Meacham Creek Watershed

Assessment and Action Plan

Summary

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Prepared for the Confederated Tribes of the
Umatilla Indian Reservation

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Meacham Creek is a stream of contrasts. Warm enough at its mouth for summer swimming; it is also host to a population of cold-seeking bull trout in its headwaters. Secluded behind locked gates and barely inhabited by people, it includes one of the busiest railroad lines in the state. The stream is capable of delivering water at the rate of 8,800 cubic feet per second during extreme floods but its flow drops to a trickle by late summer, with some sections going subsurface altogether. Its thickly-forested north-facing slopes clash with the sun-scalded grasslands facing south.

Fish have adapted to the peculiar patterns of Meacham Creek over the thousands of years and some species still do well. The productivity of young-of-the year steelhead trout is high, although chinook salmon and bull trout numbers are low.

Meacham Creek at river mile 3.3 (reach 4a).

The railroad came early to Meacham Creek and left its mark on the land. Railroad tracks border the stream throughout its length. A ledge was blasted in the upper canyon to make room for the tracks. Following construction, the meandering

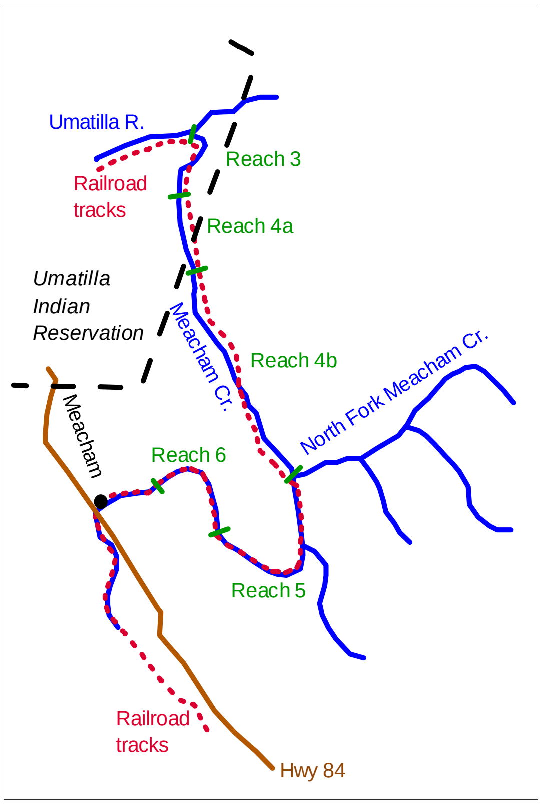
Meacham Creek repeatedly collided into the railroad prism in the lower valley and threatened to undo what had been built. So, angled dikes were constructed to force the stream away from the tracks and, following floods, bulldozers were used to create a straight channel that was free of logs. Early trains were fueled by wood and may explain why there are so few trees older than 100 years old in the valley.

The following is a summary of stream conditions for Meacham Creek. It is excerpted from a much larger document, the Meacham Creek Watershed Assessment and Action Plan. The full study is available on a compact disk or in printed form from the Department of Natural Resources at the Confederated Tribes of the Umatilla Indian Reservation.

A purpose of this study was to evaluate current conditions for fish and other aquatic life in Meacham Creek and compare this to what the stream was probably like prior to European settlement. We used two reference streams, the North Fork Meacham Creek and the Wenaha River, to provide snap shots of functioning stream conditions where human influences are minor. Another purpose of the study was to develop an action plan with recommended practical improvements to Meacham Creek that would benefit fish.

Stream channel characteristics

Meacham Creek can be divided into five distinct reaches. Reach 3, near the mouth, is now a single channel bounded by bedrock banks over much of its length. Upstream is reach 4a; once a meandering stream with multiple channels. It has been highly altered by dikes that force the stream against the western rock banks. Reach 4b also has some dikes along its length but the valley is wide and the stream still meanders across its cobble-dominated flood plain. In this reach the stream goes subsurface in one segment with a remarkable affect on downstream water temperature. Reach 5 is a more-confined version of reach 4b. Wide segments with meandering channel are interspersed with tightly-confined segments with the railroad nearby. Reach 6 is a tight bedrock canyon with greater channel gradient than downstream reaches. Blasting to construct the railroad grade undoubtedly filled the V-shaped stream channel to some extent.



