the following subsections, beginning with the example reference site. The survey was done on April 1, 2008 and represents a low flow condition in the sites. A table of all scores for each site and criteria is provide below along with a detail explanation of how these numeric scores were determined (Table 2).

Reference Site

The reference site was visited to provide an example of good quality rearing and spawning habitat. The rearing habitat was representative for both steelhead trout and Chinook salmon. The spawning habitat was more representative of and used by steelhead adults. The quality consideration was based on many years of observation by CCT biologists (Arterburn et al. 2007). Three photos of the reference site are provided in Figure 1. All of the Figures are provided as Attachment A to this memorandum. The three reference site photos were arranged from the upstream portion of the site to the downstream portion of the site. The site is a side channel of the Similkameen River and at the time of the survey was receiving a small portion of the flow from the main stem Similkameen (e.g. < 5 percent).

The upper and middle sections of the reference site illustrated good rearing habitat as indicated by diverse geomorphology, deeper pools and large woody debris (LWD) on and near the bank of the channel. Although this was a relatively large side channel, the entrance of the side channel was oriented away from the main stem flow and appeared to be stable. The entrance appeared to provide good protection from high flows. Gravel substrate separating the pools were likely good production areas of aquatic invertebrates and the bank vegetation likely contributes terrestrial invertebrates to the site. The lower section of the reach was excellent steelhead spawning habitat as illustrated by the large amounts of appropriately sized spawning gravels. Flows during steelhead spawning are at least six inches to a foot deeper than shown in the photographs, covering much of the

gravel present. An important aspect of this site was that it appears to be a stream reach that gains water with distance downstream (a gaining reach). During the site visit, it was obvious that there was more water leaving the site than entering the site. This was due to water flowing under the streambed at the top of the site becoming surface water as it traveled downstream. Since water temperature is known to be a major limiting factor in salmon and steelhead production, the cooler subsurface water entering the surface environment is important. Because the water entering the site is from below the streambed, it is cooler and an important factor in quality rearing habitat, especially during hot summer days.

Table 2. Scores for each of the six sites corresponding to each of the five general criteria.

	Criteria / Scores*					
Potential Channel Enhancement Site	**Potential to Affect Existing Habitat**	**Channel Geomorphology**	**Channel Protection**	**Water Availability**	**Other Considerations:**	**Total Score**
Site 1	3	5	4	4	4	20
Site 2	3	4	5	4	4	20
Site 3	4	2	1	3	2	12
Site4	4	2	4	2	2	14
Site 5	5	3	4	5	1	18
Site 6	2	3	3	3	4	15

***Scores are assigned between 1 and 5 with 1 describing a poor score corresponding to the criteria and 5 being a good or desirable score for accommodating a channel enhancement project. These scores are meant to be relative in nature and are not intended to reflect enhancement opportunities on any scale other than that described in this memo.**

Site 1

Site 1 was in the Similkameen River as shown in Figure 2 and described in Table 1. The channel was approximately 250 to 300 feet in length and probably averaged 20 to 30 feet in width (Figure 3). The site scored moderate for potential to affect existing habitat because it was close to the reference site described above (Table 2). The site scored relatively high in the other categories. It seemed evident that the channel occasionally carried water during high flow events but was generally protected from direct and damaging flows of the mainstem. Water was present in the head of the channel and shallow ground water or surface water is likely easy to get to the site. Substrates were generally sand and silt/organics with areas of gravel, although it appeared gravel was present below the finer substrates in much of the site. Other considerations included easy access to the main channel by fish and proximity to spawning habitat. This site received the highest score (along with site 2) with 20 points.

