



Annual Monitoring Report:

## Mahogany Creek Culvert Replacement Project

Contract No: 27255  
BPA Project No: 1992-026-01

BY

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## ABSTRACT

This annual monitoring report covers activities under the Grande Ronde Model Watershed/Bonneville Power Administration contract No. 27255, entitled *Mahogany Creek Culvert Replacement Project*. Prior to the completion of this project, the Mahogany culvert was undersized, had an outlet drop of two feet and was considered a barrier to all life history stages of all aquatic species. The primary project objective was to replace the culvert with a 15 feet wide open-bottom arch that allows passage of all life stages of all aquatic species. The stream channel was reconstructed through the newly installed culvert utilizing stream simulation techniques. This project re-opened 3.5 miles of spawning and rearing habitat for Snake River steelhead, and rearing habitat for Chinook and bull trout, upstream of the structure. This project continues to meet project objectives one year post-implementation.

## INTRODUCTION

The Mahogany Creek Culvert Replacement project area is located within the Imnaha Subbasin only 150 feet from the Imnaha River. This culvert was a known fish passage barrier and at the time was the highest priority culvert for the Forest Service to replace (Ken Bronec, Forest Service, Pers. Comm., 2005). Its replacement was supported by the Nez Perce Tribe as well as several other agencies (Brad Smith, ODFW, Pers. Comm., 2005; Gretchen Sausen, USFWS, Pers. Comm. 2005).

The bankfull width of Mahogany Creek is 10.5 feet. The old culvert was only 6 feet in diameter and had a 2-foot perch at the outlet which resulted in a total migration barrier to adult and juvenile anadromous salmonids. This culvert blocked at least 3.5 miles of spawning and rearing habitat for threatened steelhead and up to 3.5 miles of rearing habitat for threatened Chinook and, potentially, bull trout. Road fill was also eroding above both ends of the old culvert causing sediment to wash into the stream.

The Mahogany Creek Culvert Replacement Project replaced the undersized, perched culvert with a 15' wide x 7'9" high x 50' long open-bottom arch that has sufficient capacity to handle a 100-year flood event, and long enough to reduce roadfill erosion. It was installed using stream simulation techniques.

Two kinds of monitoring were used for this project: implementation monitoring ("Did the project get implemented?") and effectiveness monitoring ("Is the project effective over time?"). Effectiveness monitoring will require several years to complete, but implementation monitoring in 2006 determined that the Mahogany Creek Culvert Replacement Project accomplished all of the stated project objectives:

- Allowed passage to all aquatic species
- Increased habitat complexity in this area by re-opening more complex habitat areas
- Increased access to refugia areas during high and low flow events
- Decreased erosion from the road
- Provided educational opportunities to local students through a tour conducted with students from Whitman College.

## ASSESSMENT

Effectiveness monitoring during the 2007 field season determined that the project objectives stated in the Introduction continue to be met. One issue did arise during monitoring efforts that is worth investigating for future projects. The hydro-mulch applied in the fall of 2006 was very effective and the native grass seed germinated successfully. Much of the grass, however, did not survive throughout the summer season. This was likely due to the persistent presence of cattle on site in the spring of 2007, which removed much of the native grass and allowed for the germination and growth of undesirable species. These species were treated in 2007 and will continue to be treated indefinitely. In the meantime, the project area will be re-seeded with native grass seed in the spring of 2008.

Surveys utilized for effectiveness monitoring results were cross-sectional surveys, longitudinal surveys, Wolman pebble counts, vegetation survival rate surveys and permanent photo-points. Most of these surveys were conducted prior to construction, immediately following construction and one year post-construction. The longitudinal profile survey was 290 feet long and included the construction area as well as extended portions of undisturbed stream above and below the construction area. Surveys will be repeated 3 and 5 years post-implementation with the hope of capturing at least one high flow event within that monitoring period. If a high flow event occurs, surveys will reveal useful information about the stability of the structure at those flows.

The pre-implementation longitudinal profile is shown in Figure 1 (below), while the longitudinal profiles conducted post-construction are shown in Figure 2. The profile immediately following construction is drawn in pink, while the same survey conducted one year later is shown in dark blue. The newly installed open-bottom arch is depicted by the cylinder. It is important to note that the stations shown in Figure 2 are unique for each year, i.e. the cloth measuring tape will not lay in exactly the same place from year to year due to physical changes in streambed structure, so XS2 may appear to be in 2 different locations when it is actually a fixed point. Other fixed points that are monumented on the ground are the starting point, XS1, the culvert inlet and the culvert outlet.

