



## **Wenatchee Subbasin Larval Lamprey Monitoring Report, 2016**



**Cover Photo: Overview of river km 56.8 of the Upper Wenatchee River (upstream of Tumwater Dam, and downstream of the Highway 2 Bridge) where larval lamprey (19-26 mm) were found in August, 2016.**

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## ABSTRACT

Pacific Lamprey is an invaluable cultural and ecological species that is declining in abundance and distribution throughout their range, including the Wenatchee Subbasin. In an effort to monitor, manage and restore the species, the Yakama Nation Pacific Lamprey Program (YNPLP) has led electrofishing surveys for larval Pacific Lamprey throughout the Wenatchee Subbasin since 2014. This report highlights our 2016 electrofishing efforts in the Wenatchee Subbasin, both upstream and downstream of Tumwater Dam (river km 50.4), an assumed passage barrier to Pacific Lamprey. In the spring and fall of 2016, adult Pacific Lamprey were released into the Wenatchee Subbasin (both upstream and downstream of Tumwater Dam) in an effort to rebuild the lamprey population upstream of the dam.

In the Lower Wenatchee River (downstream of Tumwater Dam), a total of two index sites, and two exploratory sites were surveyed. Pacific Lamprey were identified at all of the sites, and no Western Brook Lamprey were identified. At the index site at river km 40.4, the estimated number of lamprey was 188,940 within a 50 m reach; the highest of any of our survey sites within the lower, middle, or upper Columbia subbasins. Lamprey density was 54.7 times higher in Type I habitat compared to Type II habitat at the index site at river km 40.4. At the index sites, captured lamprey size ranged between 18 mm to 122 mm with a mean of 47 mm in Type I habitat and 63 mm in Type II habitat. No macrophthalmia (eyed Pacific Lamprey) were captured during our surveys in the Lower Wenatchee River.

Out of the four index sites surveyed in the Upper Wenatchee River, young of the year larval lamprey (19-29 mm) were found at one site (river km 56.8). The density of lamprey at this site was 1.3 #/m<sup>2</sup>, and 360 larvae were estimated to be within the 50 m reach. Jolanda Lake (river km 50.4) was surveyed along the edge of the lake, but no larvae were found. Surveys were conducted in a side channel at river km 52.3 (4.5 river km downstream of where larval lamprey were previously found), but no lamprey were present at this site (despite quality Type I habitat).

Electrofishing surveys were also conducted in the four tributaries of the Upper Wenatchee River. No lamprey were found at four electrofished sites in the following rivers/streams: Chiwawa River (n=1), Nason Creek (n=2), and the White River (n=1). In brief, the lower reach of Chiwawa (river km 0.4 and 0.5) has Type I habitat ideal for the rearing of larval lamprey, but primarily limited to the channel margins. An exploratory site upstream (river km 3.5) revealed that Type I habitat becomes more patchy (limited to deposition behind large boulders or woody debris). In Nason Creek, two visited exploratory sites in the lower reach (river km 1.2 and 1.7) showed that available habitat in the mainstem is patchy and primarily composed of Type II habitat. However, Type I habitat was present in small quantities in a side channel. Further upstream in Nason Creek, at river km 12.7, Type I habitat was found in deep pools and along channel margins (in more abundant quantities than the lower reach). In the White River (tributary upstream of Lake Wenatchee) at river km 3.2, Type I habitat is abundant, and spans most of the channel width).

## **METHODS**

### **Site Choice and Field Survey**

Throughout the Yakama Nation Ceded Lands, the YNPLP (Yakama Nation Pacific Lamprey Project) has conducted surveys for larval lampreys (beginning in 2009). Index sites, or long-term repeat monitoring sites, have been established throughout the Ceded Lands. The index sites are spatially distributed within watersheds with the potential to hold Pacific Lamprey. The primary goal of these index sites is to monitor the status and trend of Pacific Lamprey in the lower, middle, and upper reaches of interest watersheds. In addition to the index sites, exploratory sites are established each year to further our knowledge on Pacific Lamprey distribution and habitat availability within each watershed.

For all site types, survey sites were chosen based on aerial images from Google Earth and GIS software and site visits. Sites that had higher chances of being a Type I habitat [such as visibly recognizable areas on aerial image with slow water, shallow channel margin with dark tints (usually indicating fine sediment), backwater eddies, confluence of side channels, behind island bars, and tail end of deposition bars, etc.] were given priority. We determined that targeting the preferred habitat more effectually will provide us with a better framework for evaluating presence/absence, distribution, and relative abundance. Further, due to restricted survey time, the ease of access to a survey site (e.g. sites with public road access, short hikes, or near bridges, or private properties who permit access to the rivers/streams) was a critical issue and strongly considered when choosing sites. By prioritizing accessibility, more ground could be covered throughout the expansive area of interest. Chosen habitat sites were ultimately spatially distributed throughout individual watersheds.

Surveys were focused on Type I (preferred) and/or Type II (acceptable) habitat to provide optimal opportunity to capture the largest number of larval lamprey. Type I habitat primarily consists of fine sand, silt and/or clay and is absent of coarse substrate (gravel/cobble/boulder/bedrock). Type II habitat is coarse shifting sand or other fine substrate mixed with coarse substrate. Type III (unsuitable) habitat consists of no fine sediments and was not surveyed. Type I and II habitat is generally found in backwater areas, point bars, mainstem channel margins, and side channels.

Site surveys were categorized as “Full”, “Short” or “Visit”. During a full survey, both Type I and Type II habitat were surveyed. At short surveys, only Type I habitat (or Type II habitat, in the case of no Type I habitat available) was surveyed. At visited sites, no electrofishing occurred, and were primarily designed to further assess available lamprey habitat in different reaches of a river/stream. In general, a full survey was performed at each index site (to gain the most knowledge possible). A short survey (in general) was conducted at exploratory sites, designed to focus on the best habitat and get a quick assessment of lampreys at the site (habitat availability, density, and presence/absence).

At each electrofished site (index or exploratory), a 50 m reach was measured out which encompassed the most accessible and abundant Type I and Type II larval lamprey habitat. The total area (m<sup>2</sup>) of Type I and Type II larval lamprey habitat was estimated within the 50 m reach. Electrofishing surveys were conducted separately over Type I and Type II habitat, and covered representative areas of each habitat type. At full survey sites, a minimum area of Type I and Type II habitat was surveyed (10 m<sup>2</sup> and 5 m<sup>2</sup>, respectively). At short survey sites, a minimum area of 5 m<sup>2</sup> of either habitat type was surveyed. Sediment type (sand, silt or clay) was recorded for the specific area (1 m<sup>2</sup>) where the most lampreys were observed. The sediment depth (cm), water depth (cm), and plot temperature (°C) were also recorded at this location. If no fish were observed, plot temperature was taken where the best available habitat was observed. Thalweg temperature was also recorded to represent the main channel temperature.

Electrofishing surveys were conducted with an AbP-2 Backpack Electrofisher (ETS Electrofishing Systems Inc., Madison, WI), specially designed for the sampling of larval lampreys, was used to survey available (wetted) larval habitat, using standard survey methods (slow tickle pulse of 3 pulses/sec and fast stunning pulse of 30 pulses/sec, 25% duty cycle, 3:1 burst pulse train, and 125 volts). Another person, equipped with a fine-mesh hand net was also present to help capture any electrofished larvae.

Captured lampreys were separated by habitat type, and tallied by life stage and identified to species (if of identifiable length > 50 mm). For each group of captured lampreys, 15 representative lengths were taken (+/- 1 mm). Four of these lampreys were measured to the nearest 0.01 gram (length and weight was taken on the largest, smallest and two medium sized larvae relative to the site). The combined weight of all captured lampreys were also measured (nearest 0.01 g). Missed larvae were also counted and tallied.

Genetic samples were collected from Pacific Lamprey (> 50 mm) with scissors or 2 mm whole punch (top or bottom of the caudal fin). Lampreys less than 50 mm were generally collected as whole samples (by placement on a genetic sheet or preservation in 70% Ethanol), but efforts were made to take genetic clips from larger unidentifiable larvae (> 35mm) rather than whole samples. Samples were primarily collected in areas where adult Pacific Lamprey translocation efforts are ongoing, or where the distribution of Pacific Lamprey is uncertain.

## **Analysis**

Captured and missed larvae were tallied together and added to the number captured, to determine the total number of observed lampreys from electrofishing for each habitat type. If the number of captured lampreys was less than half of the observed total, the number of captured lampreys was doubled, and used as the final observed total. If the number of captured lampreys was equal to or more than half, the recorded observed number was used as the final observed total (represented by “observed total” in the following report).

In many cases, survey visibility was less than ideal, and many lampreys went unseen. To account for unseen lamprey, the total number of lampreys observed (final observed total) was adjusted (increased) based on the following 1-5 visibility scale: (1) poor (60%), (2) fair (70%) , (3) good (80%), (4) very good (90%) and (5) excellent (100%). For each survey, the total number of observed lampreys was increased (by the percentage listed above) based on the survey's visibility rank. Survey densities ( $\#/m^2$ ) were calculated using the adjusted observed number of lampreys.

To calculate the number of lampreys within each 50 m reach, survey densities were extrapolated over their respective habitat type (estimated area within the 50 m reach) to arrive at the total number of lampreys for each habitat type. The estimated number from both habitat types was then summed together for an estimated total number of lampreys by site. The number of Pacific Lamprey within a 50 m reach was calculated from the Pacific Lamprey ratio (from identified lampreys) multiplied by the total number of lampreys estimated to reside within the reach.

A condition factor for each site was calculated by averaging the condition factor for each of the fish measured by both length and weight. The average weight of the captured lamprey (total weight g/# weighed) was calculated for each site. In the event, that not all of the captured lampreys were weighed together, the average capture weight was multiplied by the total number of captured lampreys.