Site 2

Site 2 was in the Similkameen River as shown in Figure 2 and described in Table 1. The channel was over 600 feet in length and probably averaged 10 to 20 feet in width (Figure 4). This site scored medium for potential to affect existing habitat, like site 1, because it was close to the reference site described above (Table 2). The site scored relatively high in the other categories. The channel only carries water during discharges above 1,000 CFS on the Similkameen River. A concern included the need to design the channel so that fish would not become entrapped in the channel during low flow, due to the flat gradient and long length of the channel. It was well protected from direct and damaging flows of the mainstem. Water was generally not present in the channel, although shallow ground water or surface water is likely easy to get to the site. Substrates were sand and silt/organics with few areas of gravel, and it appeared gravel was present a foot or two below the finer substrates in some of the site. Other considerations included easy access to the main channel by fish and proximity to spawning habitat. This site received the highest score (along with site 1) with 20 points.

Site 3

Site 3 was in the Okanogan River as shown in Figure 5 and described in Table 1. It is located just downstream at a cross channel that connects the Similkameen and Okanogan Rivers. The channel was about 700 to 800 feet in length and probably averaged 60 to 80 feet in width (Figure 6). The surrounding area and much of this site is heavily used for steelhead spawning. Since the amount of spawning habitat in the site is relatively abundant, a high score for potential to affect existing habitat was given.. It would be beneficial in providing rearing habitat in an area heavily utilized by spawning steelhead. The site scored relatively low in the other categories, except water availability because there are known wells nearby. The channel probably carries a large volume of water during high flow events. There are existing plans to modify a cross channel area just upstream of the site to insure water is delivered into the Okanogan during moderate flows instead of being diverted into the Similkameen. Although shallow ground water is likely available, a significant concern included maintaining a smaller channel that would confine the relatively small amount of water that would be available to affect the high temperatures in summer. The head of the channel would be difficult to protect from direct and damaging high flows from the mainstem. Substrates were dominated by gravel with some cobble and silt/organics. Other considerations included easy access to the main channel by fish and proximity to spawning habitat. The site would likely score higher if it could be combined with other partners/projects and resources on a larger scale restoration. This site received the lowest score with 12 points, mostly related to potential problems in maintaining an enhanced, smaller channel within the site as envisioned in this effort.

Site 4

Site 4 was an abandoned oxbow of the Okanogan River as shown in Figure 7 and described in Table 1. It was located between the Similkameen and Okanogan Rivers but connected to the Okanogan River. The channel was just less than about 2,000 feet in length and probably averaged around 100 feet in width (Figure 8). The area was not in proximity of any known high value habitat and scored a 5 (Table 2). The site scored relatively low in the other categories except channel protection. Since the site is off of the mainstem and the head of the channel was well above the water level during normal flows, channel protection scored a 4. The channel may carry some amount of water during high flow events and the downstream end of the channel was inundated (backwater) during the low flow period when it was observed. Although shallow ground water is likely available, providing mainstem flows in the upstream end could be challenging. The head of the channel would be protected from direct and damaging flows of the mainstem. Much of the channel was vegetated with grass and shrubs and substrates were dominated by silt and organics. Other considerations included easy access to the main channel by fish and proximity to spawning habitat. This site received a relatively low score of 14 points, mostly related to two potential issues. First, maintaining an enhanced, smaller channel within this large channel area, especially with the potential of a larger amount of existing water to warm the habitat, could be difficult. Second, the existing warm water habitats in the lower portion of the channel would likely support substantial predator populations that have the potential to negate salmonid production increases.