The channel length of Meacham Creek decreased by 1.4 miles from 1916 to 2002, with most of the loss occurring in lower reaches. Channel length decreased 9% in the heavily-diked reach 3 and reach 4a but only 5% in reach 4b where the railroad is set back further from the stream and the channel is less confined by the railroad dikes. These losses in channel sinuosity result in increased water energy during high flows and this has caused the channel to erode downwards in some segments. This is most evident in reach 4a where a deep channel has been created parallel to the bedrock banks on the west side.

The Wenaha River, a wilderness stream of similar size and elevation to Meacham Creek during high flows (the time when sediment movement occurs), appears to have different-sized substrate and geometry than reach 4b of Meacham Creek. But this is an illusion created by the ample summer flow and dense streamside vegetation in the Wenaha basin. When measured, the substrate was no coarser and channel geometry no different in reach 4b of Meacham Creek than in the Wenaha River.

Meacham Creek at river mile 8.2 (reach 4b).

Channel substrate size in upper Meacham Creek (reach 5) is slightly coarser than its gradient and bankfull flow would suggest, using North Fork Meacham Creek as a reference. This coarser substrate may be the result of cobbles and boulders entering Meacham Creek during construction of the railroad tracks over 100 years ago. Nevertheless, a majority of coarse sediments that accumulate downstream of the North Fork Meacham Creek confluence seem to originate from the relatively undisturbed North Fork rather than upper Meacham Creek. The North Fork watershed has a much greater percentage of area with steep slopes along stream channels.

Eroding banks are a common and natural feature in the North Fork Meacham reference reach and throughout lower Meacham Creek. In these reaches, the percent of stream length with an eroding bank on at least one side varies from 8 to 17%. The eroding banks usually occur on the outside of bends where the stream has meandered into a higher terrace. Scoured outside banks along bends are usually accompanied by depositional areas on the inside of the bends. These processes seem to be in balance, although the stream may still be adjusting to the high flows in 1996 and 1997 that moved considerable amounts of coarse material from upper positions in the basin into lower reaches. Over time, the stream will move any excess gravel and cobble downstream to the Umatilla River.

Deep pools provide unique habitat for fish, especially within Meacham Creek where adult chinook salmon need to find safe spots to pass the time in the summer before spawning in early fall. Deep pools provide living space, cover, and safety from predators. Most existing deep pools in Meacham Creek are created by downward scouring of the channel as it flows against bedrock banks. These pools have high velocity water during higher flows which readily flushes out any large wood that is moving downstream. Large wood in a deep pool can readily increase the pool's use by fish; the wood provides cover and zones of slow moving water. Large wood, a major sculptor of pools in smaller, undisturbed eastern Oregon streams is scarce in Meacham Creek and so creates few pools.

The stream runs along the base of the railroad grade at 6 locations for a total distance of 1 mile and creates deep trench pools that provide only summer habitat for fish. During higher flows the lack of nearby areas of low-velocity water make these pools only marginally useful for fish.