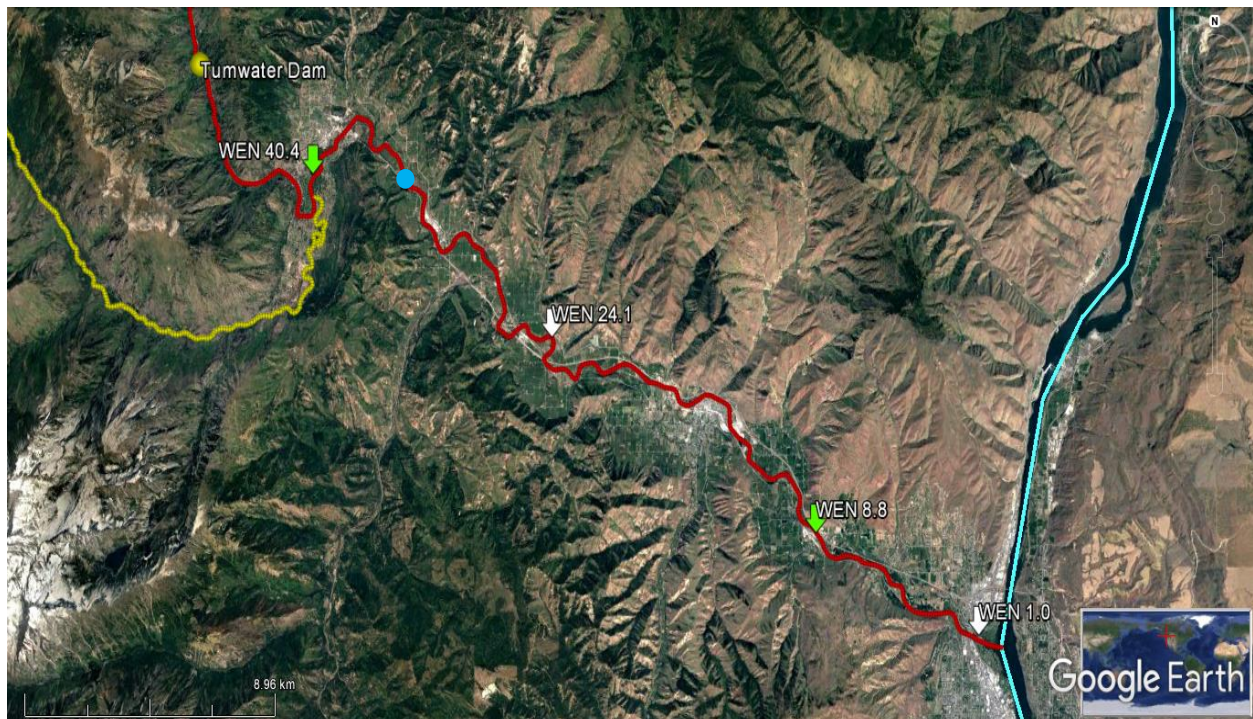
To arrive at an estimated biomass within a 50 m reach, the electrofishing density (by mass) was calculated separately for captured and missed lampreys. The biomass densities for captured and missed lampreys was summed together to get the total biomass density for the survey. The estimated final biomass density was then extrapolated over the respective habitat type. The estimated biomass for each habitat type was then summed together to arrive at a total site biomass (g).

## RESULTS

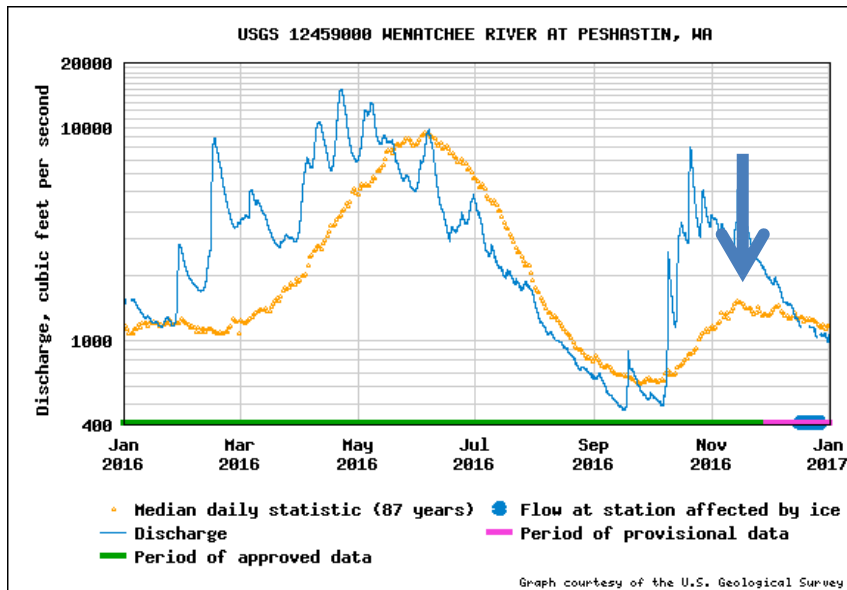
### Lower Wenatchee Subbasin (Downstream of Tumwater Dam, river km 49.6)

#### Lower Wenatchee Mainstem

The Lower Wenatchee River is defined as the Wenatchee River, and all tributary watersheds, downstream of Tumwater Dam (river km 49.6). A total of four surveys were conducted in the Lower Wenatchee River for larval lampreys. Two index sites were surveyed and two exploratory sites were surveyed (Map 1). During the time of our survey (August, 2016), the flow of the Wenatchee River was near the 58-year average according to an USGS Flow Station near Peshastin, WA (river km 34.1; Figure 1).



**Map 1. Overview of all surveyed sites in the Lower Wenatchee River (red line) in August, 2016, displaying index sites (green arrows) and surveyed exploratory sites (white arrows) where electrofishing occurred. The location of a USGS Gauging Station (near Peshastin, WA; river km 34.1) is shown by the blue dot. Also shown is Tumwater Dam (river km 49.6).**



**Figure 1. Discharge (cubic feet per second indicated by the narrow blue line) of the Wenatchee River near Peshastin, WA (river km 34.1) in 2016; blue arrow indicates YN survey period (August, 2016).**

### Lower Wenatchee Mainstem - Index Sites

- Only Type II habitat was present at river km 8.8, but both Type I and II habitat was abundant at river km 40.4. Type I habitat was primarily in the channel edge (margin) and silt was the primary fine sediment at river km 40.4. Maximum temperature was 19.0°C at river km 8.8.
- Lamprey density was 54.7 times higher in Type I habitat compared to Type II habitat at river km 40.4. The density in Type II habitat was 2.3 times higher at river km 8.8 compared to 40.4.
- Captured lamprey size ranged between 18 mm to 122 mm with a mean of 47 mm in Type I and 63 mm in Type II.
- Pacific Lamprey were found at all the sites we surveyed and no Western Brook Lamprey were identified.

**Table 1. Larval lamprey habitat details from index sites surveyed in the Lower Wenatchee River. Under “Survey Type”, a “Full” indicates that both Type I and Type II habitat were electrofished (when available). The percent of larval habitat shown is the ratio between available Type I and Type II habitat, and excludes Type III (unusable) habitat within the 50 m survey reach. Under “Type I Habitat Type”, “Side Chan.” indicates that the primary survey location (for Type I habitat) was in a side channel. Plot temp was taken where the most lampreys were found, and thalweg temp was taken in the main channel flow.**

Site Type	River Stream	River KM	Date	Survey Type	% Type I in 50 m	% Type II in 50 m	Type I Habitat Type	Primary Fine Sediment (Type I)	Primary Fine Sediment (Type II)	Plot Temp °C (Best)	Thalweg Temp °C
Index	Wenatchee	8.8	8/24/16	Full	0%	100%	-	-	Silt	19.0	17.9
Index	Wenatchee	40.4	8/24/16	Full	60%	40%	Edge	Silt	Coarse	18.4	18.1

**Table 2. Survey details, separated by habitat type, for Lower Wenatchee River index sites surveyed in August, 2016. The total number of lampreys observed was adjusted (increased) based on the following 1-5 visibility scale (estimated % visibility in parenthesis): (1) poor (60%), (2) fair (70%), (3) good (80%), (4) very good (90%) and (5) excellent (100%). Survey densities (#/m<sup>2</sup>) were calculated using the adjusted observed number of lampreys. The summary rows are a sum of presented values, except for e-fish density which is a mean of presented values.**

Site Type	River Stream	River KM	Habitat Type Surveyed	Shock Time (sec)	Shock Area (m <sup>2</sup> )	# Captured	# Observed	Survey Visibility (1-5)	Total # Observed (Adjusted)	E-Fish Density (#/m <sup>2</sup> )
Index	Wenatchee	8.8	Type I	-	-	0	-	-	-	-
Index	Wenatchee	40.4	Type I	480	8	149	3149	5	3149	393.6
Index	Wenatchee	8.8	Type II	768	12	79	158	3	198	16.5
Index	Wenatchee	40.4	Type II	300	5	18	36	5	36	7.2
<b>Site Summary</b>		<b>8.8</b>	<b>-</b>	<b>768</b>	<b>12</b>	<b>79</b>	<b>158</b>	<b>-</b>	<b>198</b>	<b>16.5</b>
		<b>40.4</b>		<b>780</b>	<b>13</b>	<b>167</b>	<b>3185</b>		<b>3185</b>	<b>200.4</b>
<b>Habitat Summary</b>			<b>Type I</b>	<b>480</b>	<b>8</b>	<b>149</b>	<b>3149</b>		<b>3149</b>	<b>393.6</b>
			<b>Type II</b>	<b>1068</b>	<b>17</b>	<b>97</b>	<b>194</b>		<b>234</b>	<b>11.8</b>

**Table 3. Measurement details of captured lampreys, separated by habitat type, for Lower Wenatchee River index sites surveyed in August, 2016 (sites without lampreys are excluded). The summary rows are a sum of presented values, except for mean weight, mean length and mean condition factor, which are a mean of presented values, and min and max length, which are the lowest and highest value, respectively.**

Site Type	River Stream	River KM	Habitat Type Surveyed	# Weighed	Total Weight of Captured (g)	Mean Weight of Captured (g)	Min. Length (mm)	Max. Length (mm)	Mean Length (mm)	Mean Condition Factor
Index	Wenatchee	8.8	Type I	0	-	-	-	-	-	-
Index	Wenatchee	40.4	Type I	14	-	-	18	111	47	-
Index	Wenatchee	8.8	Type II	79	-	-	59	122	80	-
Index	Wenatchee	40.4	Type II	12	-	-	20	91	46	-
<b>Site Summary</b>		<b>8.8</b>	<b>-</b>	<b>79</b>	<b>-</b>	<b>-</b>	<b>59</b>	<b>122</b>	<b>80</b>	<b>-</b>
		<b>40.4</b>		<b>26</b>			<b>18</b>	<b>91</b>	<b>47</b>	
<b>Habitat Summary</b>			<b>Type I</b>	<b>14</b>	<b>-</b>	<b>-</b>	<b>18</b>	<b>111</b>	<b>47</b>	<b>-</b>
			<b>Type II</b>	<b>91</b>			<b>20</b>	<b>122</b>	<b>63</b>	



**Table 4. Lamprey identification details, separated by habitat type, for Lower Wenatchee River index sites surveyed in August, 2016. The summary rows are a sum of presented values except for % values, which are a weighted average.**

Site Type	River Stream	River KM	Habitat Type	# Identified	# of Pacific	# of Western Brook	% Pacific	% Western Brook	% of Cap. Identified
Index	Wenatchee	8.8	Type I	-	-	-	-	-	-
Index	Wenatchee	40.4	Type I	6	6	0	100%	0%	4%
Index	Wenatchee	8.8	Type II	15	15	0	100%	0%	19%
Index	Wenatchee	40.4	Type II	7	7	0	100%	0%	39%
<b>Site Summary</b>		<b>8.8</b>	-	<b>15</b>	<b>15</b>	<b>0</b>	<b>100%</b>	<b>0%</b>	<b>19%</b>
		<b>40.4</b>	-	<b>13</b>	<b>13</b>	<b>0</b>	<b>100%</b>	<b>0%</b>	<b>8%</b>
<b>Habitat Summary</b>			<b>Type I</b>	<b>6</b>	<b>6</b>	<b>0</b>	<b>100%</b>	<b>0%</b>	<b>4%</b>
			<b>Type II</b>	<b>22</b>	<b>22</b>	<b>0</b>	<b>100%</b>	<b>0%</b>	<b>23%</b>