Site 5

Site 5 was next to the Okanogan River as shown in Figure 9 and described in Table 1. The channel was around 1,900 feet in length and although the channel was not well defined in the upstream end of the site it probably averaged 5-10 feet in width toward the downstream end where it emptied into the Okanogan River (Figure 10). It is not a side channel but a small drainage located on a cultivated field with water originating from a spring. The water originated from a spring across the road from the buildings seen in Figures 9 and 10. The upper part of the site had little open water but about 1/2 way downstream surface water was observed and it was obviously running near the downstream end where it connected with the Okanogan River. This site scored a 4 (high) for potential to affect existing habitat because, although there is existing habitat nearby in the Okanogan, the potential to affect it would be unlikely (Table 2). The site scored moderate to high in the other categories. The entire channel probably runs with water during rains, only, but there is a well nearby that was thought to have a relatively high production capacity. The channel design would likely include a small deep channel that would function much like a meadow stream. It would depend on spring and ground water and would not require water from the Okanogan mainstem. It was obviously well protected from direct and damaging flows of the mainstem. Substrates were silt and organics typical of a wetland. Other considerations included complicating factors resulting from a culvert going under the railroad with a substantial gradient between the railroad grade and the Okanogan River that is now represented by a perched culvert. This site received the second highest score with 18 points.

Site 6

Site 6 was located within a side channel – gravel bar in the Okanogan River. Enhancement measures would also include some channel modification in Wanucut Creek as shown in Figure 11 and described in Table 1. The channel where enhancement could take place was around 400 to 500 feet in length. The Wanucut Creek channel was dry at the time of the visit but appeared to be about 10 feet wide and potentially located in more

than one channel during higher flows. The water from the creek could run into a small constructed channel along the river margin in the side channel and would be protected from mainstem high flows. It would then empty into a larger portion of the side channel that probably always has some water and connection to the mainstem and was wetted during the field visit (Figure 12). The enhanced channel would therefore be constructed from the confluence on Wanucut Creek, downstream about 500 feet to the wetted channel. The site scored low for potential to affect existing habitat because there are potential spawning sites for lamprey in the area (Table 2). The site scored moderate to low in the other categories. Water availability from a groundwater perspective could be complicated due to a sizable housing development that is up gradient with well(s) that may affect the surface water in the area to date. There was a wetland just upstream of Wanucut Creek that had flowing water and had some potential for enhancing the project. Ability to protect the creek portion would be easy but it could be difficult to protect the area in the side channel from flood flows. Substrates in the stream were sand and silt/organics and were generally small and large gravel in the side channel area. Other considerations included easy access to the main channel by fish and proximity to spawning. This site received a relatively low score or 15 points.

CONCLUSIONS

Conclusions as a result of this reconnaissance level survey and the resulting level of specific information are presented in bullets that follow.

- A side channel enhancement project, within the area investigated and using the level of information in the evaluation, was determined to be feasible and would likely result in substantial benefits to anadromous salmonid fish population in the area. Other native species would also likely benefit.

- Considering that the limiting physical habitat parameter for anadromous salmonid populations in the area is most likely water temperature and that habitat to support the rearing lifestage is also limiting, a focus on these two limiting factors would be appropriate in design of a channel enhancement Project.

- Three of the six sites examined appear to have greater potential for channel enhancement success as indicated by the scores related to the criteria that was selected. The three sites with higher scores were Sites 1, 2, and 5.

- It would be most prudent to complete a project on a small scale (i.e. Pilot) project. This could give more flexibility to evaluate and refine the two main aspects including 1.) engineering and hydrology/hydraulic design and 2.) fish use.

- Costs were not directly assessed in this evaluation, although practicality associated with some criteria would include some cost implications (e.g. scale of the project). It would be important to include a cost-benefit assessment in the next level of site feasibility assessment.

REFERENCES

Arterburn, J., K.Kistler, C. Fisher, M. Rayton 2007. Okanogan Basin Spring Spawner Report For 2007. Report# CCT/AF-2007-6. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA.

Okanogan Public Utility District No. 1 (OKPUD). 2007. Enloe Hydroelectric Project Draft License Application FERC Project No. 12569. November.

A) 

C) 

Figure 1. Reference side channel illustrating good rearing habitat in the upstream portion – looking upstream (A), and middle portion of the channel - looking downstream (B), and spawning habitat in the downstream portion of the channel – looking downstream (C).