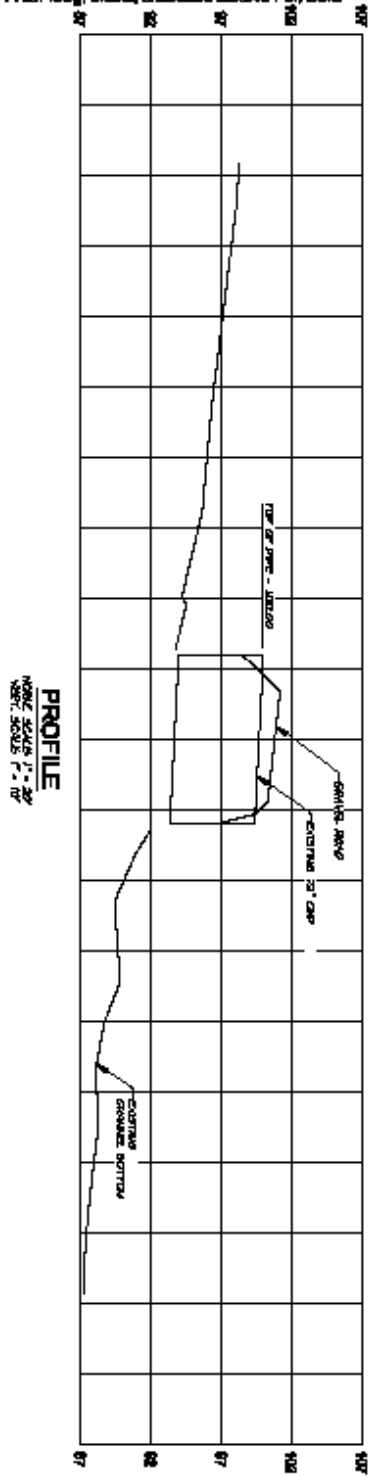
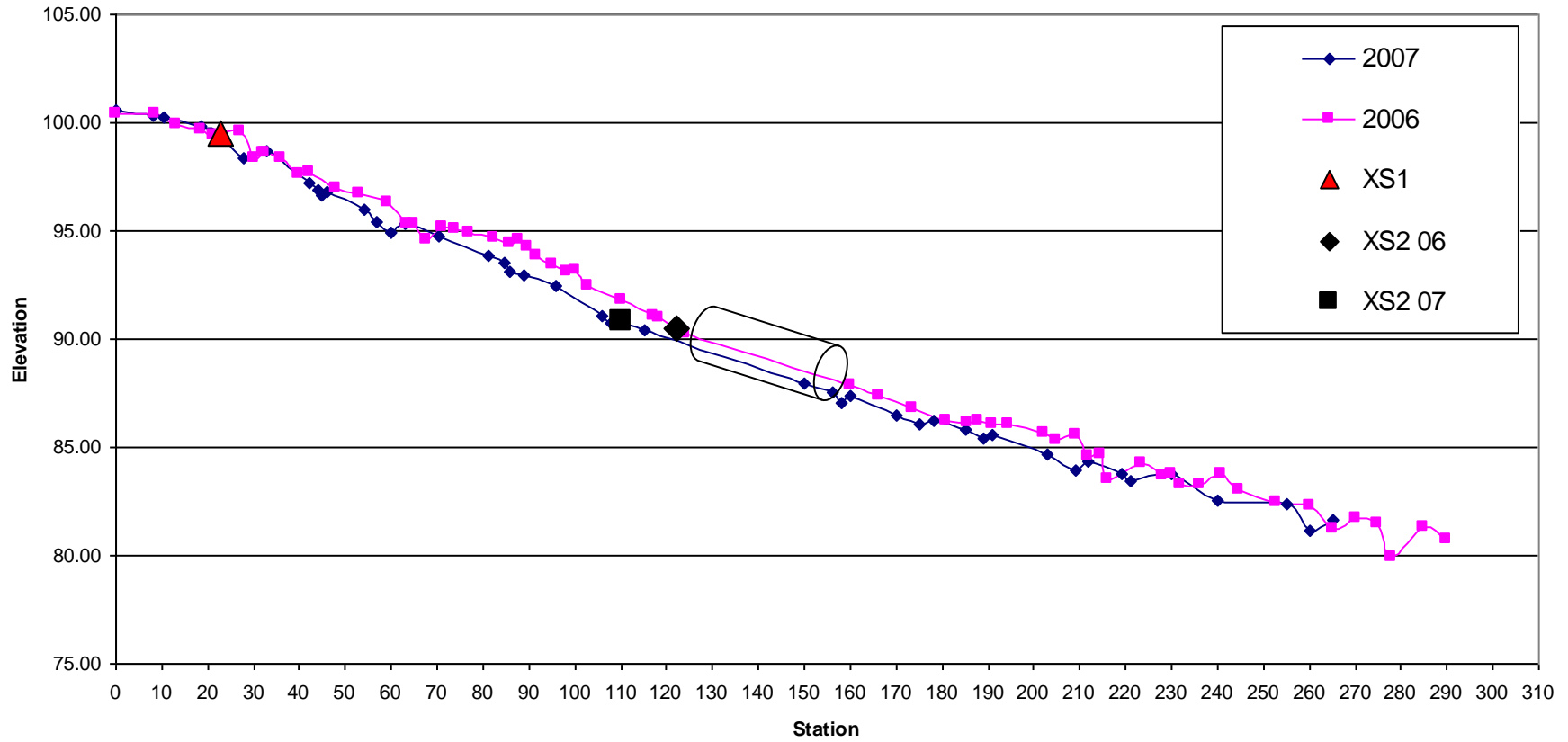