**Table 5. Lamprey population and biomass estimates within a 50 m reach, separated by habitat type, for Lower Wenatchee River index sites surveyed in August, 2016. “Estimated # of Pacific Lamprey” is calculated based on the identified ratio of Pacific Lamprey (to Western Brook Lamprey) generally > 50 mm in length. Summary rows are a sum of presented values, except for e-fish density and mean weight of captured, which are a mean of presented values.**

Site Type	River Stream	River KM	Habitat Type	50 m Habitat Area (m2)	E-Fish Density (#/m2)	Estimated # in 50 m	Estimated # of Pacific Lamprey in 50 m	Mean Weight of Cap. (g)	Estimated Mass Density (g/m2)	Estimated Mass (g) in 50 m
Index	Wenatchee	8.8	Type I	0	-	-	-	-	-	-
Index	Wenatchee	40.4	Type I	480	393.6	188940	188940	-	-	-
Index	Wenatchee	8.8	Type II	150	16.5	2469	2469	-	-	-
Index	Wenatchee	40.4	Type II	320	7.2	1152	1152	-	-	-
<b>Site Summary</b>		<b>8.8</b>	-	<b>150</b>	<b>16.5</b>	<b>2469</b>	<b>2469</b>	-	-	-
		<b>40.4</b>	-	<b>800</b>	<b>200.4</b>	<b>190092</b>	<b>190092</b>	-	-	-
<b>Habitat Summary</b>			<b>Type I</b>	<b>480</b>	<b>393.6</b>	<b>188940</b>	<b>188940</b>	-	-	-
			<b>Type II</b>	<b>470</b>	<b>11.8</b>	<b>3621</b>	<b>3621</b>	-	-	-

**Additional Index Site Observations:**

- **River km 8.8** – This site is located just downstream of the Main Street bridge and is located on the right bank looking downstream off of McKee Lane. The site does not contain any Type I habitat, but the quality is close to Type I with limited amount of coarse substrate and has ample organic matter mixed in. Because larval lamprey habitat is rather limited in this lower reach of mainstem Wenatchee, lamprey (especially larger ones) seem to take advantage of this habitat and are found in relatively high density (for being Type II habitat).
- **River km 40.4** – This site is located along the trail within the Enchantment Park (near the Leavenworth Golf Club end) on the left bank near a small side channel and an island. The channel margin has lots of large wood debris and has created a high quality slow water habitat for larval lamprey. The density of larvae is phenomenal, especially for young-of-

the-year larvae. Medium and large size classes were also present. The habitat here is crucial for the Wenatchee River larval lamprey subpopulations.

### Lower Wenatchee Mainstem – Exploratory Sites

- Only Type II habitat was present at both sites (river km 1.0 and 24.1). The maximum temperature was 21.0 °C at river km 1.0. Lamprey density was 8 times higher at river km 24.1 compared to river km 1.0.
- Captured lamprey size ranged between 30 mm to 123 mm with a mean of 52 mm at river km 1.0 and 73 mm at river km 24.1.
- Pacific Lamprey were found at all the sites we surveyed and no Western Brook Lamprey were identified.
- Site at river km 24.1 has the potential to be included as an index site in the future years; it has relatively stable and extensive habitat (300 m<sup>2</sup>) and is also a site where we may continue to release salvaged lamprey. Site at river km 1.0 has limited habitat and limited number of larvae; therefore, not a suitable site for index site monitoring.

**Table 6. Larval lamprey habitat details from the exploratory sites surveyed in the Lower Wenatchee River in August, 2016. Under “Survey Type”, a “Full” indicates that both Type I and Type II habitat were electrofished (when available). The percent of larval habitat shown is the ratio between available Type I and Type II habitat, and excludes Type III (unusable) habitat within the 50 m survey reach. Under “Type I Habitat Type”, “Edge” indicates that the primary survey location (for Type I habitat) was on the edge of the main channel. Plot temp was taken where the most lampreys were found, and thalweg temp was taken in the main channel flow.**

Site Type	Stream	River KM	Date	Survey Type	%	%	Type I Habitat Type	Primary	Primary	Plot Temp °C (Best)	Thalweg Temp °C
					in 50 m	in 50 m		Fine Sediment (Type I)	Fine Sediment (Type II)		
Index	Wenatchee	8.8	8/24/16	Full	0%	100%	-	-	Silt	19.0	17.9
Index	Wenatchee	40.4	8/24/16	Full	60%	40%	Edge	Silt	Coarse	18.4	18.1

**Table 7. Survey details, separated by habitat type, for the Lower Wenatchee River exploratory sites surveyed in August, 2016. The total number of lampreys observed was adjusted (increased) based on the following 1-5 visibility scale (estimated % visibility in parenthesis): (1) poor (60%), (2) fair (70%), (3) good (80%), (4) very good (90%) and (5) excellent (100%). Survey densities (#/m<sup>2</sup>) were calculated using the adjusted observed number of lampreys. The summary rows are a sum of presented values, except for e-fish density which is a mean of presented values.**

Site Type	Stream	River KM	Habitat Type Surveyed	Shock Time (sec)	Shock Area (m2)	# Captured	# Observed	Survey Visibility (1-5)	Total # Observed (Adjusted)	E-Fish Density (#/m2)
Expl.	Wenatchee	1.0	Type I	0	-	-	-	-	-	-
Expl.	Wenatchee	24.1	Type I	0	-	-	-	-	-	-
Expl.	Wenatchee	1.0	Type II	624	11	5	20	3	25	2.3
Expl.	Wenatchee	24.1	Type II	855	14	128	256	5	256	18.3
<b>Site Summary</b>		<b>1.0</b>	<b>-</b>	<b>624</b>	<b>11</b>	<b>5</b>	<b>20</b>	<b>-</b>	<b>25</b>	<b>2.3</b>
		<b>24.1</b>		<b>855</b>	<b>14</b>	<b>128</b>	<b>256</b>		<b>256</b>	<b>18.3</b>
<b>Habitat Summary</b>			<b>Type I</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
			<b>Type II</b>	<b>1479</b>	<b>25</b>	<b>133</b>	<b>276</b>	<b>-</b>	<b>281</b>	<b>10.3</b>

**Table 8. Measurement details of captured lampreys, separated by habitat type, for the Lower Wenatchee River exploratory site surveyed in August, 2016 (sites without lampreys are excluded). The summary rows are a sum of presented values, except for mean weight, mean length and mean condition factor, which are a mean of presented values, and min and max length, which are the lowest and highest value, respectively.**

Site Type	Stream	River KM	Habitat Type Surveyed	# Weighed	Total Weight of Captured (g)	Mean Weight of Captured (g)	Min. Length (mm)	Max. Length (mm)	Mean Length (mm)	Mean Condition Factor
Expl.	Wenatchee	1.0	Type I	-	-	-	-	-	-	-
Expl.	Wenatchee	24.1	Type I	-	-	-	-	-	-	-
Expl.	Wenatchee	1.0	Type II	0	-	-	30	68	52	-
Expl.	Wenatchee	24.1	Type II	0	-	-	31	123	73	-
<b>Site Summary</b>		<b>1.0</b>	<b>-</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>30</b>	<b>68</b>	<b>52</b>	<b>-</b>
		<b>24.1</b>		<b>0</b>			<b>31</b>	<b>123</b>	<b>73</b>	
<b>Habitat Summary</b>			<b>Type I</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
			<b>Type II</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>30</b>	<b>123</b>	<b>62</b>	<b>-</b>

**Table 9. Lamprey identification details, separated by habitat type, for the Lower Wenatchee River exploratory sites surveyed in August, 2016. The summary rows are a sum of presented values except for % values, which are a weighted average.**

Site Type	Stream	River KM	Habitat Type	# Identified	# of Pacific	# of Western Brook	% Pacific	% Western Brook	% of Cap. Identified
Expl.	Wenatchee	1.0	Type I	-	-	-	-	-	-
Expl.	Wenatchee	24.1	Type I	-	-	-	-	-	-
Expl.	Wenatchee	1.0	Type II	3	3	0	100%	0%	60%
Expl.	Wenatchee	24.1	Type II	25	25	0	100%	0%	20%
<b>Site Summary</b>		<b>1.0</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>100%</b>	<b>0%</b>	<b>60%</b>
		<b>24.1</b>		<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Habitat Summary</b>			<b>Type I</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
			<b>Type II</b>	<b>28</b>	<b>28</b>	<b>0</b>	<b>100%</b>	<b>0%</b>	<b>21%</b>

**Table 10. Lamprey population and biomass estimates within a 50 m reach, separated by habitat type, for the Lower Wenatchee River exploratory sites surveyed in August, 2016. “Estimated # of Pacific Lamprey” is calculated based on the identified ratio of Pacific Lamprey (to Western Brook Lamprey) generally >50 mm in length. Summary rows are a sum of presented values, except for e-fish density and mean weight of captured, which are a mean of presented values.**

Site Type	Stream	River KM	Habitat Type	50 m		Estimated # in 50 m	Estimated # of Pacific Lamprey in 50 m	Mean Weight of Cap. (g)	Estimated Mass Density (g/m <sup>2</sup> )	Estimated Mass (g) in 50 m
				Habitat Area (m <sup>2</sup> )	E-Fish Density (#/m <sup>2</sup> )					
Expl.	Wenatchee	1.0	Type I	0	-	-	-	-	-	-
Expl.	Wenatchee	24.1	Type I	0	-	-	-	-	-	-
Expl.	Wenatchee	1.0	Type II	196	2.3	625	625	-	-	-
Expl.	Wenatchee	24.1	Type II	300	18.3	5486	5486	-	-	-
<b>Site Summary</b>		<b>1.0</b>	-	<b>196</b>	<b>2.3</b>	<b>625.0</b>	<b>625.0</b>			
		<b>24.1</b>		<b>300</b>	<b>18.3</b>	<b>5486</b>	<b>5486</b>			
<b>Habitat Summary</b>			<b>Type I</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>-</b>			
			<b>Type II</b>	<b>496</b>	<b>10.3</b>	<b>6111</b>	<b>6111</b>			