321300
321400
5421600
5421500
5421400
Site 1
Site 2
9940273384
9940273370
SIMILKAMEEN
RIVER
Flow
RM 4
Enloe Dam
Oroville
Loomis
Tonasket
Okanogan River
97
Okanogan County
Omak
Miles
Enloe Dam Licensing Project
Figure 2
Potential Channel Enhancement
Sites 1 and 2
Potential Enhancement Site
Feet
Meters
EITRIX

A) 

B) 

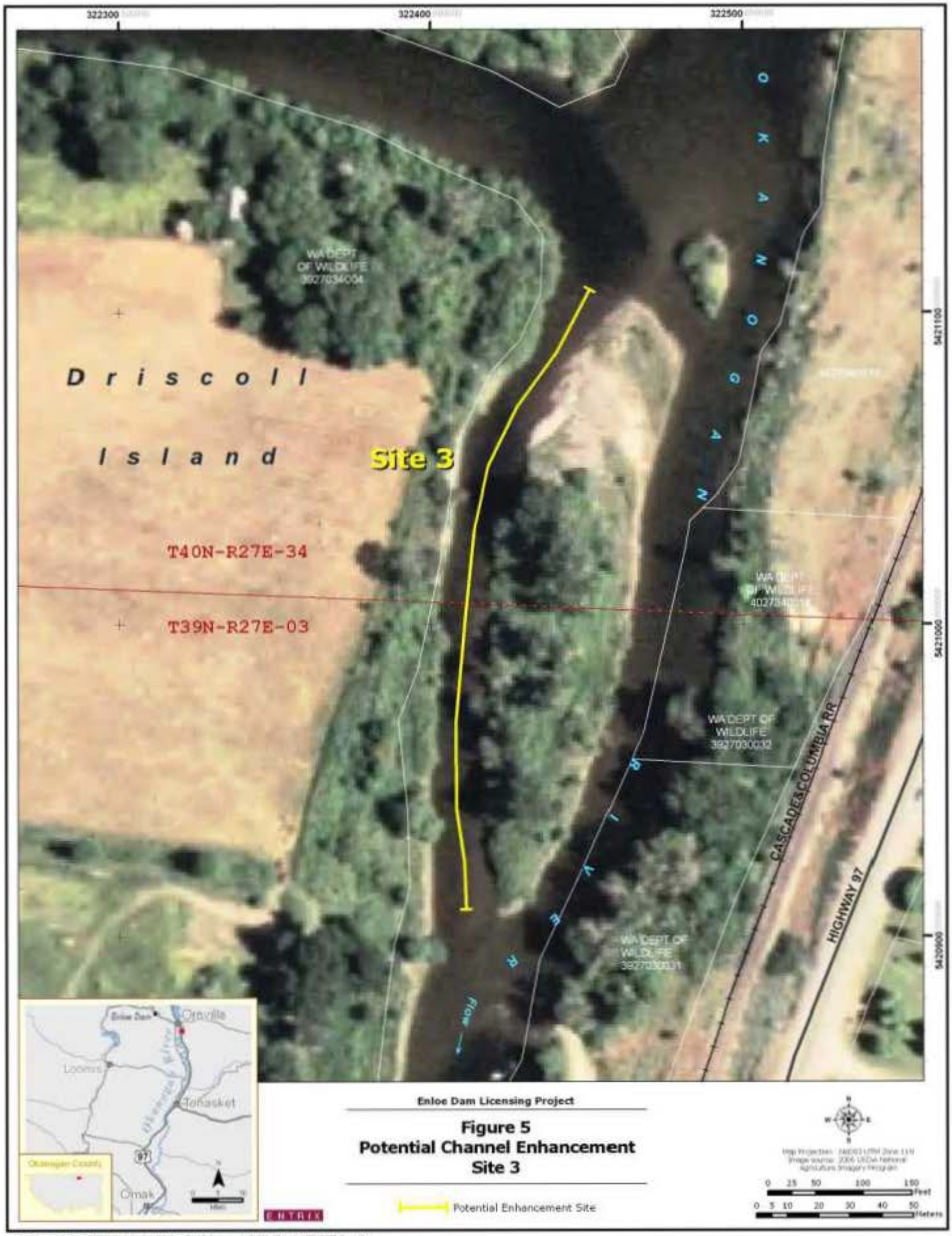
C) 