Figure 1. Pre-implementation longitudinal profile for Mahogany Creek (2004).

### Mahogany Longitudinal Profiles



**Figure 2.** Post-implementation longitudinal profiles for Mahogany Creek (2006 and 2007).

Figures 3 and 4 display the results of cross-sectional surveys taken immediately after construction (2006) and again one year after implementation (2007). A cross-sectional survey was not conducted prior to implementation. The location along the longitudinal profile for these two cross sections is depicted in Figure 2 above as “XS1” and “XS2”. Cross-section 1 is located upstream of the project area and was undisturbed during culvert installation. Cross-section 2 is located within the project area, near the culvert inlet.

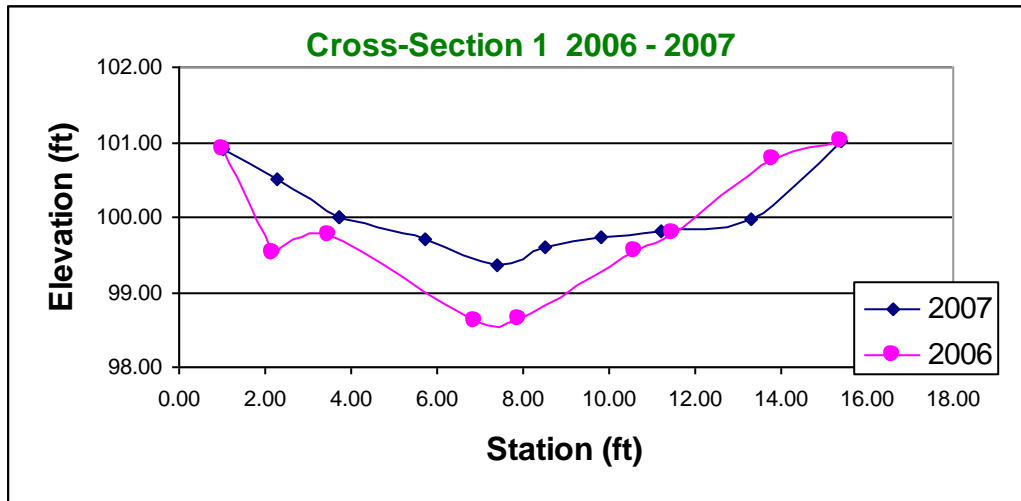


Figure 3. XS1 elevations in 2006 and 2007.