#### Additional Exploratory Site Observations

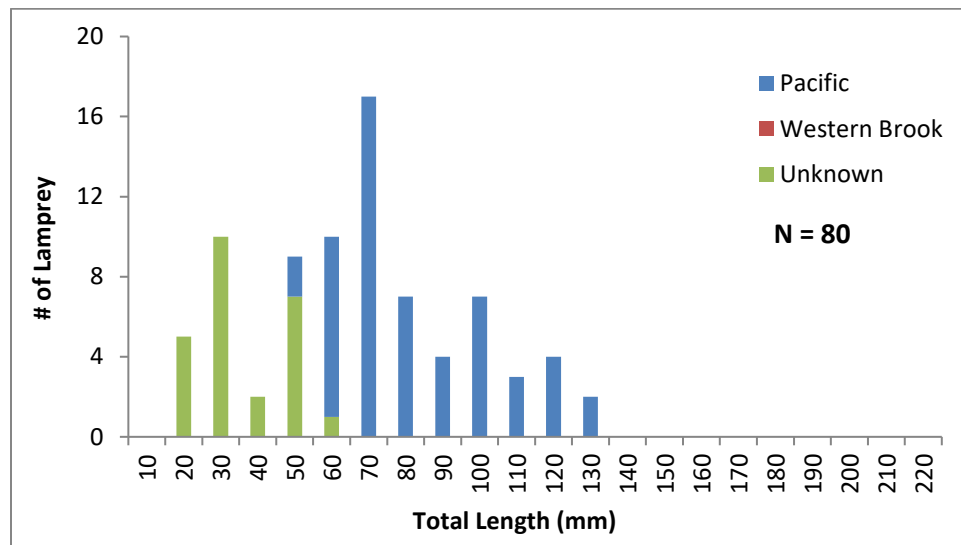
- River km 1.0** – This site is located within the Wenatchee Confluence State Park (off of Old Station Road) and is located between the train trestle and the Apple Capitol Recreational Loop Trail. During prior year visits, there used to be some Type I habitat and more Type II habitat available, but the quality has decreased based on what we observed this year. Only smaller lamprey were captured and habitat was limited to the left bank (looking downstream) and the train trestle pilings.
- River km 24.1** – This site is located off of Depot Road (at the north end of a gravel road parking that accesses the river as well as a series of spring water fed ponds). This site was also used in 2016 to release salvaged lamprey collected from Dryden Diversion (during dewatering operation) and in the area immediately upstream of Dryden Diversion (during dredging operations). It has an extensive area of larval lamprey habitat along the inside meander bend on the channel margin, composed of sifting sand and mixed sediment (fine and coarse sediment). Although sifting sand is primarily all fine sediment (coarse sand), due to their instable nature, they are considered Type II habitat. Density was relatively high (especially for being a Type II habitat). Water temperature in the ponds were also measured and ranged between 22.0 C and 26.4 C, indicating they may become too warm for larval lamprey during the summer low flow period (the outlet only had a small trickle of water flowing out). However, subsurface fine sediment temperature may be considerably lower due to the ponds being primarily spring fed (we plan to measure this in future visits).

## Genetic Samples – Lower Wenatchee River

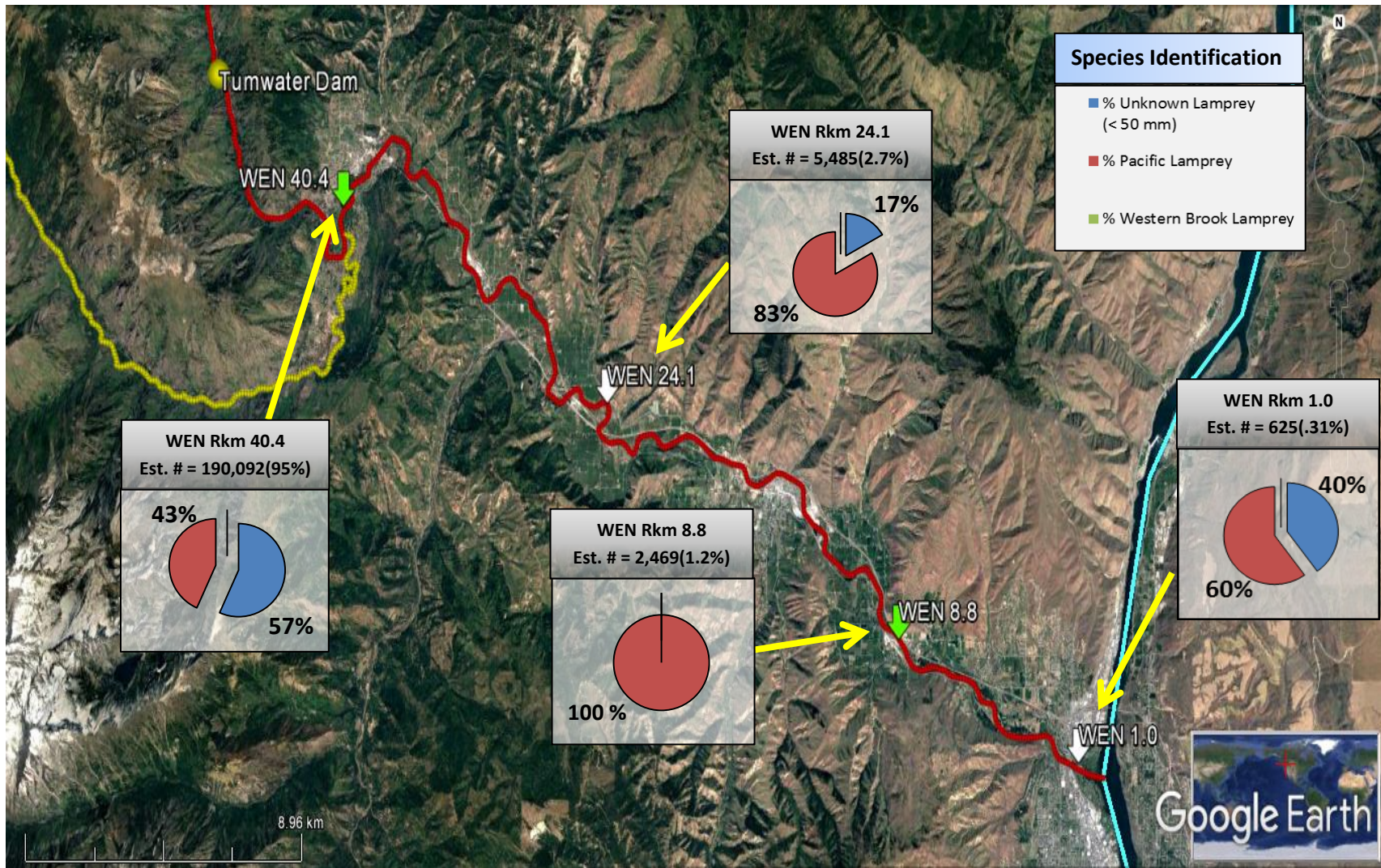
A total of 31 genetic samples were collected from the Lower Wenatchee River (Table 11). These samples will be used to understand the spawning success of released adults into the Wenatchee Subbasin in 2015 and 2016.

**Table 11. Genetic samples collected from the Lower Wenatchee River mainstem downstream of Tumwater Dam in August, 2016.**

Stream Name	River KM	Collection Date	# of Pacific Samples (Larvae)	# of Pacific Samples (Macro.)	# of Western Brook Samples	# Unknown Species Samples (< 50 mm)	Primary Collection Purpose
Wenatchee	1.0	8/24/16	0	0	0	20	Translocaiton Success
Wenatchee	24.1	8/24/16	0	0	0	4	Translocaiton Success
Wenatchee	40.4	8/24/16	0	0	0	7	Translocaiton Success
<b>Total</b>			<b>0</b>	<b>0</b>	<b>0</b>	<b>31</b>	



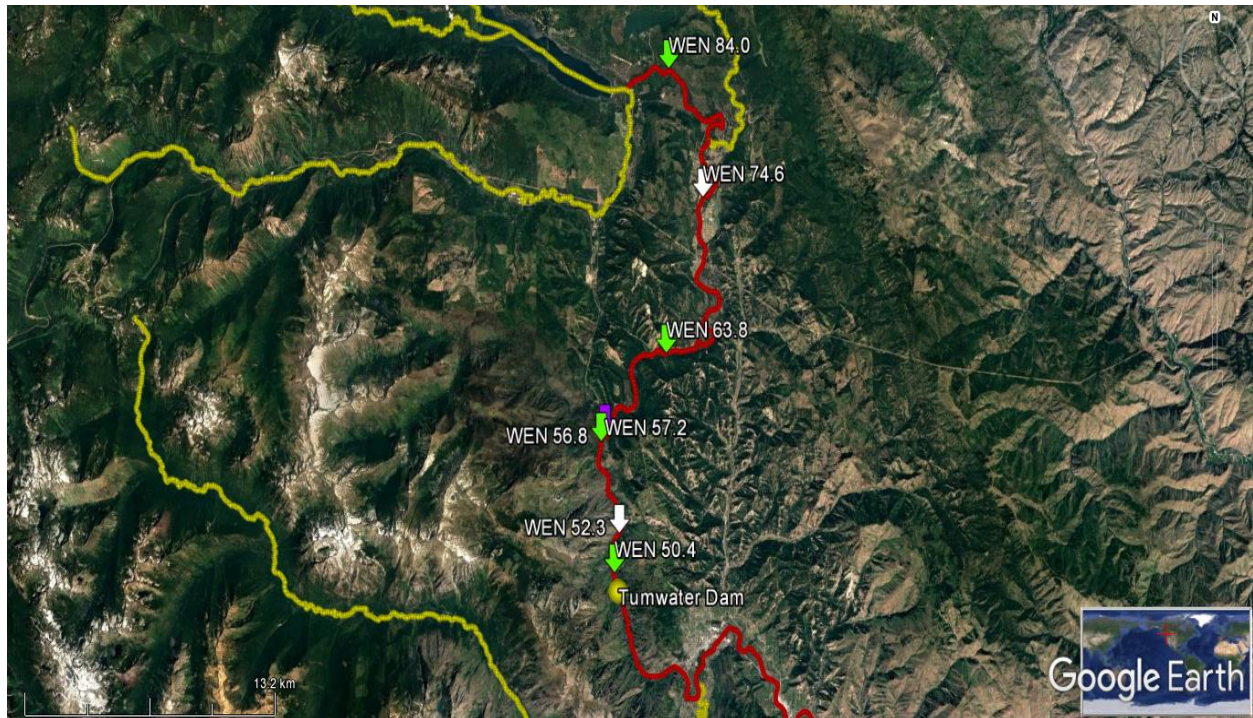
**Figure 2. Histogram of all measured lampreys captured during electrofishing surveys, separated by species (“PA”= Pacific Lamprey (blue), “UN”=Unknown Lamprey <50 mm (green)), in the Lower Wenatchee River in August, 2016.**



Map 2. Displayed is the distribution of Pacific Lamprey (red), and Unknown Lamprey <50 mm (blue) in the Lower Wenatchee River mainstem from August, 2016 electrofishing surveys. Species ratio and ratio of unknown lampreys is based on captured and measured data only. Also shown is the estimated number of lampreys at each surveyed site. Index sites are labeled by green arrows and exploratory sites labeled by white arrows Note no data is available for river km 191.8.

