

### **Criteria for Ranking Culverts and Other Passage Obstructions for Replacement**

As part of its response to the listing of salmonids under the Endangered Species Act, the City of Portland has been investigating the degree to which culverts obstruct salmonid access and movement within local watersheds. Culverts and other instream structures may impede adult migration to spawning areas, smolt migration to the ocean, or juvenile movement within the watershed during rearing. Replacement of passage restricting structures is one approach for increasing the amount of spawning and rearing habitat available to salmon, or improving access to these areas. The City is evaluating culverts for the purpose of prioritizing impassable or partially passable culverts for replacement with more passable structures (e.g., arch culverts or bridges).

Based on Oregon Dept. of Fish and Wildlife assessments, the City has information on the degree to which culverts beneath state and county roads, city-owned streets, and Gresham streets obstruct salmon passage. The City is attempting to gather information on privately owned culverts, culverts that are not located beneath roads (e.g., Oaks Bottom), and on other instream passage obstructions such as dams, weirs, and exposed pipe crossings.

Ultimately, the goal of a salmon recovery program should be to restore access to designated critical habitat. However, replacement of passage obstructions in an urban environment can be very expensive, and funds available for salmon recovery are limited. It is therefore important to develop a framework for prioritizing the replacement of passage obstructions as funds become available, and in fact as support for justifying these funds in budget requests. The framework should establish objective criteria for ranking replacements and upgrades that will result in the most benefit to salmon populations per unit of project cost.

The framework and criteria need to be more sophisticated than ranking obstructions solely on degree of passage blockage. Replacement of a completely impassable culvert that is downstream of marginal habitat may be of less value than replacing a culvert that only partially obstructs salmon but leads to high quality habitat. Similarly, while the quality and quantity of habitat behind a culvert is one of the most important criteria for ranking culverts for replacement, it may need to be considered in conjunction with other factors. If prime habitat lies behind a particular culvert, but the presence of utilities, railroad tracks, and other infrastructure above that culvert makes it an order of magnitude more expensive to replace than other key culverts, there may be more net habitat benefits in replacing several lower cost culverts first. These hypothetical examples are presented to illustrate the need to evaluate all the relevant factors involved in passage obstructions to develop an optimal replacement and upgrade strategy.

The Riparian and Waterbody Construction and Maintenance technical team of the City's ESA Program has proposed the following criteria for rating culverts and other passage obstructions.

**Degree of Blockage** - Culverts and other blockages may be completely impassable, partially impassable (impassable only during certain flow conditions, or impassable to earlier life stages), or passable to all life stages during all flows. Obviously the extent to which a structure blocks salmon movements is a key consideration in ranking it for replacement.

**Amount of Habitat Above the Culvert** - Culverts which are at the uppermost extent of a watershed, or that are a short distance below another passage blockage may be lower priorities to replace than a culvert which blocks access to a large amount of quality habitat.

**Quality of Habitat Above the Culvert** - High quality habitat is extremely rare within urban areas. Culverts that block passage to good habitat should be weighted heavily as priorities for replacement.

**Maintenance Considerations** - Culverts present maintenance challenges as well as passage obstructions. They tend to accumulate woody debris, trash, and other items that block flow to the culvert, and may require frequent maintenance to prevent flooding or failure. Many culverts are located in areas that are difficult to access with appropriate equipment. Maintenance costs for problem culverts may be significant. In prioritizing culverts for replacement, some weight should be given to upgrading or replacing culverts that have high maintenance costs or that are scheduled for replacement due to age or poor condition. Replacing culverts that are maintenance problems as well as passage obstructions may meet two objectives simultaneously and improve the cost effectiveness of the project.

In addition, culvert replacements should be coordinated with the scheduling of Capital Improvement Projects (CIP). In particular, road maintenance is a key consideration. If a road overlying a culvert is scheduled for maintenance, it may reduce the cost of upgrading the culvert below it considerably if the upgrade is done simultaneously with the road maintenance. (This consideration should be accounted for in the "Expense of Replacement" criteria.) Conversely, it is an inefficient use of public funds to repave a road and then replace a culvert below it a year or two later, requiring destruction of a newly paved surface. Culverts underlying projects identified in the 5-year CIP Plan should be given a higher rating under Maintenance Considerations than those that are not identified in the 5-year CIP Plan.