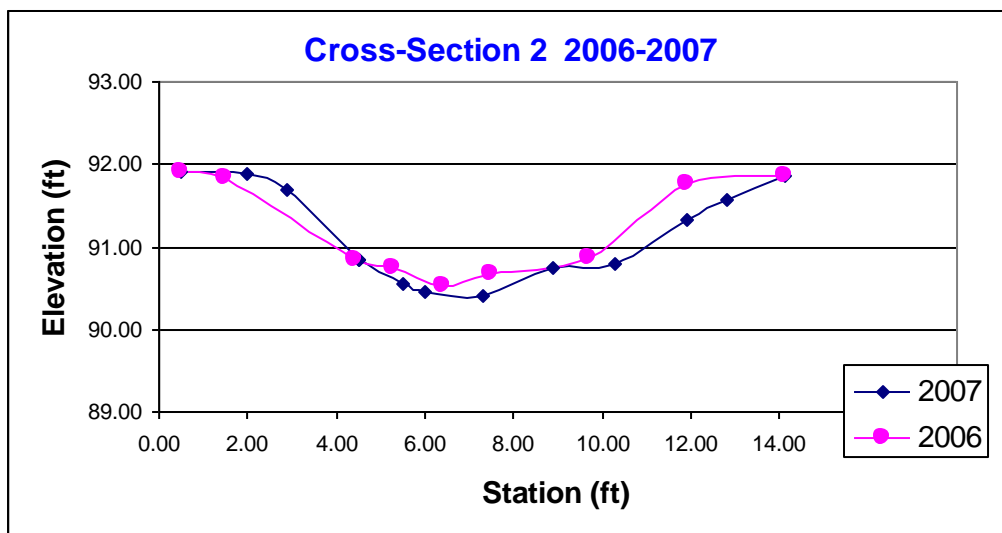
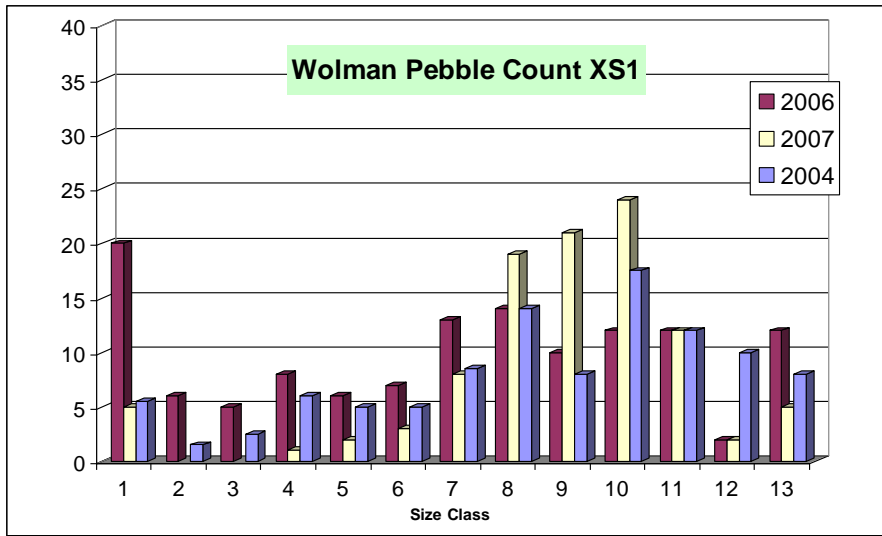
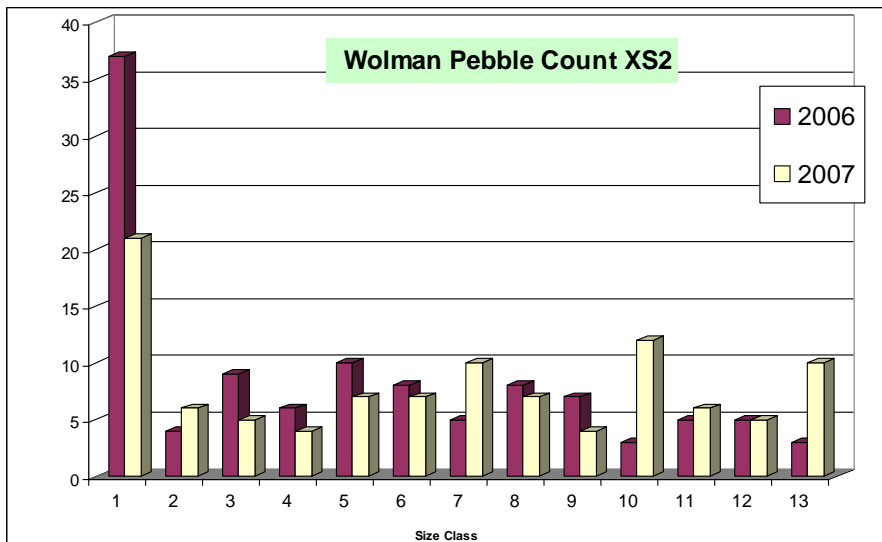


Figure 4. XS2 elevations in 2006 and 2007.

The results of the Wolman pebble counts are displayed in Figures 5 and 6. Pebble counts were conducted at each cross section. Figure 5 represents a comparison of the particle sizes at XS1 for pre-, post- and one year post-implementation. Figure 6 represents a comparison of particle sizes for post- and one year post-implementation for XS2. A Wolman pebble count was not measured for XS2 in 2004. These figures allow for a comparison of the substrate particle sizes across time both inside and outside the construction zone. The hypothesis is that there will not be a biologically significant<sup>1</sup> difference in particle size distribution at each cross-section at the end of the monitoring period.