Figure 3. Potential channel enhancement Site 1 illustrating the channel from the upstream end with the Similkameen River in the foreground (A), the upstream end – looking downstream, (B) and the middle to downstream portion of the channel – looking downstream (C).

A) 

C) 

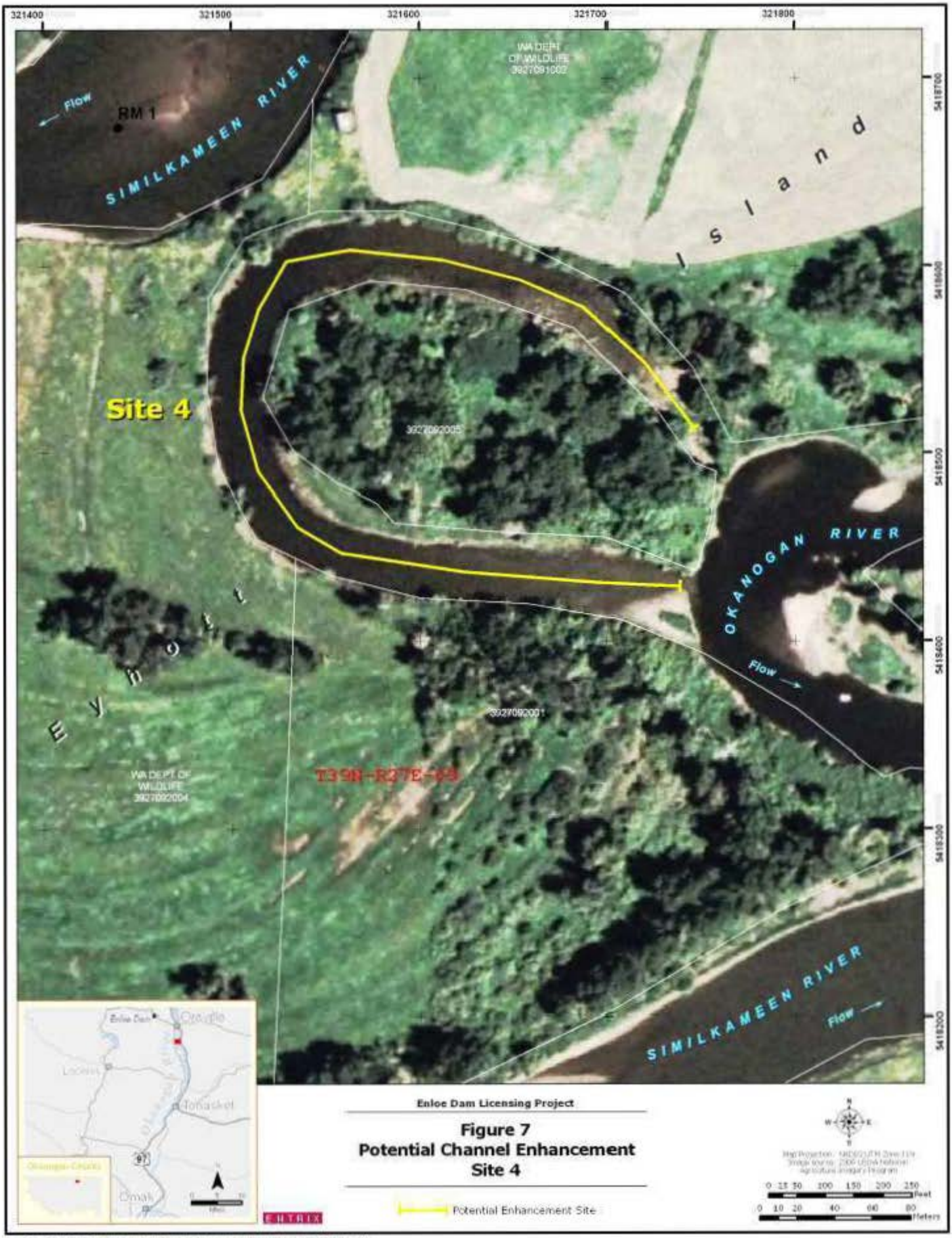
Figure 4. Potential channel enhancement Site 2 illustrating the channel from the upstream end – looking downstream (A), the middle part of the channel – looking downstream (b) and downstream portion of the channel – looking downstream (C).