## Upper Wenatchee Subbasin (Downstream of Tumwater Dam, river km 49.6)

### Upper Wenatchee Mainstem



**Map 3. Overview of all surveyed sites in the Upper Wenatchee River (red line) in August, 2016 displaying index sites (green arrows) and surveyed exploratory sites (white arrows) where electrofishing occurred. Exploratory sites where electrofishing did not occur are highlighted in purple. Also shown is Tumwater Dam (river km 49.6).**

## Upper Wenatchee Mainstem – Index Sites

- A total of four index sites were found upstream of Tumwater Dam in the mainstem of the Wenatchee River. Out of the four index sites, young of the year larval lamprey (19-29 mm) were found at one site (river km 56.8). Genetics samples were collected from all six larvae.
- Type I and Type II habitat were present at each of the sites. Surveys were primarily conducted on the edge of the main channel, although at river km 63.8, the survey was conducted in a side channel.

**Table 12. Larval lamprey habitat details from index sites surveyed in the Upper Wenatchee River. Under “Survey Type”, a “Full” indicates that both Type I and Type II habitat were electrofished (when available). The percent of larval habitat shown is the ratio between available Type I and Type II habitat, and excludes Type III (unusable) habitat within the 50 m survey reach. Under “Type I Habitat Type”, “Edge” indicates that the primary survey location (for Type I habitat) was on the edge of the main channel; “Side Chan.” indicates this took place in a side channel. Plot temp was taken where the most lampreys were found, and thalweg temp was taken in the main channel flow.**

Site Type	Stream	River KM	Date	Survey Type	% Type I in 50 m	% Type II in 50 m	Type I Habitat Type	Primary Fine Sediment (Type I)	Primary Fine Sediment (Type II)	Plot Temp °C (Best)	Thalweg Temp °C
Index	Wenatchee	50.4	8/24/16	Short	100%	0%	Edge	Clay	-	-	-
Index	Wenatchee	56.8	8/24/16	Short	60%	40%	Edge	Silt	-	19.2	18.8
Index	Wenatchee	63.8	8/24/16	Short	38%	62%	Side Chan.	Sand	-	19.2	18.6
Index	Wenatchee	84.0	8/24/16	Short	83%	17%	Edge	Sand	-	-	18.1

**Table 13. Survey details, separated by habitat type, for the Upper Wenatchee River index sites surveyed in August, 2016. The total number of lampreys observed was adjusted (increased) based on the following 1-5 visibility scale (estimated % visibility shown in parenthesis): (1) poor (60%), (2) fair (70%), (3) good (80%), (4) very good (90%) and (5) excellent (100%). Survey densities (#/m<sup>2</sup>) were calculated using the adjusted observed number of lampreys. The summary rows are a sum of presented values, except for e-fish density which is a mean of presented values.**

Site Type	Stream	River KM	Habitat Type Surveyed	Shock Time (sec)	Shock Area (m <sup>2</sup> )	# Captured	# Observed	Survey Visibility (1-5)	Total # Observed (Adjusted)	E-Fish Density (#/m <sup>2</sup> )
Index	Wenatchee	50.4	Type I	1106	20	0	0	3	-	-
Index	Wenatchee	56.8	Type I	494	9	6	12	5	12	1.3
Index	Wenatchee	63.8	Type I	1047	20	0	0	5	-	-
Index	Wenatchee	84.0	Type I	1574	30	0	0	5	-	-
Index	Wenatchee	50.4	Type II	0	-	-	-	-	-	-
Index	Wenatchee	56.8	Type II	0	-	-	-	-	-	-
Index	Wenatchee	63.8	Type II	0	-	-	-	-	-	-
Index	Wenatchee	84.0	Type II	0	-	-	-	-	-	-
<b>Site Summary</b>		<b>50.4</b>		<b>1106</b>	<b>20</b>	<b>0</b>	<b>0</b>		<b>-</b>	<b>-</b>
		<b>56.8</b>	<b>-</b>	<b>494</b>	<b>9</b>	<b>6</b>	<b>12</b>	<b>-</b>	<b>12</b>	<b>1.3</b>
		<b>63.8</b>		<b>1047</b>	<b>20</b>	<b>0</b>	<b>0</b>		<b>-</b>	<b>-</b>
		<b>84.0</b>		<b>1574</b>	<b>30</b>	<b>0</b>	<b>0</b>		<b>-</b>	<b>-</b>
<b>Habitat Summary</b>		<b>-</b>	<b>Type I</b>	<b>4221</b>	<b>79</b>	<b>6</b>	<b>12</b>	<b>-</b>	<b>12</b>	<b>1.3</b>
			<b>Type II</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>-</b>		<b>-</b>	<b>-</b>



**Table 14. Measurement details of captured lampreys, separated by habitat type, for the Upper Wenatchee River index sites surveyed in August, 2016 (sites without lampreys are excluded) The summary rows are a sum of presented values, except for mean weight, mean length and mean condition factor, which are a mean of presented values, and min and max length, which are the lowest and highest value, respectively.**

Site Type	Stream	River KM	Habitat Type Surveyed	# Weighed	Total Weight of Captured (g)	Mean Weight of Captured (g)	Min. Length (mm)	Max. Length (mm)	Mean Length (mm)	Mean Condition Factor
Index	Wenatchee	56.8	Type I	0	-	-	19	29	26	-
Index	Wenatchee	56.8	Type II	-	-	-	-	-	-	-
<b>Site Summary</b>		<b>56.8</b>	-	<b>0</b>	-	-	<b>19</b>	<b>29</b>	<b>26</b>	-
<b>Habitat Summary</b>			Type I	<b>0</b>	-	-	<b>19</b>	<b>29</b>	<b>26</b>	-
			Type II	-	-	-	-	-	-	-

**Table 15. Lamprey population and biomass estimates within a 50 m reach, separated by habitat type, for the Upper Wenatchee River index sites surveyed in August, 2016. “Estimated # of Pacific Lamprey” is calculated based on the identified ratio of Pacific Lamprey (to Western Brook Lamprey) generally > 50 mm in length. Summary rows are a sum of presented values, except for e-fish density and mean weight of captured, which are a mean of presented values.**

Site Type	Stream	River KM	Habitat Type	50 m Area (m2)	E-Fish Density (#/m2)	Estimated # in 50 m	Estimated # of Pacific Lamprey in 50 m	Mean Weight of Cap. (g)	Estimated Mass Density (g/m2)	Estimated Mass (g) in 50 m
Index	Wenatchee	56.8	Type I	270	1.3	360	0	-	-	-
Index	Wenatchee	56.8	Type II	180	-	-	-	-	-	-
<b>Site Summary</b>		<b>56.8</b>		<b>450</b>	<b>1.3</b>	<b>360</b>	<b>0</b>	-	-	-
<b>Habitat Summary</b>			Type I	<b>270</b>	<b>1.3</b>	<b>360</b>	<b>0</b>			
			Type II	<b>180</b>	-	-	-			

**Additional Index Site Observations:**

- **River km 50.4** – This site is located at Jolanda Lake behind the coffee shop. Type I habitat is abundant within the lake, and our survey took place along the left bank in shallow water (at the edge where it drops off to deeper water).
- **River km 56.8** – This site is located downstream of the Highway 2 Bridge north of Jolanda Lake. Our survey was conducted where a side channel merges back with the main river. This is the only site where larval lamprey were found upstream of Tumwater Dam. Lamprey were found on the shallow edge of a pool in a small backwater area.
- **River km 63.8** – This site is located north of River Road, north of Jolanda Lake. This site is on the left bank of the river. Crossing the river is necessary to reach this site without a boat. Our survey was focused at the mouth of a side channel. There was abundant Type I habitat near the mouth, though further upstream, the side channel is mostly Type III habitat.
- **River km 84.0** – This site is located 2.6 river km downstream of Lake Wenatchee accessed off of Old Highway 150. Large deposits of Type I habitat are located along the channel margins intermixed with large woody debris (primarily on the left bank). Type I habitat is located primarily along the left bank. This is a great place for larval lamprey!

## Upper Wenatchee Mainstem – Exploratory Sites

- A total of three exploratory sites were surveyed upstream of Tumwater Dam in the mainstem of the Wenatchee River. No lamprey were found at the supplemental sites. Of the available habitat present, the percent of Type I was low (13-21%). Surveys were conducted in a side channel at river km 52.3 (downstream of where larval lamprey were found), but no lamprey were present at this site (despite quality Type I habitat).

**Table 16. Larval lamprey habitat details from exploratory sites surveyed in the Upper Wenatchee River. Under “Survey Type”, a “Short Survey” indicates that only Type I or Type II habitat was electrofished, and “Visited” indicates that a site was not electrofished. The percent of larval habitat shown is the ratio between available Type I and Type II habitat, and excludes Type III (unusable) habitat within the 50 m survey reach. Under “Type I Habitat Type”, “Edge” indicates that the primary survey location (for Type I habitat) was on the edge of the main channel. Plot temp was taken where the most lampreys were found, and thalwag temp was taken in the main channel flow. Plot temp was taken where the most lampreys were found, and thalwag temp was taken in the main channel flow.**

Site Type	Stream	River KM	Date	Survey Type	% Type I in 50 m	% Type II in 50 m	Type I Habitat Type	Primary Fine Sediment (Type I)	Primary Fine Sediment (Type II)	Plot Temp °C (Best)	Thalwag Temp °C
Expl.	Wenatchee	52.3	8/24/16	Visit	13%	87%	Side Chan.	Sand	-	18.0	-
Expl.	Wenatchee	57.2	8/24/16	Visit	0%	0%	-	-	-	-	-
Expl.	Wenatchee	74.6	8/24/16	Short	21%	79%	Edge	0%	-	-	17.0

**Table 17. Survey details, separated by habitat type, for the Upper Wenatchee River exploratory sites surveyed in in August, 2016. The total number of lampreys observed was adjusted (increased) based on the following 1-5 visibility scale (estimated % visibility in parenthesis): (1) poor (60%), (2) fair (70%), (3) good (80%), (4) very good (90%) and (5) excellent (100%). Survey densities (#/m<sup>2</sup>) were calculated using the adjusted observed number of lampreys. The summary rows are a sum of presented values, except for e-fish density which is a mean of presented values.**