Streamside trees and large wood

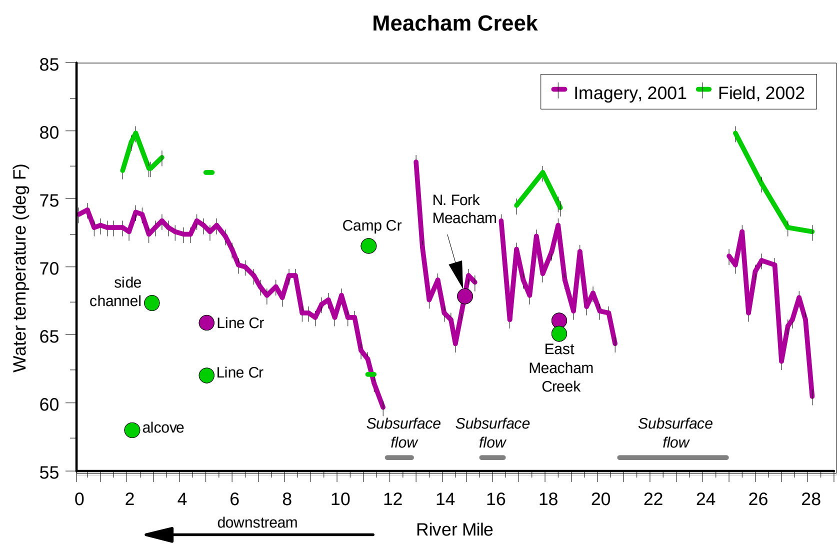
Large wood throughout Meacham Creek and in the North Fork Meacham Creek reference reach is scarce and likely a result of intentional removal over the decades. During early railroad days, wood in the stream and trees along the stream were probably used to fuel steam locomotives. Early settlement in North Fork Meacham Creek, along with a sawmill located at the lower end, also likely contributed to early removal of trees from the stream and those trees growing along the stream. Furthermore, jams of wood were commonly removed from the stream following large floods. Over a century of cattle grazing has limited tree regeneration in many areas. Natural regeneration is currently most successful where trees can escape trampling by cattle. This includes cobble bars with little grass and the tops and surfaces of dikes. Large trees growing along most segments of Meacham Creek are uncommon and so the future supply of large wood in streams is limited.

Wildfires in Meacham Creek during the last decade have killed only relatively small areas of trees. Less than 5% of the watershed has burned with only 11% of these 5342 acres actually being burned trees. The burned trees had limited value due to their small size and the difficult access. All fires seem to have originated at the railroad tracks and would have probably spread to a larger area if they had not been contained by fire crews. The prospect of a wildfire beginning in North Fork Meacham Creek seems most ominous for the future. The north-facing slopes and riparian corridor of this basin support a nearly-continuous belt of timber; a fire starting at the mouth of the basin, where trains pass by, could readily spread to the east through these stands of dense pine, Douglas-fir, and grand fir.

Water temperature

The water temperature of Meacham Creek was measured using thermal imagery, long-term recording gauges, and field measurements on hot summer days. Maximum water temperature found in reaches 3 and 4a of lower Meacham Creek routinely exceed the upper incipient lethal level for adult chinook salmon (77 deg F) and limit the ability of juvenile fish to rear in these reaches during the summer. Juvenile salmonids have some access to thermal refuges such as the downstream ends of gravel bars, alcoves, side channels, and tributary confluences, to escape high temperatures in the main channel.

Favorable temperature conditions exist in most of reach 4b, especially immediately downstream of river mile 12 where the stream exits a subsurface reach at a very cold temperature. This cooling phenomenon also occurs twice in reach 5. It is not possible to estimate the exact temperature regime of Meacham Creek prior to European settlement since the type of vegetation bordering the stream at that time is unknown. Nevertheless, current temperature patterns in much of Meacham Creek are probably close to natural since the channel is much too wide for streamside trees to cast a shadow on the water and summer flows have not been diminished by water withdrawals. Even the heavily-forested Wenaha River is only minimally shaded by the streamside trees. There is the possibility that other subsurface flow sections once existed downstream of river mile 7 but these reverted to surface flow after the dikes were installed. This would have eliminated the unusually cool water zones that typically exist downstream of subsurface reaches.



Water quality and quantity

Nutrients in Meacham Creek are both scarce and tightly cycled within its aquatic environment. Obvious sources of nutrient enrichment are lacking in the watershed.

Nutrients resulting from moderate to heavy grazing along Meacham Creek are not showing up in the water column.

Episodic increases in nutrients potentially include those associated with train derailments or fire-fighting. Nitrogen in the form of liquid ammonia or granular fertilizer could be introduced into Meacham Creek during a train derailment. Phosphorus in the form of granular fertilizer could be added to the stream during a train derailment or in the form of fire retardant while trying to control a wildfire.