**Environmental Zone Designation** - While good habitat may presently occur upstream of a culvert, the possibility of development and degradation of the habitat is a distinct possibility in an urban environment. Existing riparian protections should be considered in prioritizing culverts: investing in the replacement of a culvert should provide salmon habitat benefits for a number of years to be worthwhile.

**Proposed Future Land Use** - Similar to the previous criterion, any knowledge of proposed land use changes should be considered in light of the effect they may have on protecting habitat that would be accessed by replacing a culvert. The evaluation of these last two criteria will be coordinated with the Planning Bureau and the Office of Planning and Development Review to ensure that land use and planning decisions are integrated into passage restoration efforts.

**Steelhead Present?** - The listing of steelhead as threatened under the ESA means that extra weight should be given to replacing culverts that have existing steelhead populations present below the culvert.

**Fish Access from Downstream** - It does not make sense to replace a culvert before replacing an impassable culvert that exists below it. Culverts in the lower reaches of a watershed should typically be replaced first. The rating of this criterion is not always straightforward, however. In Tryon Creek, there is a long culvert at the mouth of the creek that will be very expensive to replace because of highways, utilities, and rail lines in place above it. This culvert is partially passable. Higher in the watershed there is a completely impassable culvert at Boones Ferry Road that is expensive and difficult to maintain. Identifying the cost benefit ratio and prioritizing between these two culverts will be difficult.

The potential listing of cutthroat may require revision of this criterion, as resident life forms may benefit from expanded habitat access throughout the watershed even in areas where migration out of the watershed is blocked.

**Expense of Replacement** - Culverts with utilities, highways, rail lines, and development above them may be orders of magnitude more expensive to replace than culverts with small roads or trails above them. Expensive culvert replacements should not be excluded from consideration for replacement, but replacement cost should be one of the factors used to prioritize culverts. For an equal cost, the quality and quantity of habitat made accessible by replacing several "inexpensive" culverts may exceed the habitat made available by replacing one expensive culvert. Replacement of high priority culverts with extremely high replacement costs may require partnerships, outside funding and grants, and other creative approaches.

The Riparian and Waterbody Construction and Maintenance technical team struggled with the most appropriate way to incorporate the expense criteria in ranking culverts for replacement. The cost of replacing culverts of similar dimensions can vary by an order of magnitude based on factors such as overlying infrastructure and utilities, soil contamination, and other factors that are not immediately obvious without conducting a site assessment. The technical team expressed concern that costs should be estimated reasonably accurately to rate the expense criteria effectively. Furthermore, back-of-the-envelope ballpark estimates can "take on a life of their own" when written into a document, and can impair the ability to secure adequate budget for a project when costs are more accurately estimated at a later date. These factors argue for assigning an engineer to visit each culvert and develop an accurate estimate of upgrade costs.

However, there are over 70 culverts within City limits, and the cost of obtaining accurate estimates on all the culverts would be considerable. In addition, it may not be cost-effective to obtain estimates on all the culverts, since there may be many culverts that are very low in priority for replacement (e.g., all habitat above the culvert is heavily developed and of marginal quality; the culvert is upstream of a culvert that is prohibitively expensive to replace).

To address these issues, the Riparian team decided on the following approach. Culverts will be ranked without the expense criterion as a first cut. From this ranking, the top 25 culverts will be assessed for cost estimates. These cost estimates will then be used to re-rank the top culverts incorporating expense of replacement as a criterion in the final ranking of culverts.

**Weighting Factor:**

Some factors may be more important than others in rating culverts for replacement. To reflect this, the ratings under each factor are weighted according to importance. *Degree of Blockage* and *Steelhead Presence* were weighted most heavily, with a weighting factor of three. *Instream Habitat Quality*, *Riparian Habitat Quality*, *E-Zone Designation*, *Fish Access from Downstream*, and *Maintenance Factors* were weighted at two. *Proposed Future Land Use* was weighted at one. There was some trial and error involved in setting weighting factors. For example, both instream and riparian habitat quality were originally weighted at three. However, these factors began to dominate the rankings (they are somewhat correlated, and it in a sense "double counted" habitat), so that other factors became irrelevant (e.g., passable culverts with good habitat were ranking high for replacement). Adjusting both the habitat weightings to two seemed to provide a more balanced ranking.