**Figure 5.** XS1 Wolman pebble count results in 2004, 2006 and 2007.



**Figure 6.** XS2 Wolman pebble count results in 2006 and 2007.

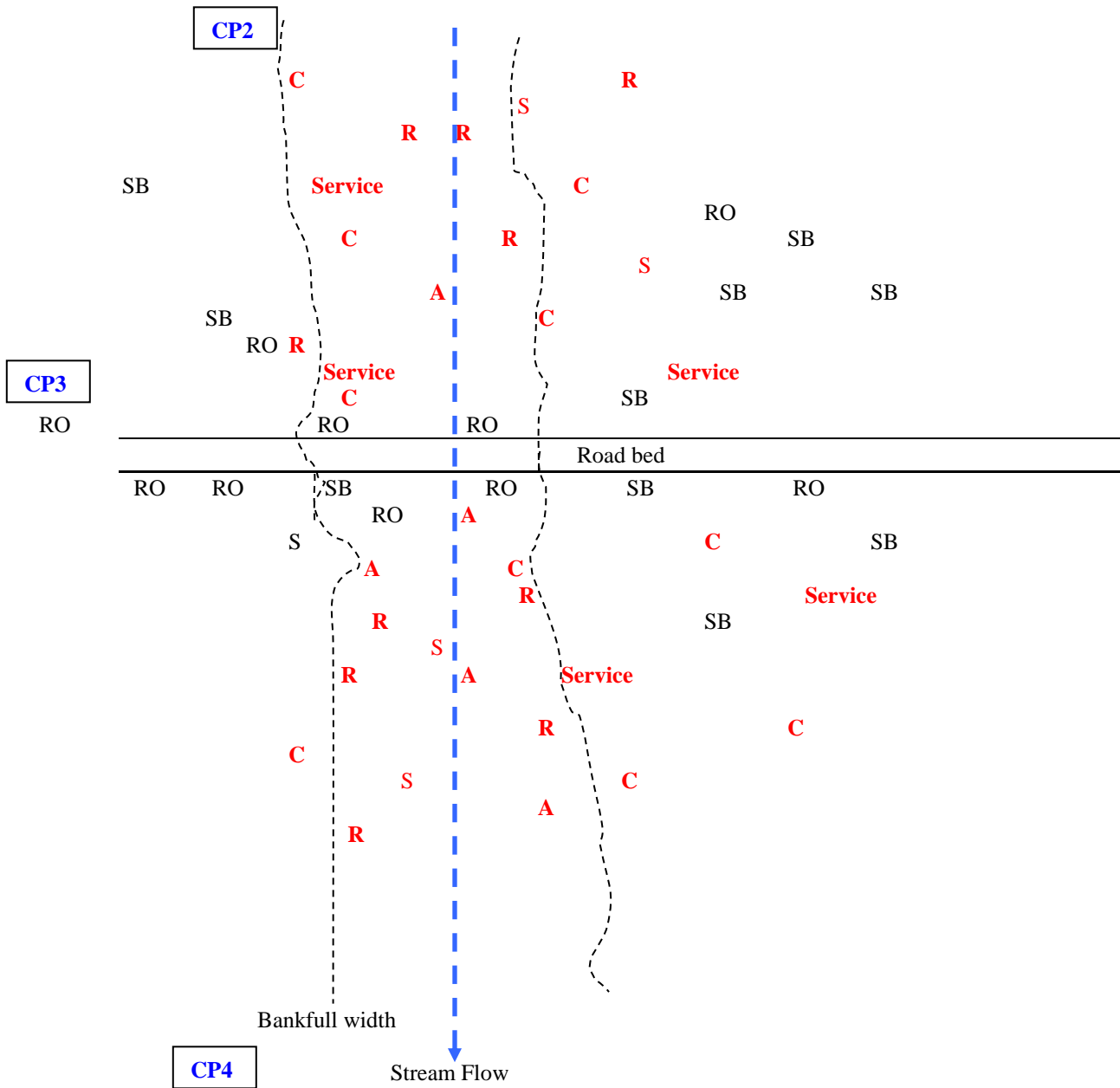
<sup>1</sup> Statistical significance typically refers to a predetermined alpha level of 0.05. However, biological significance in this instance refers to enough of a change to be important biologically and to begin to influence the behavior of aquatic organisms.

Table 1 lists the non-willow plant species that were planted post-implementation. The first five plants listed were caged with wire cages to protect them from ungulates (see photographs in the *Permanent Photographic Monitoring Points* section of this document). The letter code in Table 1 is the key to the plant species locations shown in Figure 7.