Turbidity values and suspended sediment loads measured in Meacham Creek from 1998 to 2001 water years are low. The velocity and geometry of Meacham Creek, combined with a limited source of fine sediments throughout the basin, result in few fines among the gravel and cobble surface substrate. Obvious sources of fine soil particles entering Meacham Creek are few. Most roads are located away from stream channels and where heavy grazing occurs along streams the ground is level. A surge of fine sediments must have occurred during construction of the railroad and access road, but this material seems to have been moved out of the system during the last 120 years.

Flows in Meacham Creek and its tributaries are essentially natural flows. Exercised water rights result in only minor reductions in streamflow. Further allocation of water from Meacham Creek is unlikely due either to senior water rights in the lower Umatilla River or the large instream water rights that were granted for fish rearing in 1998 and 1990. In the future, houses may be built on plots of private land along Meacham Creek and small water rights would probably be granted for domestic use but not for irrigation.

Fish passage

The Meacham Creek study area has few fish barriers that are human-caused. An effort to improve fish habitat at river mile 1.7 of Meacham Creek has resulted in a barrier to the upstream movement of juvenile fish during the summer. Old concrete dams in lower Camp Creek (R.M. 0.3) and upper Meacham Creek (R.M. 20.2) are obstacles to juvenile fish and resident trout. All other obstacles are natural features. Camp Creek has a 40-foot-high falls at river mile 3.1 and is a blockage to all fish, although isolated resident fish may live upstream of the falls. Segments of subsurface flow in lower Meacham Creek (R.M. 12.0 to 13.2) and in upper Meacham Creek (R.M. 15.2 to 15.6 and 20.8 to 24.9) are barriers to all fish by the middle of summer.

Past stream improvement efforts

Efforts to add structural features to improve fish habitat occurred prior to 1991 in lower Meacham Creek (downstream of river mile 5) where summer water temperatures are high. Much of the work was done prior to the high flow on November 28, 1995, (10-25 year recurrence interval) during which some of these features were washed out or rearranged by the high flow.

We inventoried all of the 91 stream improvement structures, of which over one-half were log/boulder structures. Most of the others were boulder berms or rock barbs. Overall, only 9% of the structures created *good* or *very good* fish habitat. Nearly 60% created only *minimal* habitat improvement. The most common problem with the log/boulder structures was their small size compared to the size of the stream. Logs were usually less than 50 feet long and were too small in diameter to have rootwads large enough to provide much stability during high flows. Structures usually consisted of only single logs which further promoted downstream movement. Boulder berms were usually stable in the channel but did not create much usable fish habitat. Pools adjacent to boulders were small and too turbulent for fish to use during high flows.

Future efforts to improve stream structure would benefit fish more if structures were located upstream of Line Creek (river mile 4.95) where water temperatures are low enough to support fish year-round. Design features that promote stability and fish habitat creation include the use of long logs with large attached rootwads and limited cabling to ensure that the jam acts as a single but flexible unit.

Very good fish habitat created by placed logs near river mile 2.5.

Fencing of the lower 4.5 miles of Meacham Creek to keep out cattle began in 1989 and has resulted in a marked improvement in vegetative growth along the stream, although some of the recovering vegetation was scoured out during the 1996 flood. Most notable has been the return of dense alder and willow along the channel fringe. The high-tensile wire fences have been durable in spite of the many elk in the valley and trees that periodically fall onto the fence. Long-term leases were arranged with participating landowners for the fence to be installed.

Overall habitat condition

Overall, Meacham Creek provides important habitat for steelhead trout, chinook salmon, and other native fishes. Where fish habitat is less than ideal, both human and natural forces are accountable. The most influential human disruption of fish habitat has been the channelization of reaches 3 and 4a in lower Meacham Creek, a result of diking to keep the stream from meandering into the railroad prism. Natural features with strong influence on fish habitat include the three sections of subsurface flow that keep juvenile fish from migrating upstream to cool water portions of the basin such as North Fork Meacham Creek and East Meacham Creek during the summer. On the other hand, cool water refuges exists downstream of the subsurface flow sections and these greatly benefit fish.