**Additional Notes:**

There are a few general considerations that became apparent in ranking the culverts. While these considerations are for the most part reflected in how the culverts rank using the above criteria, it is worthwhile to re-emphasize them as general issues to consider before selecting culverts for replacement.

- ◆ The culvert ranking is a dynamic list that will change as conditions or information changes. The replacement of a culvert obviously affects the rankings of culverts above it, as they are now more accessible to salmon. In addition, the quality of information on a few of the ranking factors is uneven. The quality of habitat above each culvert is in some watersheds based on thorough ODF&W habitat surveys, in others on more anecdotal or qualitative habitat assessments. Until ODF&W habitat surveys are completed for each watershed throughout the City, habitat quality ratings will be qualitative and subject to revision in watersheds that have not been surveyed by ODF&W. Similarly, the criteria for "Steelhead Present" and "Fish Access from Downstream" will be qualitative and subject to revision until fish surveys have been completed to verify the rankings.
- ◆ The rankings emphasize the fact that Johnson Creek is a priority watershed for culvert replacements. Unlike other Portland watersheds, there are no large culverts on the lower mainstem of Johnson Creek, and existing anadromous salmon runs still reach high into the watershed. In contrast, Tryon Creek has a very long culvert near its mouth, and most of Fanno Creek is inaccessible to salmon due to impassable culverts outside of City limits.
- ◆ It is important to emphasize that while the rankings provide an objective means by which to prioritize culverts for replacement, it is critical to assess each culvert individually in greater detail prior to a final decision on replacement. For example, a few culverts in Tryon Creek - particularly at Boones Ferry Rd. - rank highly for replacement. However, any culvert replacements in Tryon Creek need to be coordinated with plans for the long culvert at the mouth of Tryon Creek. This culvert is within Lake Oswego city limits. ODOT is evaluating it for replacement since it underlies State Road 43. Because it is outside of Portland city limits it was not ranked for replacement in this assessment (its presence and impact on habitat access is accounted for in the rankings of other Tryon Creek culverts, however, through criteria such as "Fish Access from Downstream" and "Steelhead Presence"). Plans for replacement of this culvert have major implications for habitat access efforts throughout the Tryon Creek watershed. It is a long culvert (150') at the mouth of the watershed. Directly above it lies one of the largest expanses of high quality salmon habitat within the City (Tryon Creek State Park). This culvert is rated as "Passable" under ODF&W criteria, largely because of baffles in the culvert. However, because of the critical location of this culvert this rating should be evaluated in greater detail. A number of characteristics of that culvert are marginal in terms of passage (e.g., length - 150'; slope - 2%; drop - 12"). It may be that seasonal conditions or a combination of several marginal characteristics render the culvert impassable during critical migration periods, or that a considerable percentage of salmon attempting passage are deterred. Any proposed culvert replacements higher in the watershed need to evaluate the impact of the culvert under State Road 43 on the potential benefits of the project. In addition, the Portland ESA Program should investigate the possibility of measures or partnerships that could improve passage through this critical culvert, regardless of its jurisdictional location.
- ◆ The culverts at the base of the Forest Park watersheds require special consideration. A large contiguous expanse of high quality watersheds is a unique resource in an urban environment.

The vast majority of this protected landscape is inaccessible to salmon, however. The lower portions of these watersheds are piped under the Industrial section at the base of Forest Park. There are a number of complex factors that need further study, the complexity of which cannot be accurately captured in the rating criteria here (e.g., contamination issues associated with daylighting streams into industrial landscapes; habitat factors such as topographic slope need to be evaluated for suitability for steelhead).

- ◆ Finally, two of what are potentially the most critical culverts for salmon restoration were not evaluated in this ranking - culverts at Smith & Bybee Lakes and Oaks Bottom. The culvert at Smith & Bybee Lake is owned by Metro, is already scheduled for replacement, and has secured partial funding for the project. The culvert at Oaks Bottom is being evaluated under a larger assessment that is looking at habitat restoration and access issues throughout the park that will benefit salmon.