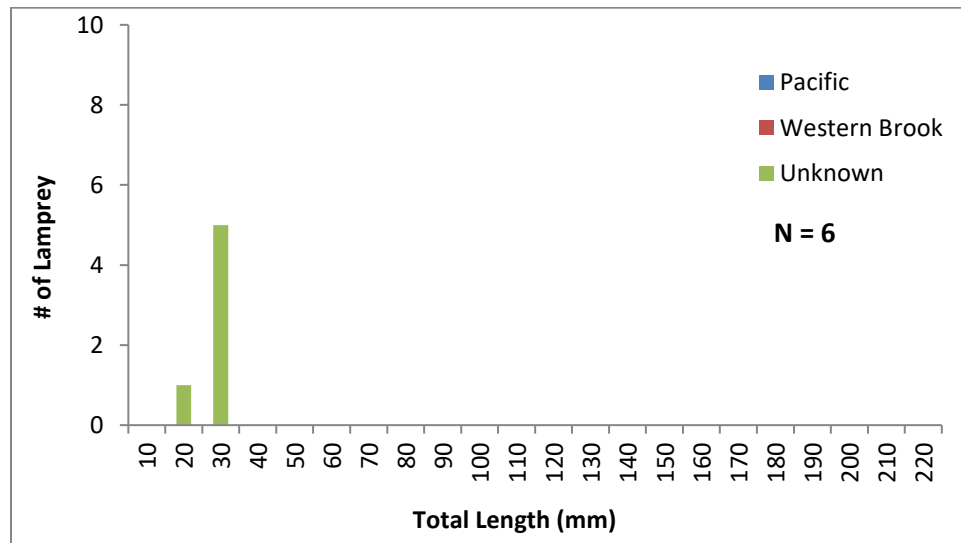
Site Type	Stream	River KM	Habitat Type Surveyed	Shock Time (sec)	Shock Area (m2)	# Captured	# Observed	Survey Visibility (1-5)	Total # Observed (Adjusted)	E-Fish Density (#/m2)
Expl.	Wenatchee	52.3	Type I	862	20	0	0	1	-	-
Expl.	Wenatchee	74.6	Type I	767	14	0	0	3	-	-
Expl.	Wenatchee	52.3	Type II	0	-	-	-	-	-	-
Expl.	Wenatchee	74.6	Type II	0	-	-	-	-	-	-
<b>Site Summary</b>		<b>52.3</b>	-	<b>862</b>	<b>20</b>	<b>0</b>	<b>0</b>	<b>1</b>	-	-
		<b>74.6</b>		<b>767</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>3</b>		
<b>Habitat Summary</b>		-	<b>Type I</b>	<b>767</b>	<b>14</b>	<b>0</b>	<b>0</b>	-	-	-
			<b>Type II</b>	-	-	<b>0</b>	<b>0</b>			

## Genetic Samples – Lower Wenatchee River

A total of six genetic samples were collected from the Upper Wenatchee River (Table 19). These genetic samples are crucial to understand the spawning success and migration patterns of adult Pacific Lamprey released upstream of Tumwater Dam in 2015 and 2016.

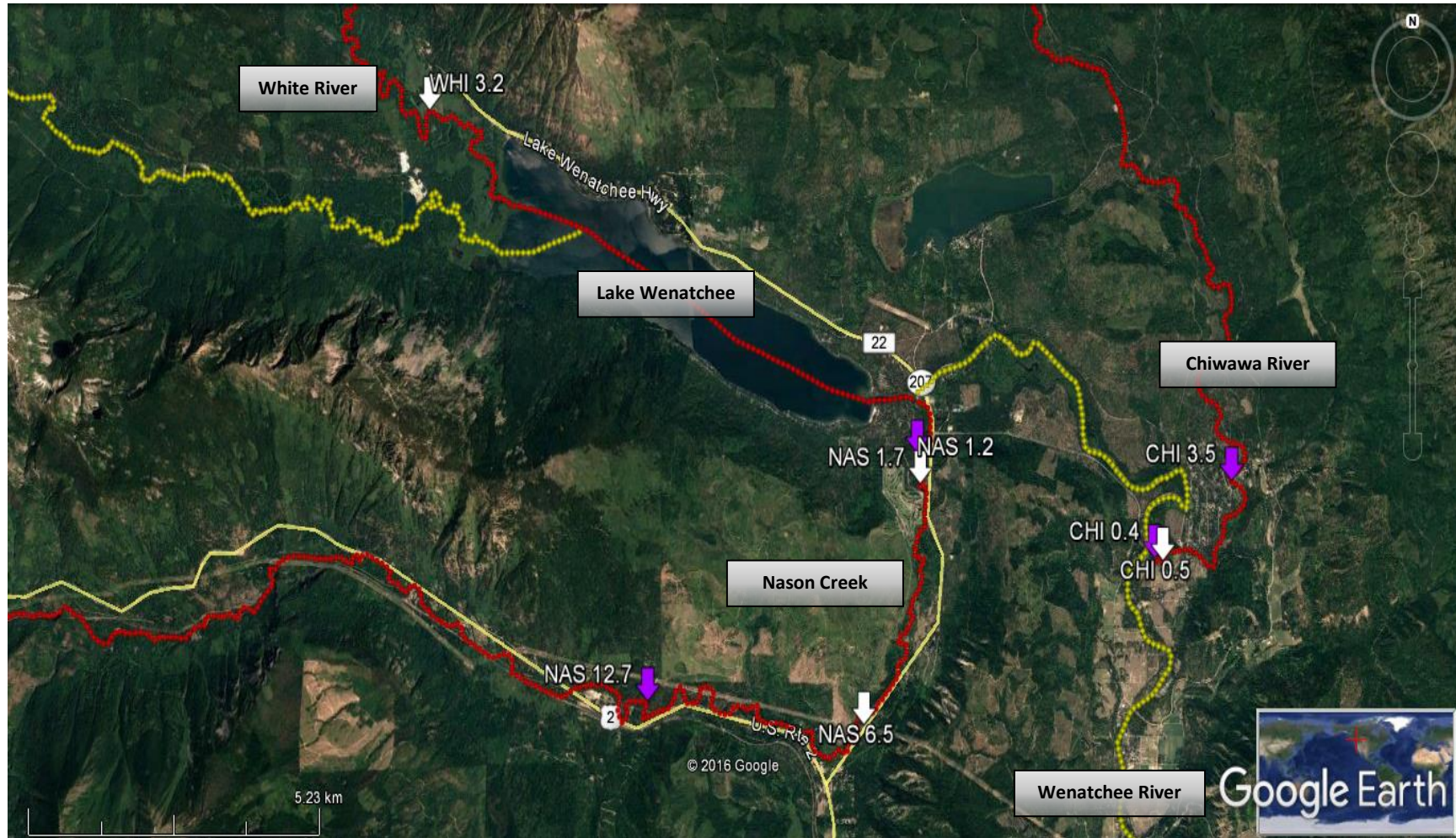
**Table 19. Genetic samples collected from the Upper Wenatchee River August, 2016.**

Stream Name	River KM	Collection Date	# of Pacific Samples (Larvae)	# of Pacific Samples (Macro.)	# of Western Brook Samples	# Unknown Species Samples (< 50 mm)	Primary Collection Purpose
Wenatchee	56.8	8/24/16	0	0	0	6	Translocaiton Success
<b>Total</b>			<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>	



**Figure 3. Histogram of all measured lampreys captured during electrofishing surveys, separated by species (“PA”= Pacific Lamprey (blue), “UN”=Unknown Lamprey <50 mm (green)), in the Upper Wenatchee River in August, 2016.**

## Upper Wenatchee Tributaries



Map 3. Overview of tributary streams of the Upper Wenatchee Subbasin (Chiwawa River, Nason Creek, and White River) shown with a red line. The Wenatchee River is shown with a yellow line. White arrows indicate exploratory sites where electrofishing occurred. Purple arrows indicate exploratory sites that were visited but not surveyed.

**Table 18. Larval lamprey habitat details from exploratory sites surveyed in tributary watersheds of the Upper Wenatchee River. Under “Survey Type”, a “Short Survey” indicates that only Type I or Type II habitat was electrofished; “Visit” indicates that no electrofishing occurred. The percent of larval habitat shown is the ratio between available Type I and Type II habitat, and excludes Type III (unusable) habitat within the 50 m survey reach. Under “Type I Habitat Type”, “Edge” indicates that the primary survey location (for Type I habitat) was on the edge of the main channel; “Side Chan.” indicates that this occurred in a side channel. Plot temp was taken where the most lampreys were found, and thalweg temp was taken in the main channel flow.**

Site Type	Stream	River KM	Date	Survey Type	%	%	Type I Habitat Type	Primary Fine Sediment (Type I)	Primary Fine Sediment (Type II)	Plot Temp °C (Best)	Thalweg Temp °C
					in 50 m	Type II in 50 m					
Expl.	Chiwawa	0.4	8/24/16	Visit	-	-	-	-	-	-	14.0
Expl.	Chiwawa	0.5	8/24/16	Short	24%	76%	Edge	Sand	-	-	14.0
Expl.	Chiwawa	3.5	8/24/16	Visit	-	-	-	-	-	-	-
Expl.	Nason	1.7	8/24/16	Visit	-	-	-	Sand	-	-	-
Expl.	Nason	1.9	8/24/16	Visit	-	-	-	-	-	-	-
Expl.	Nason	6.5	8/24/16	Short	69%	31%	Side Chan.	Sand	-	14.2	14.2
Expl.	Nason	12.7	8/24/16	Visit	-	-	-	Sand	-	-	-
Expl.	White	3.2	8/23/16	Short	98%	2%	Edge	Sand	-	12.8	-

**Table 19. Survey details, separated by habitat type, for tributary watersheds of the Upper Wenatchee River exploratory sites surveyed in August, 2016. The total number of lampreys observed was adjusted (increased) based on the following 1-5 visibility scale (estimated visibility % in parenthesis): (1) poor (60%), (2) fair (70%), (3) good (80%), (4) very good (90%) and (5) excellent (100%). Survey densities (#s/m<sup>2</sup>) were calculated using the adjusted observed number of lampreys. The summary rows are a sum of presented values, except for e-fish density which is a mean of presented values.**

Site Type	Stream	River KM	Habitat Type Surveyed	Shock Time (sec)	Shock Area (m <sup>2</sup> )	# Captured	# Observed	Survey Visibility (1-5)	Total # Observed (Adjusted)	E-Fish Density (#/m <sup>2</sup> )
Expl.	Chiwawa	0.5	Type I	513	9	0	0	5	-	-
Expl.	Nason	6.5	Type I	480	12	0	0	5	-	-
Expl.	White	3.2	Type I	671	13	0	0	5	-	-
Expl.	Chiwawa	0.5	Type II	0	-	-	-	-	-	-
Expl.	Nason	6.5	Type II	0	-	-	-	-	-	-
Expl.	White	3.2	Type II	0	-	-	-	-	-	-
<b>Site Summary</b>		<b>0.5</b>		<b>513</b>	<b>9</b>	<b>0</b>	<b>0</b>			
		<b>6.5</b>		<b>480</b>	<b>12</b>	<b>0</b>	<b>0</b>			
		<b>3.2</b>		<b>671</b>	<b>13</b>	<b>0</b>	<b>0</b>			
<b>Habitat Summary</b>			<b>Type I</b>	<b>1664</b>	<b>34</b>	<b>0</b>	<b>0</b>			
			<b>Type II</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>			