Large wood is scarce throughout the study area. The flood plain of lower Meacham Creek is wide and probably retained only the very largest pieces of wood following floods, even prior to disturbance by humans. A scarcity of large trees growing along the stream now does not indicate that natural delivery of large wood will improve conditions much during the next century.

The ***original condition*** of Meacham Creek, based on our current understanding of how the stream once operated to support populations of fish, is detailed below:

A. Stream temperatures alternated between warm and cool in a downstream direction. Fish were able to access zones of thermal refuge downstream of subsurface reaches and where tributaries and springs entered.

B. The meandering channel accessed the entire valley bottom with no propensity to run along the steep valley walls to the west or along the railroad grade. It created complex channel features that provided fish options for feeding and refuge from fast water. The channel form was only slightly entrenched allowing flood flows to overtop the streambanks without constrictions.

C. The stream was bordered by diverse and abundant streamside forests, including areas of older trees that were large enough to be stable in the stream when eventually undercut by the stream. Large trees in the channel provided jams of wood that sculpted the channel and provided holding pools for spawners, high-quality feeding areas for juvenile fish, and refuge from high-velocity water and predation.

D. Diverse and dense vegetation among streamside trees filtered out finer sediments during high flows, thereby creating a fertile top soil that promoted vigorous vegetation along the stream.

E. Channels were unobstructed to the passage of fish (except in subsurface reaches during the summer), allowing them to access their traditional spawning and rearing areas.

F. Wildfires resulted in cool burns that crept along the ground, leaving riparian areas relatively intact, and sparing most of the older, green trees.

G. Summer flows were undiminished by water withdrawals. Water was low in fine sediments and nutrients were tightly recycled by aquatic biota with little excess to support nuisance growths of algae.

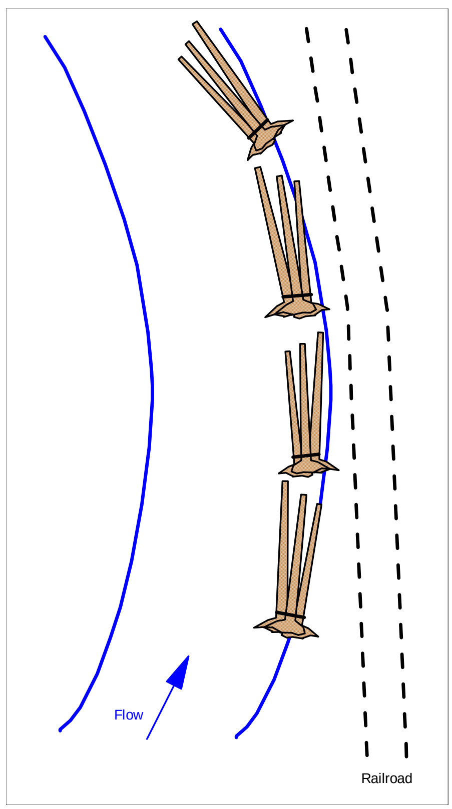
Action plan

Much of Meacham Creek flows across private land and any efforts to improve conditions for fish must acknowledge and respect the wishes of these landowners. Cooperative efforts to fence cattle out of streamside areas in the lower valley have been successful and illustrate the potential of improvements for a common good. The Union Pacific Railroad is also an important ally in any efforts to improve conditions for fish. A number of actions could occur that not only lessen the impact of the railroad tracks on fish, but also maintain good relationships with neighboring landowners. The road the company maintains alongside the tracks provides the only access into the valley.

We have developed actions for improving conditions for fish in Meacham Creek that are sensitive to the needs of valley landowners and the railroad company. These actions also respond to the vision of restoring the original conditions of Meacham Creek. Some of these improvements could yield results in a few years; others will take decades to express themselves. The overall aim is to restore those initial characteristics of Meacham Creek that are most responsible for maintaining healthy fish populations. The actions include:

1. **Add large wood where the stream flows against the railroad tracks (original condition C).**

   The main channel of Meacham Creek runs parallel and along the base of the railroad prism at 6 locations in lower Meacham Creek (downstream of the North Fork Meacham Creek confluence). The summed length of stream channel in this condition is 1 mile or 7% of the total length of lower Meacham Creek.