**Table 1.** Letter code, common and scientific names of the hardwoods planted.

<b>Letter Code Contained in Figure 7</b>	<b>Common Name</b>	<b>Scientific Name</b>
C	Cottonwood	<i>Populus trichocarpa</i>
A	Thinleaf Alder	<i>Alnus incana</i>
S	Syringa (Mock Orange)	<i>Philadelphus lewisii</i>
Service	Serviceberry	<i>Amelanchier alnifolia</i>
R	Redosier Dogwood	<i>Cornus sericea</i>
RO	Woods Rose	<i>Rosa woodsii</i>
SB	Snowberry	<i>Symphoricarpos albus</i>

Figure 7 is a diagram depicting the planting locations for non-willow species utilized to reclaim the site after construction. These species were planted in late October 2006 by NPT staff. There are three control points depicted in blue font. These control points correspond to the permanent photographic monitoring points discussed in the next section.



**Figure 7.** Diagram depicting the planting locations, species and control points.

Table 2 below shows the first year’s survival rates for Cottonwood, Thinleaf alder, Syringa, Serviceberry and Dogwood planted in 2006. These species are depicted in red font in Figure 7, above. Rose and snowberry survival rates were not determined as they are common on site, will likely regenerate naturally within a relatively short time frame, and are of a lesser importance for long term recovery of the site. Survival rates will be monitored again for the 3-year and 5-year monitoring report.

**Table 2.** Hardwood survival rates after one season.

Species	Number Planted October '06	Number Alive (September '07)	Survival Rate (percent)
Cottonwood	10	8	80
Thinleaf alder	5	4	80
Syringa	5	2	40
Serviceberry	5	3	60
Dogwood	10	6	60



There were approximately 250 snowberry berries collected and distributed on site in the fall of 2006 in addition to the plantings. A portion of these berries germinated and were alive and healthy in the summer of 2007.