## Additional Exploratory Site Observations

- **Chiwawa River, river km 0.4** – This site is located downstream of the WDFW Chinook acclimation site. The site was accessed from the acclimation site. Type I habitat is located on the inside edge of a bend in the stream. The majority of the available habitat at this site, however, is Type II habitat. There is a dry side channel also at this site (Type III habitat only within the dry side channel).
- **Chiwawa River, river km 0.5** – This site is located downstream of the WDFW Chinook acclimation site. The site was accessed from the acclimation site. The electrofishing survey took place in Type I habitat collected on the left bank of the river. Type I habitat was focused along the bank though the majority of the available habitat was Type II habitat. This is a great site for lamprey.
- **Chiwawa River, river km 3.5** – This site is located upstream of the Old High 150 Bridge where it crosses the Chiwawa River. The majority of the available habitat here is Type II habitat. Type I habitat is limited, primarily located behind large woody debris near the bridge.
- **Nason Creek, river km 1.7** – This site is located at the Nason Creek Campground (where the only bridge crosses the stream). There was only Type II habitat (silt on top of boulders and cobble) visible from the bridge as far as we could see (~25 upstream and ~25 downstream of the bridge).
- **Nason Creek, river km 1.9** – This site is located at the Nason Creek Campground (towards the East End of the campground downstream of the bridge mentioned above). The only available habitat was located in a side channel (more Type II than Type I). There was limited flow into the side channel and most of the channel was dry (and was primarily Type III habitat).
- **Nason Creek, river km 12.7** – This site is located downstream of Riverside Road (a private road) where it crosses Nason Creek. We walked ~ 100 m downstream of the bridge and Type I habitat is located in a deep pool. Type II is spread throughout the reach. Also, at river km 12.8 (under the bridge) there is Type I habitat located along the channel margins (primarily the left bank).
- **White River, river km 3.2** – The White River is located upstream of Lake Wenatchee. This site is upstream of the Little Wenatchee Road Bridge where it crosses the White River. The majority of this reach of river is Type I habitat. The channel is wide with slower flows at this location allowing for sediment to deposit throughout the reach.

## Appendix: Additional Site Maps and Photos

### Lower Wenatchee River Mainstem (downstream of Tumwater Dam, Rkm 50.1)



**Map A1.** Site map of Lower Wenatchee River site at river km 1.0 (surveyed in August , 2016); red balloon indicates presence of Pacific Lamprey. The small red dots indicate stream distance of 100 m.



**Photo A1.** Lower Wenatchee River index site at river km 1.0; overview of habitat (left) and close-up of best Type I habitat (right) from 2016 survey.



**Map A2.** Site map of Lower Wenatchee River index site at river km 8.8 (surveyed in August, 2016); red balloon indicates presence of Pacific Lamprey. The small red dots indicate stream distance of 100 m.



**Photo A2.** Lower Wenatchee River index site at river km 8.8; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand/organic debris (right) from 2016 survey.





**Map A3. Site map of Lower Wenatchee River site at river km 24.1 (surveyed in August, 2016); red balloon indicates presence of Pacific Lamprey. The small red dots indicate stream distance of 100 m.**



**Photo A3. Lower Wenatchee River site at river km 24.1; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.**



**Map A4. Site map of Lower Wenatchee River index site at river km 40.4 (surveyed in August, 2016); red balloon indicates presence of Pacific Lamprey. The small red dots indicate stream distance of 100 m.**



**Photo A4. Lower Wenatchee River index site at river km 40.4; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand/organic debris (right) from 2016 survey.**

## Upper Wenatchee River Mainstem (upstream of Tumwater Dam, Rkm 50.1)



Map A6. Site map of Upper Wenatchee River index site at river km 50.4 (surveyed in August, 2016); white balloon indicates that no lamprey were present at this site. The small red dots indicate stream distance of 100 m.



Photo A6. Upper Wenatchee River index site at river km 50.4; overview of Type I habitat (left) and close-up of best Type I habitat (right) from 2016 survey.



**Map A7. Site map of Upper Wenatchee River site at river km 52.3 (surveyed in August, 2016); white balloon indicates that no lamprey were present at this site. The small red dots indicate stream distance of 100 m.**



**Photo A7. Upper Wenatchee River site at river km 52.3; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.**



**Map A8. Site map of Upper Wenatchee River index site at river km 56.8 (surveyed in August, 2016); yellow balloon indicates that lamprey of unknown species (<50 mm) were present at this site. The small red dots indicate stream distance of 100 m.**



**Photo A8. Upper Wenatchee River index site at river km 56.8; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.**



**Map A9.** Site map of Upper Wenatchee River site at river km 57.2 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.



**Photo A9.** Upper Wenatchee River site at river km 57.2; upstream view of site (left) and close-up of best Type I habitat (right) from 2016 survey.



**Map A10. Site map of Upper Wenatchee River index site at river km 63.8 (surveyed in August, 2016); white balloon indicates that no lamprey were present at this site. The small red dots indicate stream distance of 100 m.**



**Photo A10. Upper Wenatchee River index site at river km 63.8; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.**



**Map A11. Site map of Upper Wenatchee River site at river km 74.6 (surveyed in August, 2016); white balloon indicates that no lamprey were present at this site. The small red dots indicate stream distance of 100 m.**



**Photo A11. Upper Wenatchee River site at river km 74.6; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.**





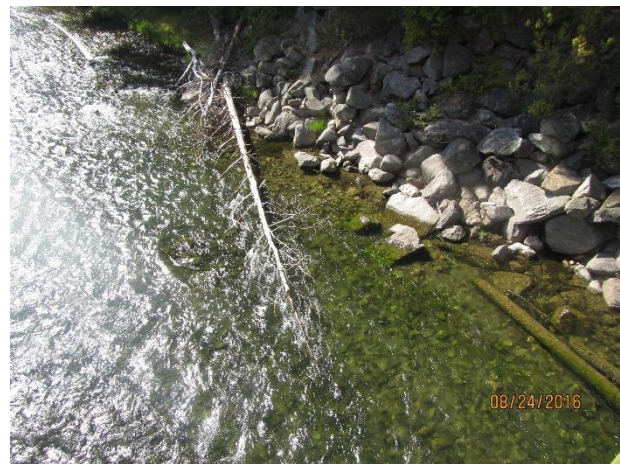
**Map A12. Site map of Upper Wenatchee River index site at river km 84.0 (surveyed in August, 2016); white balloon indicates that no lamprey were present at this site. The small red dots indicate stream distance of 100 m.**



**Photo A12. Upper Wenatchee River index site at river km 84.0; overview of Type I habitat (left) and close-up of best Type I habitat sediment (right) from 2016 survey.**



**Map A13.** Site map of Upper Wenatchee River site at river km 86.5 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.



**Photo A13.** Upper Wenatchee River site at river km 86.5; overview of site (left) and overview of best habitat (right) from 2016 survey.

## Upper Wenatchee River Tributaries

### Chiwawa River



**Map A14.** Site map of Chiwawa River site at river km 0.4 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.



**Photo A14.** Chiwawa River site at river km 0.4; overview of Type I habitat (left) and close-up of best Type I habitat (right) from 2016 survey.



**Map A15. Site map of Chiwawa River site at river km 0.5 (surveyed in August, 2016); white balloon indicates that no lamprey were present at this site. The small red dots indicate stream distance of 100 m.**



**Photo A15. Chiwawa River site at river km 0.5; close-up of Type I habitat (left) and overview of best Type I habitat (right) from 2016 survey.**



**Map A16.** Site map of Chiwawa River site at river km 3.5 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.

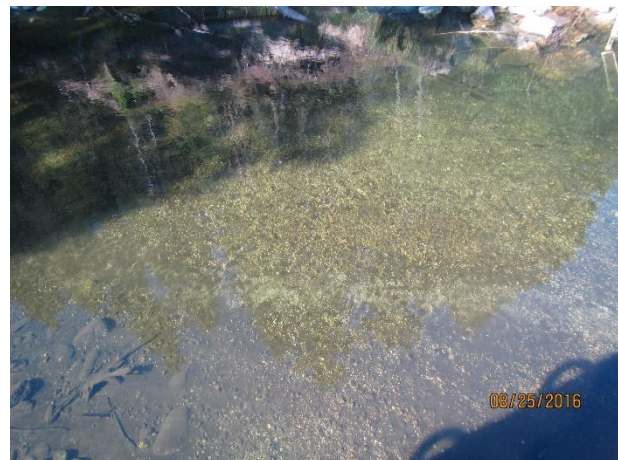
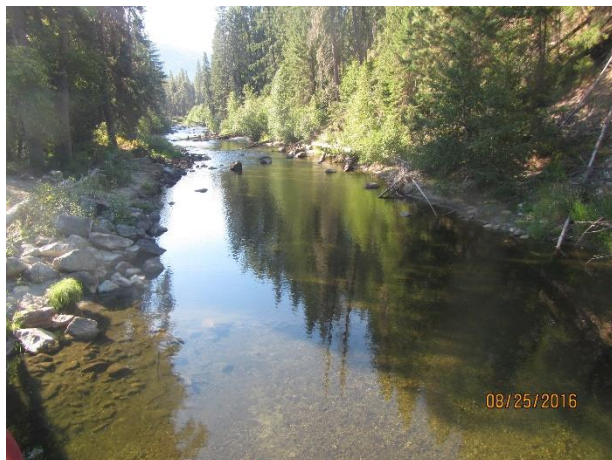


**Photo A16.** Chiwawa River site at river km 3.5; upstream view of site (left) and close-up of best Type I habitat (right) from 2016 survey.