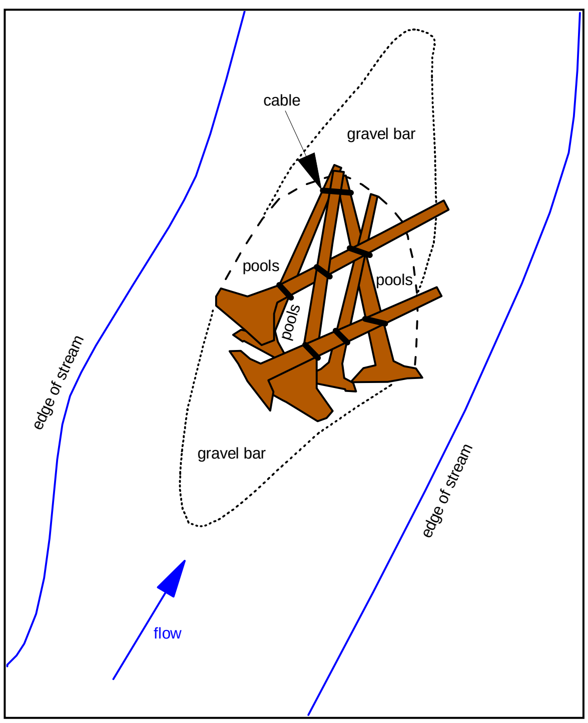


   The deep pools associated with the stream running along the base of the railroad prism can be altered so that they not only provide high quality habitat for fish but also provide a means to protect the railroad prism from future erosion. Placing groups of 3 to 4 conifer logs with their rootwads attached and bundled with cable at the large end would provide a substantive hard surface for the stream to flow against while providing cover, zones of slow water, and feeding areas for fish. By using large logs (greater than 28 inches diameter and greater than 50 feet long) with attached rootwads and bundling them in groups, these log structures would be resistant to downstream movement during high flows.

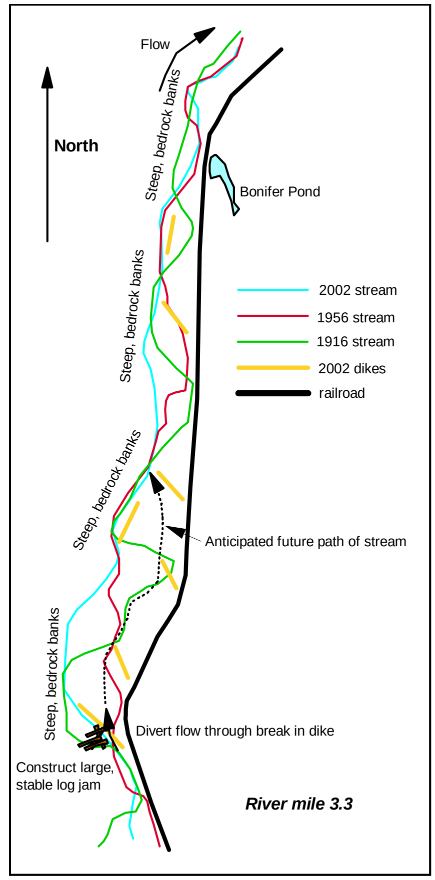
2. **Add stable large wood structures to segments with favorable temperature (original condition C).**

Previous attempts to add large wood to Meacham Creek generally have not resulted in much habitat for fish. Logs have been too short or the rootwads have been too small. More importantly, logs have been placed individually or in only groups of two. Even with attached boulders, many have been rafted onto terraces or moved downstream. Furthermore, log structures have been added where the stream is too warm for fish during the hottest part of the summer.

The proposed action is to add stable, log structures to portions of Meacham Creek and lower North Fork Meacham Creek that have year-round flow and summer water temperatures that are favorable for fish. The structures would scour deep pools with ample cover that could be used by spawners and rearing juvenile fish. As described in action #1, these structures would consist of multiple large logs with rootwads and a minimal amount of cabling to keep them together during floods.