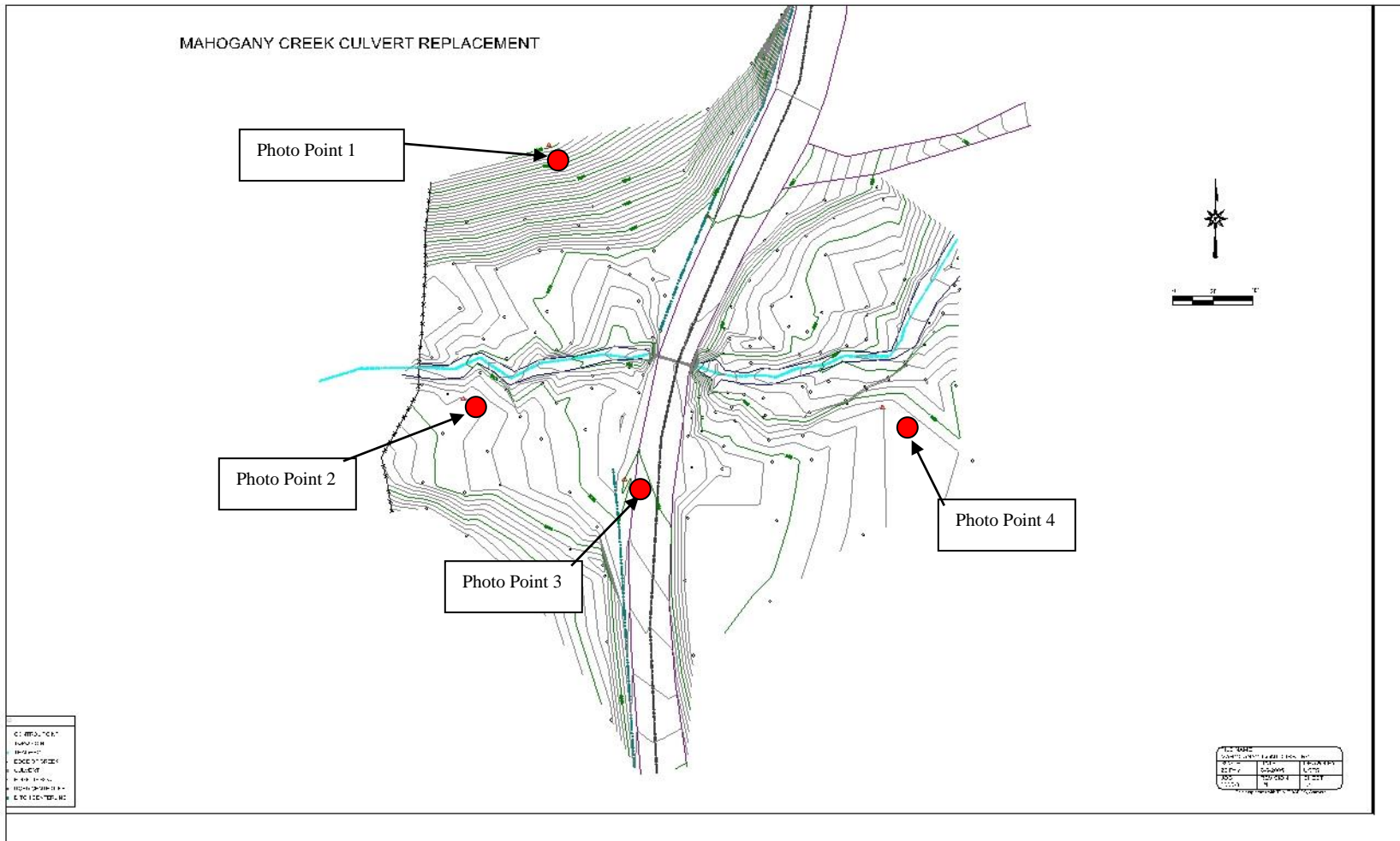


One of the stated objectives was to couple this restoration effort with an educational component. Along those lines, a class from Whitman College in Walla Walla, WA, toured the site in August 2006 as part of an environmental studies course titled “Semester in the West”. More information regarding

this semester-long course, including their visit to the Mahogany Creek Culvert Replacement Project can be found at [www.semesterinthewest.org](http://www.semesterinthewest.org).

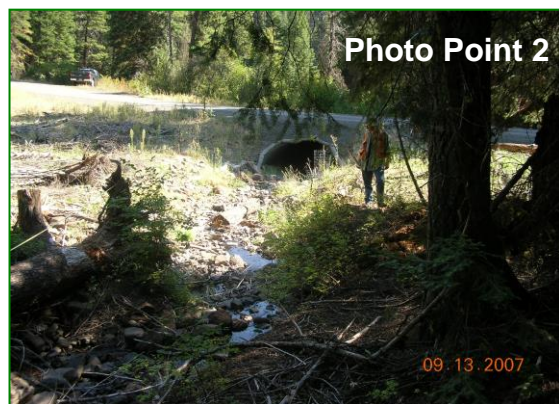
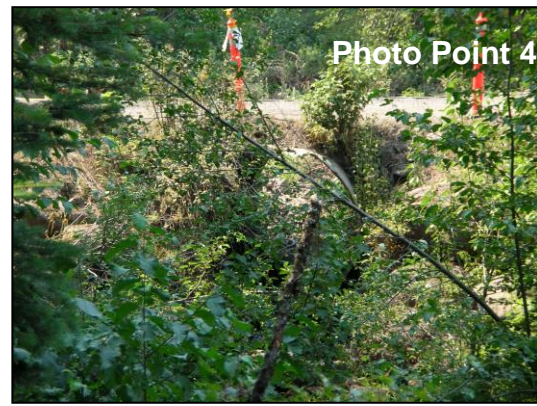
## PERMANENT PHOTOGRAPHIC MONITORING POINTS

The figure below depicts the locations of the permanent photographic points that are part of the monitoring plan for this project. These locations correspond to four of the five control points associated with the surveys that were conducted prior to implementation. After project completion, photographic point number 3 was discontinued as it did not show anything that isn't already captured in other photographic points. Additional photographs were taken and will continue to be taken at the inlet and outlet of the new arch.



**Figure 8.** Map depicting the permanent photographic points.

**Figure 9.** Photographic series at three photographic points during the project.





This photograph depicts the culvert outlet in 2005 before implementation. This is taken close to the location for Photo Point 4.

This picture was taken immediately after construction in 2006 and prior to any planting. This is taken from the same location as Photo Point 4. The difference is that it was taken with a telephoto lens, unlike previous photographs from this location.



Immediately following construction of this project, seventy-five willow plants that were salvaged from the site prior to implementation were planted along the newly constructed channel, shown in the picture to the right. Additionally, all disturbed areas were hydro-mulched on October 20, 2006. The hydro-mulch mixture was comprised of a native grass seed mixture suitable for this site that was obtained from the Forest Service.





above also contains an example of the cages used for plant protection.

The two photographs here depict examples of plant survival and vigor. The photograph



## DISCUSSION

For this discussion, implementation and effectiveness monitoring will be discussed. However, the focus will be directed at the effectiveness monitoring component. The implementation monitoring demonstrated that this project was accomplished in a timely manner. Effectiveness monitoring results to date indicate that the project is currently meeting all of the objectives, and there are no concerns for streambed stability.