## Nason Creek



**Map A17. Site map of Nason Creek site at river km 1.2 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.**



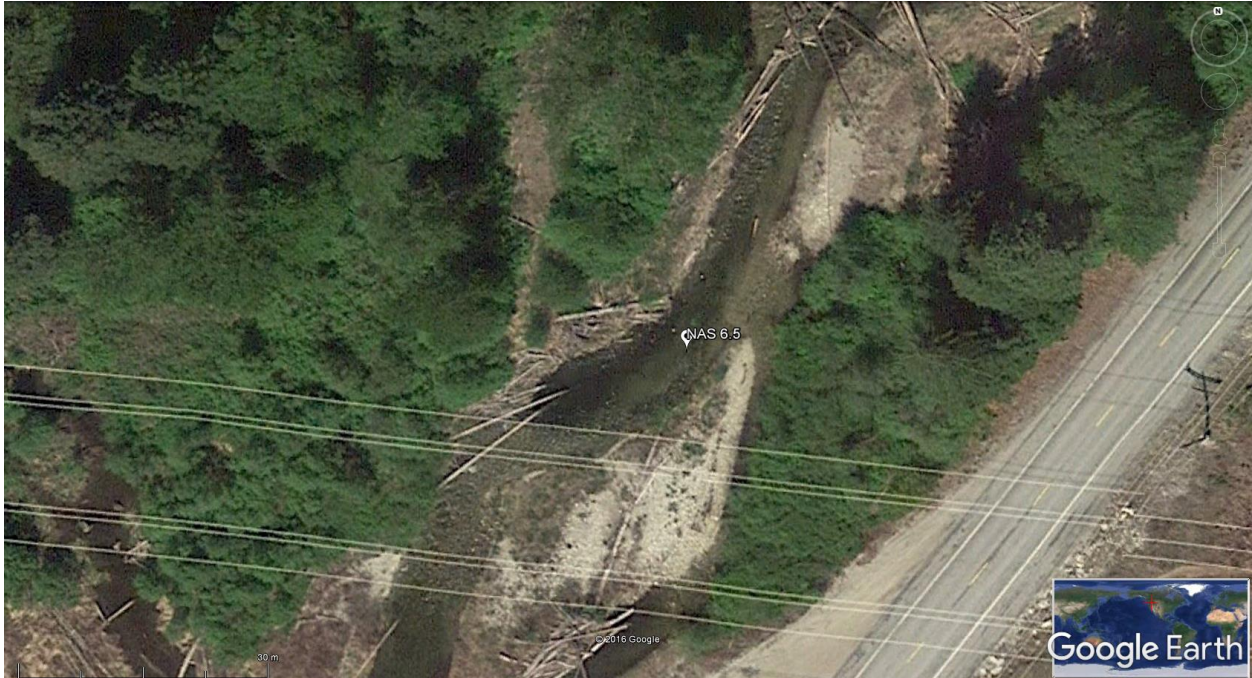
**Photo A17. Nason Creek site at river km 1.2; overview of site (left) and close-up of best Type I habitat (right) from 2016 survey.**



**Map A18. Site map of Nason Creek site at river km 1.7 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.**



**Photo A18. Nason Creek site at river km 1.7; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.**

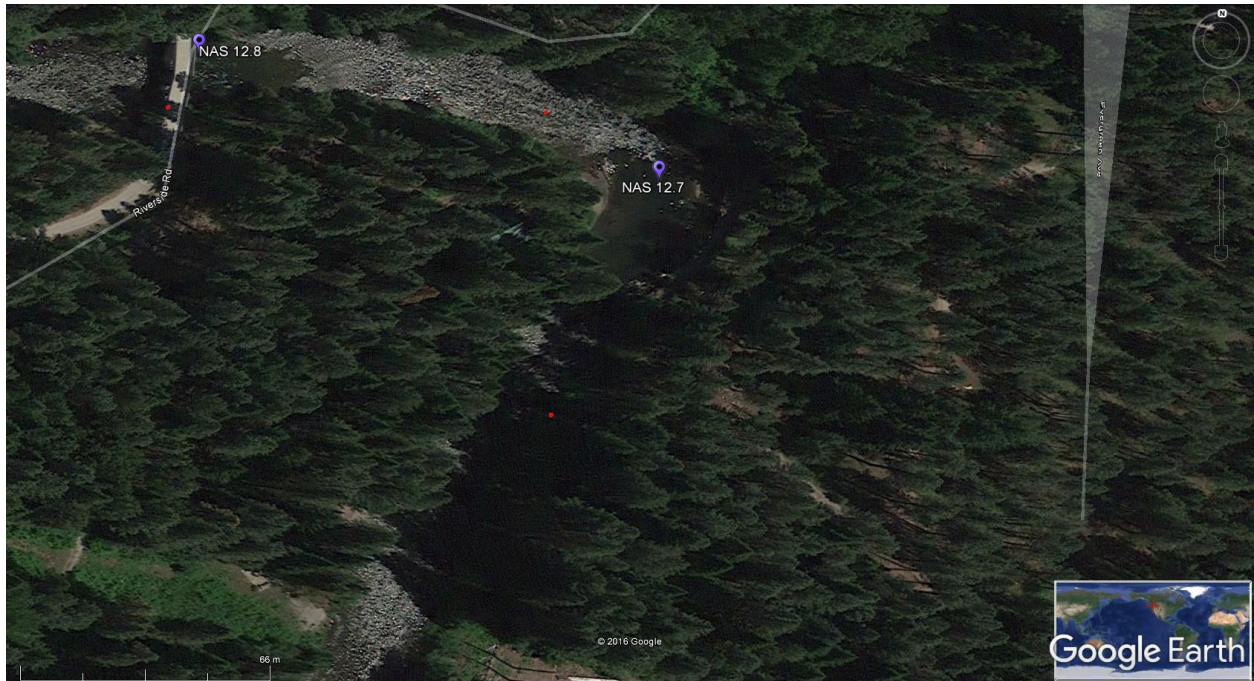


**Map A19.** Site map of Nason Creek index site at river km 6.5 (surveyed in August, 2016); white balloon indicates that no lamprey were present at this site. The small red dots indicate stream distance of 100 m.



**Photo A19.** Nason Creek index site at river km 6.5; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.

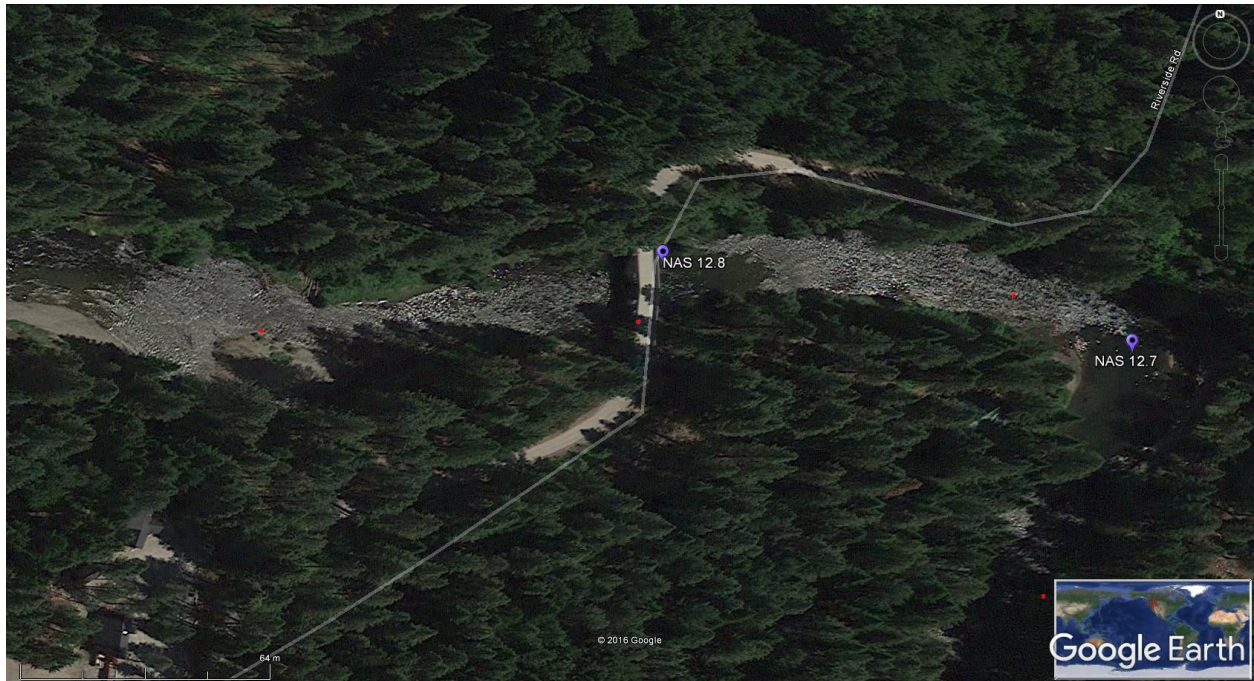




**Map A20.** Site map of Nason Creek index site at river km 12.7(visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.



**Photo A20.** Nason Creek index site at river km 12.7; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.

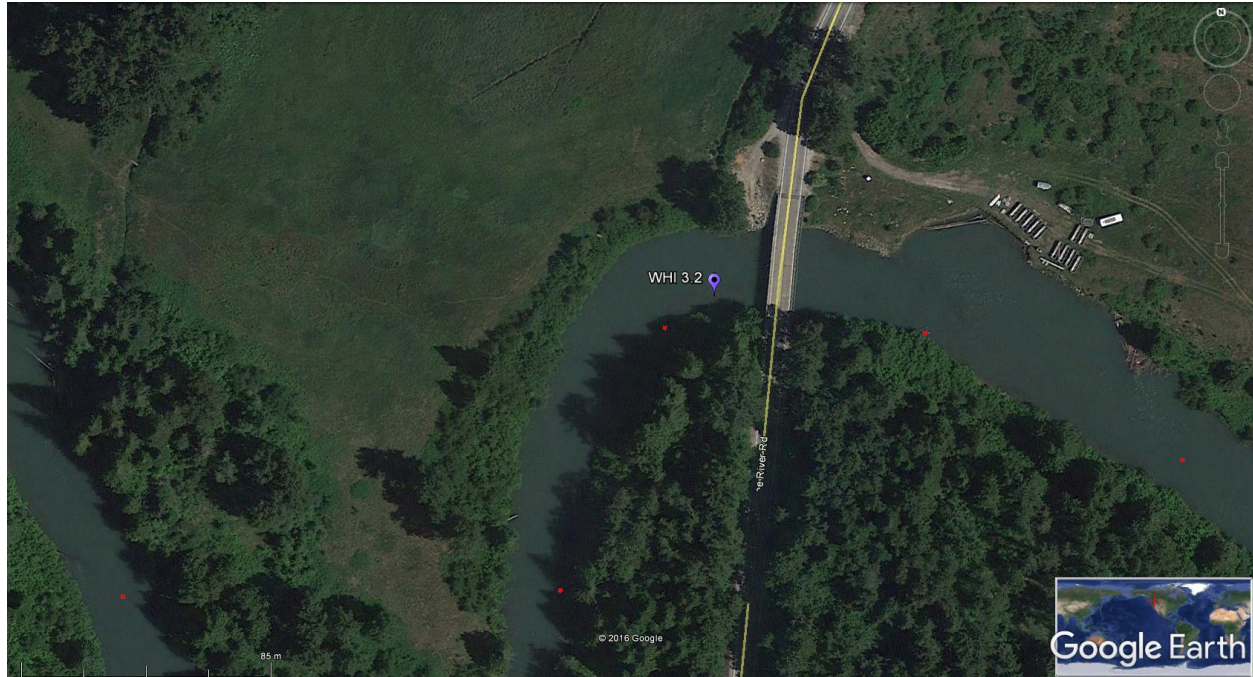


**Map A21.** Site map of Nason Creek site at river km 12.8 (visited in July, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.



**Photo A21.** Nason Creek site at river km 12.8; overview of Type I habitat (left) and close-up of best Type I habitat (right) from 2016 survey.

## White River



**Map A22.** Site map of White River index site at river km 3.2 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016. The small red dots indicate stream distance of 100 m.



**Photo A22.** White River index site at river km 3.2; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.