

TRYON CREEK @ HWY 43 CULVERT ALTERNATES ANALYSIS

*Prepared for:
City of Lake Oswego, Oregon
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HENDERSON LAND SERVICES LLC



*In association with
DJ Warren Associates, Inc.*



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STUDY FUNDING

Metro Regional Parks and Greenspaces Program

US Fish and Wildlife Service

PARTNERSHIP MEMBERS

City of Lake Oswego

Douglas Schmitz, City Manager

Jane Heisler, Assistant City Manager

Kim Gilmer, Parks Director

Lisa Hamerlynck, Natural Resource Coordinator, Project Manager

Massoud Saberian, Transportation Engineer

US Fish and Wildlife Service

Jennifer Thompson, Project Coordinator

NOAA Fisheries

John Johnson, Hydraulic Engineer

Oregon Department of Fish and Wildlife

Devin Simmons, ODOT Liaison

Tom Murtagh, Habitat Biologist

Oregon Department of Transportation

Ron Kroop, District Manager

Gail Curtis, Senior Transportation Planner

Melissa Hogan, Environmental Coordinator

Tryon Creek State Natural Area Park

MG Devereux, Park Manager

Tryon Creek Watershed Council

Jen Seamans Blatner

Friends of Tryon Creek

Stephanie Wagner, Executive Director

City of Portland Bureau of Environmental Services

Amin Wahab, Watershed Manager

Cynthia Studebaker, Biologist

Metro

Ross Roberts, Corridor Planning Manager

Jaimie Snook, Rails to Trails Project Manager

Portland & Western Railroad

Mark Werner, Project Manager





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CONSULTANT TEAM

HENDERSON LAND SERVICES LLC

Bruce A. Henderson, Project Manager, Partnership Communications

DJ Warren & Associates, Inc.

Daniel J. Warren, Project Management Assistance

ALTERNATES DESIGN AND COSTING ASSISTANCE FROM

ODOT Bridge Engineering Unit

Antonios Stratis, P.E., Bridge Engineering Unit Manager

Nowzar Ardalan, P.E., Senior Structural Design Engineer

Contech Bridge Solutions, Inc.

Matthew Houser, P.E., Oregon Regional Manager





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PREFACE

An 80-year old culvert beneath Hwy 43 above the mouth of Tryon Creek is a known impediment to fish and wildlife passage from the confluence of Tryon Creek and the Willamette River upstream into the Tryon Creek State Natural Area Park. This lowest reach of Tryon Creek represents an important greenway corridor for wildlife and a critical link for sensitive and listed fish habitat protection. This 400-foot long culvert inhibits several indigenous fish species from accessing the middle and upper reaches of Tryon Creek and its tributaries above Hwy 43. Consequently, the presence of this culvert greatly reduces the value of the Tryon Creek watershed for fish and wildlife that would otherwise be able to access and use upstream habitats. In 2002, the City of Lake Oswego worked with Metro and the City of Portland to purchase property along Tryon Creek downstream of this culvert to the Willamette River for the future Tryon Cove Park. With this purchase, an unprecedented opportunity was secured to work with other stakeholders in replacing the Hwy 43 culvert and open up many acres of wildlife habitat and many miles of stream habitat.

Replacing the existing Hwy 43 culvert with an alternative structure would achieve the goals of 1) being passable to fish, 2) providing for safe wildlife movement between the Tryon Creek confluence with the Willamette River and the Tryon Creek State Natural Area Park, and 3) meeting transportation-related objectives for the area which have been identified as a high priority for the City of Lake Oswego and many other stakeholders. Very few habitat restoration opportunities, with potential benefits as significant as those that could be achieved here, exist within the Portland metropolitan region.

Numerous stakeholders are interested in the Hwy 43 culvert analysis project because it interfaces with many planning efforts and projects. This makes the project complex. Successful planning and implementation of potential culvert replacement will require the support and involvement of many key agencies and organizations. The City of Lake Oswego initiated the Tryon Creek @ Hwy 43 Culvert Alternates Analysis Study that ultimately lead to the alternatives evaluated and recommendations presented herein. This Study brought together key public and private interests to gather input, identify and evaluate alternates for culvert replacement and to develop consensus among key stakeholders for preferred design concept to be evaluated further. Creating a shared future vision for lower Tryon Creek, including the culvert and approximately 6.5 acres of public land adjacent to Tryon Creek's intersection with Hwy 43 was the primary objective of this Study.





NEED FOR CONCEPTUAL CULVERT ALTERNATES ANALYSIS

Compiling existing information, analysis and planning is a critical first step in gaining a full understanding of how best to restore native fish runs within the Tryon Creek watershed. Following are prior analysis and planning efforts by several Partnership jurisdictions which uniformly prioritize Tryon Creek for restoration efforts and provide useful sources of information for developing and analyzing Study alternates.

Portland Endangered Species Act Framework Plan

City of Portland's Bureau of Environmental Services (BES) has prioritized Tryon Creek for development of a Watershed Management and Recovery Plan. BES staff have been conducting field assessments, which provide valuable background data for the Partnership.