The following is a summary of the accomplishments of this project to date:

- Re-opened 3.5 miles of habitat
- Reconstructed 114 feet of channel
- Planted 75 willow cuttings;
- Planted 47 other shrub/tree species
- Site tour with 21 students from Whitman College

The longitudinal profiles obtained post-construction (Fig 2) show that the new channel constructed was at the same gradient as the natural channel above, throughout and below the project area. The 20-ft section of scour downstream of the culvert outlet depicted in the 2004 profile (Fig 1) was removed with the construction of the new channel, as was the 13-ft section of aggradation downstream of the scour. Comparing the 2006 and 2007 profiles, it appears as though the channel has settled on average five inches through the construction area from station 70 to station 220. This is close to the average settling of about 6 inches for this type of project (Anne Connor, Pers. Comm., 2008). It also looks as though the channel has reached a consistent gradient and appears to be stable. The profile clearly demonstrates that no headcuts have formed along its entire length and that a natural step-pool sequence has formed.

The cross-sectional surveys indicate that the channel upstream of the work zone aggraded approximately one foot in the year post-implementation (Fig 3). This was most likely the result of increased woody debris immediately downstream of the cross-sectional area, although woody debris counts were not conducted. The cross-section contained within the work zone appears relatively stable both vertically and horizontally (Fig 4). This data

is also consistent with that which is depicted in the longitudinal surveys from 2006 to 2007 (Fig 2) when actual elevations are compared.

The Wolman pebble count data are shown in Figures 5 & 6. The key issues to discuss associated with these data are the following: 1) the location of the data collection; 2) the relative distribution of particle size classes within each figure; and 3) the comparative particle size class distribution between the two locations.

First, pebble count data were collected both outside (XS1) and within (XS2) the work zone. These were chosen to allow project managers to compare particle size class distributions within each location and from the natural channel to the constructed channel post-implementation. The 2004 data represent the control prior to construction.

Second, it appears that immediately after construction the particle size distribution shifted to the left, or became finer, in cross-sections both outside and inside the construction zone (Figs 5 & 6). That is to be expected for XS2, but is unexpected in XS1, which is outside the construction zone. One conclusion may be that this reflects the natural movement of wood or large substrate within this system. One year post-implementation, the particle size distribution shifted back to the right for both cross-sections and appears to be moving toward the pre-implementation distribution in XS1. The data obtained from the construction zone (Fig 6) show the size classes represented fairly evenly, with less material in the 65-90 mm and 91-128 mm size classes than the prior sampling event. It is expected that more of the fine sediment (<5.6 mm), located within the work zone, will be redistributed downstream each spring during high flow events, similar to what has already happened between 2006 and 2007, and that more substrate will move into the cross-sectional area in those size classes that are deficient (65-128 mm). However, no definite conclusions can be drawn from the data at this time. It will take a number of years and repeated surveys to draw meaningful conclusions regarding the particle size distributions. When the size class distributions are consistent across years at the same location, the stream has achieved relative stability.

Third, when comparing Figure 5 to Figure 6, it appears that the particle size distributions outside and within the work zone were fairly different in 2006 relative to 2007. As mentioned above, they are expected to move closer together over time.

This site will be monitored two more times at 3 and 5 years post-implementation with hope of capturing a flow event greater than the 2-year flow event. After the end of the 5-year monitoring period, statistical analysis will be performed on all of the data collected to compare channel conditions across time and help project managers determine whether the site is or will be stable under higher flow conditions. Plant survival will be monitored at the same time, and the presence and noxious weeds will be monitored and treated indefinitely by the Forest Service.

## **CONCLUSION / RECOMMENDATIONS**

In conclusion, at this point in time it appears as though this project was successfully implemented and the new structure and bed are relatively stable and moving toward pre-implementation particle size distribution. Further monitoring is necessary to make a final determination on the long term stability of this structure. It is recommended that a standardized effectiveness monitoring protocol be adopted for all culvert replacement projects and further, that the adopted protocol be implemented for all culvert replacement projects. This will ultimately enable project managers to determine what is effective and what is not.

## **REFERENCES**

Brad Smith, ODFW, Fisheries Biologist, Personal Communication, 2005.  
Ken Bronec, Forest Service, Fisheries Biologist, Personal Communication, 2004 & 2005.  
Gretchen Sausen, USFWS, Fisheries Biologist, Personal Communication , 2005.  
Anne Connor, Forest Service, Hydrologist, Personal Communication , 2008.