3. Restore channel sinuosity in lower Meacham Creek (original condition B).



Lower Meacham Creek experienced a 7% loss in main channel length from 1916 to 2002. Correspondingly, overall channel sinuosity has declined from 1.20 to 1.11. Channel straightening has been a result of diking and channel bulldozing with the purpose being to keep the stream from encroaching upon the railroad and high-quality riparian pasture. Channel straightening and entrenchment creates faster water during high flows and a lowering of the water table on adjacent terraces during the dry season. Fish are more likely to be displaced downstream when faced with high-velocity water, and vegetation establishment on surrounding terraces becomes more difficult with a lower water table.

Opportunities to reverse channel straightening and entrenchment exists at river mile 3.3 and 6.7. At these locations, the stream is diverted abruptly to the west by dikes and then flows against the steep, bedrock banks for about a mile. The combination of creating a break in the diversion dike and constructing a large, stable log jam just downstream of the diversion point would allow the stream to occupy its original channels across the wide terrace east of the stream's current location. Here, the stream would not be incised and would not be confined to a single straight and deep channel.

The excavated break in the dike would provide a low spot for the stream to enter the terrace and the full-spanning log jam located immediately downstream would trap gravel and elevate the stream high enough so that it flows through the break in the dike even during the summer.

4. Remedy manmade obstacles to fish passage (initial condition E).

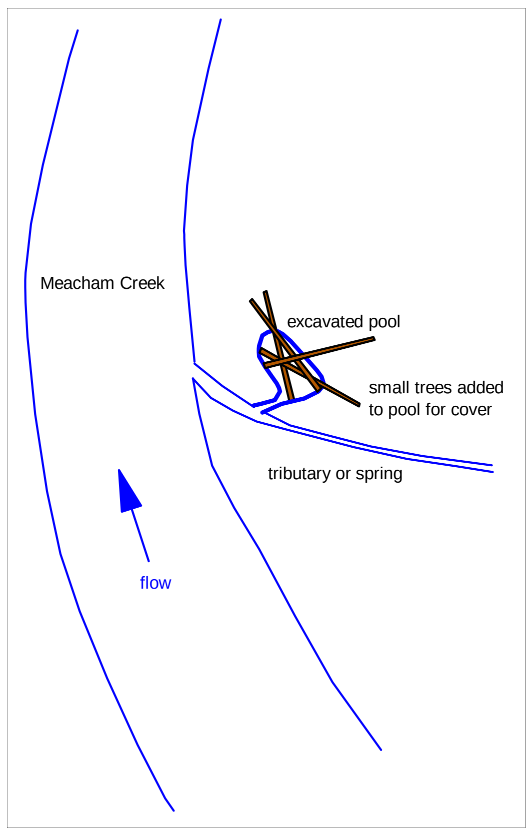
Several manmade obstacles to fish passage exist in the Meacham Creek basin. Removing the obstacles or creating fishways around the obstacles would allow unfettered access by fish.

A concrete dam in upper Meacham Creek (river mile 20.2) is a relic from the steam locomotive days and is no longer used. The dam creates a 2.5-foot-high jump that is a barrier to upstream movement of juvenile steelhead and resident fish during the summer. The best option here is to remove the dam.

A concrete dam within Camp Creek exists 0.3 miles upstream of its confluence with Meacham Creek and is a barrier to juvenile and resident trout passage (4.3 feet high). This may be the site of a water withdrawal for the irrigation of 23 acres and so it will be important to work with the landowner to find a solution that allows both continued access to irrigation water and fish passage.

A stream improvement structure consisting of large boulders cabled together across the top of a bedrock ledge in lower Meacham Creek (downstream of the first railroad bridge) is a barrier to juvenile and resident fish in the summer. Downstream of this site, the water becomes so warm that fish evacuate this segment during hot spells. Without the ability to search out cool water in upstream reaches of Meacham Creek, fish are forced to move downstream into the warm Umatilla River to find thermal refuge. Removal of all or some of the boulders would allow fish passage.