322300
322400
322500
5421100
5421000
5420900
O K A N O G A N
Driscoll
Island
Site 3
T40N-R27E-34
T39N-R27E-03
WA DEPT OF WILDLIFE
3927034004
WA DEPT OF WILDLIFE
3927030032
WA DEPT OF WILDLIFE
3927030031
R I V E R
Flow
CASCADE&COLUMBIA RR
HIGHWAY 97
Enloe Dam
Oroville
Loomis
Tonasket
Okanogan River
97
Okanogan County
Omak
Enloe Dam Licensing Project
Figure 5
Potential Channel Enhancement
Site 3
Potential Enhancement Site
Map Projection: NAD83 UTM Zone 11N
Image source: 2006 USDA National Agriculture Imagery Program
0 25 50 100 150 Feet
0 5 10 20 30 40 50 Meters

A) 

C) 

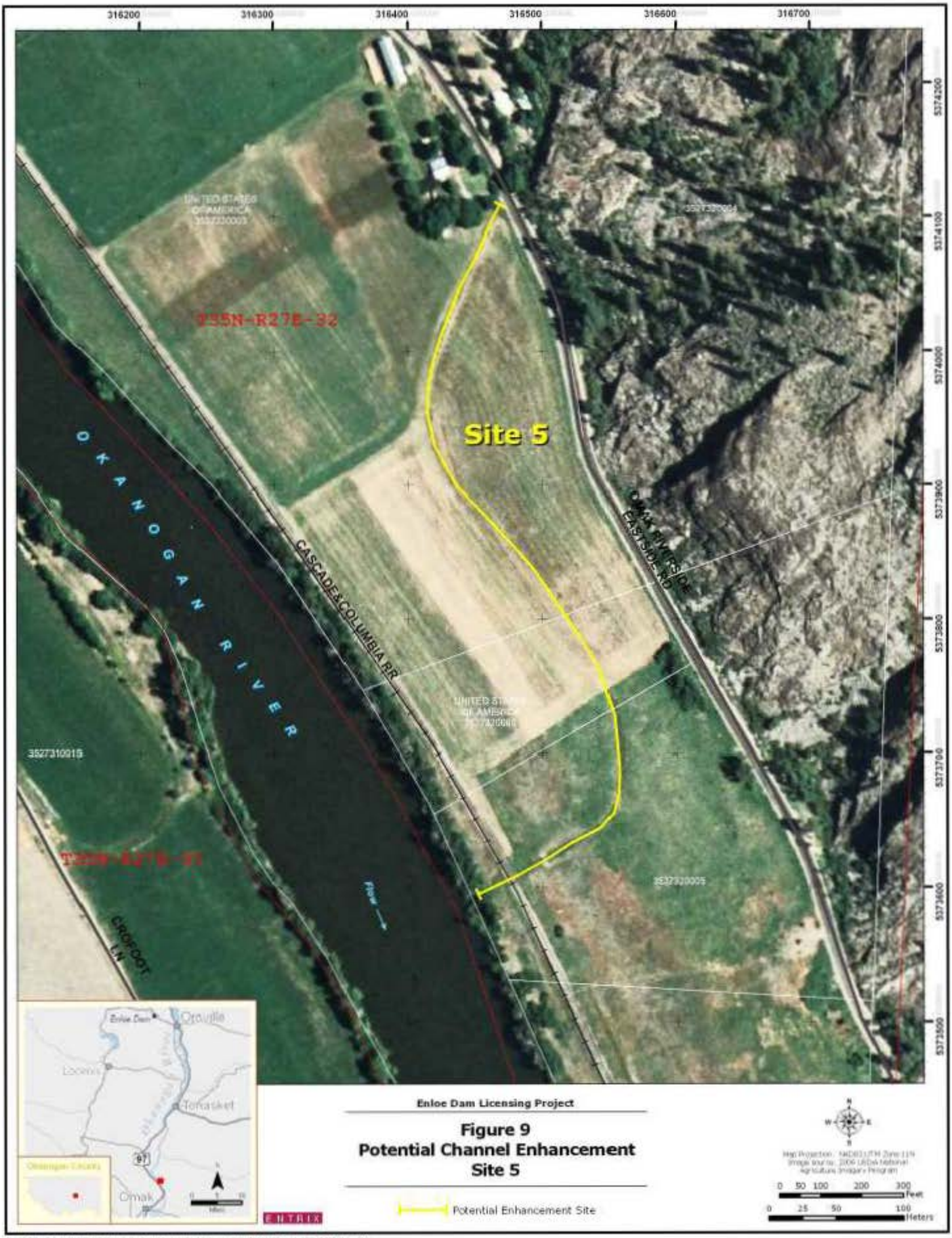
Figure 6. Potential channel enhancement Site 3 illustrating the channel from the upstream end - looking downstream (A), near the middle of the channel – looking upstream (B) and from the downstream end of the channel - looking upstream (C).


321400
321500
321600
321700
321800
5418700
5418600
5418500
5418400
5418300
5418200
Flow
RM 1
SIMILKAMEEN RIVER
WA DEPT OF WILDLIFE 3927091002
Island
Site 4
3927092005
OKANOGAN RIVER
Flow
Eymont
3927092001
WA DEPT OF WILDLIFE 3927092004
T39N-R27E-09
SIMILKAMEEN RIVER
Flow
Enloe Dam
Oroville
Loomis
Tonasket
Okanogan County
97
Omak
Enloe Dam Licensing Project
Figure 7
Potential Channel Enhancement
Site 4
Potential Enhancement Site
Feet
Meters

A) 

C) 

Figure 8. Potential channel enhancement Site 4 illustrating the channel from the upstream end – looking downstream (A), the middle portion of the channel – looking downstream (B) and downstream portion of the channel – looking downstream (C).



Enloe Dam Licensing Project

Figure 9
Potential Channel Enhancement
Site 5

A) 

B) 

C) 

Figure 10. Potential channel enhancement Site 5 illustrating the upstream portion of the channel – looking upstream toward the spring water source (A), the middle to lower channel –looking downstream toward railroad culvert (B), and the confluence with the Okanogan River – looking upstream at culvert just below railroad grade (C).


317200
317300
317400
5367300
5367200
5367100
OKANOGAN RIVER
WANACUT CREEK
Site 6
OMAK RIVER RD
CASCADE&COLUMBIA RR
USA INTRUST
3427200011
USA INTRUST
3427200007
3427200014
Flow
Enloe Dam
Omak
Okanogan County
97
Enloe Dam Licensing Project
Figure 11
Potential Channel Enhancement
Site 6
Potential Enhancement Site
Feet
Meters

A) 

C) 

Figure 12. Potential channel enhancement Site 6 illustrating the channel coming from a wetland near Wanucut Creek (A), side channel in upstream and mid channel area (B), and the downstream portion – looking downstream to the wetted side channel (C).