5. **Excavate deep and protected pools at cool water sources (original condition A).**



Areas of cool water are found at selected locations throughout Meacham Creek, providing thermal refuge for fish during the hottest part of the summer. Reaches 3 and 4a of lower Meacham Creek and portions of reach 5 in upper Meacham Creek have summer temperatures that are generally too high for fish during the daytime. Nevertheless, cool water can be found at a number of tributary junctions, springs, and within alcoves. However, in only a few of these areas is the water deep enough for juvenile fish to migrate into during the day and be safe from predators. Also, living space and cover is limited at these cool-water zones.

Excavating pools adjacent to the cool water sources near Meacham Creek in places would allow fish to move easily from Meacham Creek to the pool during warm days. The pools would be excavated 6 to 8 feet deep in locations they would not readily fill with bedload moving down Meacham Creek or the cool water tributary. Small logs added to the pools would provide fish protection from overhead predators.

6. **Fireproof land near mouth of North Fork Meacham Creek in order to minimize risk of railroad-caused fire in the North Fork basin (original condition F).**

   If a wildfire began at the mouth of the North Fork Meacham Creek watershed it could be easily transported throughout the basin by a nearly-continuous belt of dense timber growing along the stream and on north-facing slopes. Widespread mortality of brush and trees along North Fork Meacham Creek and its tributaries would probably increase summer water temperatures and degrade conditions for bull trout and adult chinook salmon that rely on cold water.

   Reducing the amount of fine fuels and pathways for fire to be carried into the forest canopy near the lower end of North Fork Meacham Creek would help keep fires sparked by trains from entering the basin. A 1.5-mile segment of railroad where the tracks are on the east side of the stream and upstream of the North Fork confluence would need to be treated. Actions could include; 1) Removing brush and small trees capable of transporting a ground fire into the forest canopy, as well as removing the lower limbs of larger trees in a 300-foot-wide corridor, 2) Piling and burning fine woody material and brush within the corridor 300 feet east of the railroad tracks, 3) Eliminating grass growing within a corridor 50 feet east of the tracks, 4) Regularly inspect tracks in this stretch to detect defects that might lead to sparking, and 5) Locating a deep spot in the channel near this 1.5-mile stretch of stream where a ramp could be developed so that a pumper truck could efficiently obtain water for fighting any fires that started.

7. **Fence additional portions of stream and re-establish vegetation along stream (initial conditions D and C).**

   Tree and shrub regeneration is generally scarce along portions of reach 4 in lower Meacham Creek and is likely a result of heavy grazing. North Fork Meacham Creek, where grazing pressure is less, has a more abundant tree and shrub growth in the stream corridor. Fencing the cattle out of Meacham Creek downstream of river mile 5 has resulted in rapid regrowth of vegetation, especially of hardwood trees close to the channel. Even in heavily grazed portions of Meacham Creek that are not fenced, ponderosa pine has been able to regenerate on streamside terraces in the last few decades but it has been most successful where trampling by cattle is least (on dikes and rocky areas without grass).

   Greater establishment of vegetation close to the stream could be attained by working with landowners to fence out cattle from portions of the stream. A good place to start would be the parcels managed by the Forest Service. Supplemental planting may be needed in areas where not enough root stock or seed exists for plants to regenerate on their own.

8. **Replace road bridge at furthest downstream railroad crossing (original condition C).**

Adjacent to the first railroad bridge on Meacham Creek approaching from the Umatilla River is a road bridge of dubious design. The road bridge is old, has an overall span of about 70 feet, and was constructed using two sets of steel support pillars located in the stream channel. Wood floating downstream during high flows commonly catches on the pillars and is either removed by the maintenance crew or floats away during subsequent high flows.

The bridge presents a problem for the planning of upstream stream improvement projects. While any log structures added to Meacham Creek would be designed to minimize their downstream movement during flood flows, the certainty of stability becomes more important when a vulnerable bridge is downstream. Log structures would need to be more expensive and design options more limited to ensure stability and prevent damage to the bridge.

Replacing the access road bridge with one that is capable of readily passing large wood would solve two problems. Upstream habitat improvement projects could proceed with a wider range of options knowing that large wood movement during floods would not be fatal to a downstream bridge. In addition, railroad crews and valley landowners would be assured safer access out of the valley during and after flooding.