City of Portland Tryon Creek Watershed Management Plan

In the fall of 2002, BES introduced their initial progress report findings of 2002 fish counts in Tryon Creek conducted in concert with the Oregon Department of Fish and Wildlife (ODFW). Report findings were that “*key breaks in longitudinal stream connectivity exist at the State Street [Hwy 43] Culvert (impassable year round).*” Tremendous efforts to protect, restore, and enhance upstream habitats by Partnership members would be significantly improved by making this habitat more accessible by indigenous fish and wildlife species from lower Tryon Creek and the Willamette River.

City of Portland Department of Transportation draft Criteria for Ranking Culverts (and other fish passage obstructions) for Replacement

City of Portland's Department of Transportation's 'Criteria for Ranking Culverts for Replacement' identifies the Hwy 43 culvert as a barrier for fish migration in the Tryon Creek watershed. “*Directly above it [the culvert] lies one of the largest expanses of high quality salmon habitat within the City. Because of the critical location of this culvert this rating should be evaluated in greater detail.*” Because of the opportunities presented by replacement of the Hwy 43 culvert, this project received priority ranking.

Lake Oswego Comprehensive Plan

The City of Lake Oswego has identified stream restoration, riparian area protection, and fish and wildlife habitat as high priorities. In the City's Comprehensive Plan Goal 5 and Goal 15, purchase of properties at the mouth of Tryon Creek for the purpose of restoring fish and wildlife habitat are identified as 'high priority'.





Lake Oswego Foothills District Master Plan

In 2002, and further refined in 2005, the City of Lake Oswego completed a redevelopment plan for the Foothills District along the Willamette River. Several scenarios presented in this study develop conceptual designs for replacing the Hwy 43 culvert with a vehicular bridge as well as for pedestrian transit across Tryon Creek.

Lake Oswego Trails and Pathways Master Plan

Completed in 2003, the City of Lake Oswego's Trails and Pathways Master Plan envisioned three regional trails and one neighborhood connector trail at the juncture of Hwy 43, Terwilliger Blvd., and Tryon Creek. These regional trails are also identified on Metro's Regional Trails Plan. Due to geographical constraints, this location has historically been a recreation and transportation barrier for pedestrian and bicycle transit. The City's Trails and Pathways Master Plan ranks these trail segments as a top priority for implementation of both local and regional trail systems, specifically recommending a 'grade-separated' crossing of Hwy 43.

Lake Oswego Open Space Plan

The City of Lake Oswego completed an Open Space Plan in 2002 which identified the confluence of Tryon Creek with the Willamette River as a critical area for property acquisition and to "provide a pedestrian and bicycle connection from the Tryon Creek State Natural Area Park to the Willamette River. A safe crossing or underpass is required at the intersection of Hwy 43 and Terwilliger Blvd."

THE PARTNERSHIP

Stakeholder agencies, volunteer organizations, and private interests have coalesced into a composite study group for lower Tryon Creek, herein called the *Partnership*. Shared perspectives of, and interests within, this area are brought together by the Partnership in development of a long-term vision for the study area centered on the Hwy 43 culvert. Contributing Partnership members are acknowledged herein.





PARTNERSHIP STUDY OBJECTIVES

In December of 2006, an early meeting of the Partnership was facilitated by the City of Lake Oswego. Partnership representatives helped City staff further identify issues and design criteria integrated into this Study. Consensus amongst this group established the following criteria:

Required Design Criteria	Desirable Design Criteria
☞ Must provide year-round fish passage to all native species during all life stages	☞ Shall provide passage to wildlife that occur in the project vicinity
☞ Must be able to meet regulatory requirements (e.g., Clean Water Act, Section 404 permits and associated Endangered Species Act, Section 7 consultation; Oregon Department of Fish and Wildlife fish passage requirements)	☞ Shall incorporate “sustainable building” design and construction practices (e.g., state of the art storm water management, specifying sustainable harvest materials, etc.)
☞ Must be feasible to construct in light of given site constraints	☞ Shall allow for improved traffic flow at the Terwilliger intersection with Hwy 43
☞ Must provide or allow for bike and pedestrian access between Tryon Cove park and Tryon Creek State Natural Area Park	☞ Shall assume that existing railroad tracks will remain and that no new at grade crossings will be developed.
☞ Must be compatible with existing planning efforts of different agencies.	☞ Shall allow for improved traffic access to Foothills Redevelopment area
	☞ Shall be aesthetically appealing and provide for an iconic sense of entry into the City
	☞ Shall allow for improved automobile access from Hwy 43 to Stampher Road

The primary objective of this Study is to evaluate how several possible culvert replacement designs meet the criteria above. Improving passage of targeted fish species, primarily salmonid and lamprey, between the lower and upper reaches of Tryon Creek will also provide for the needs of other indigenous fish and wildlife in this watershed. US Fish and Wildlife Service, the Oregon Department of Fish and Wildlife, and the City of Portland’s Bureau of Environmental Services have completed fish surveys within the Tryon Creek Watershed. Survey results cumulatively indicate the seriousness of the Hwy 43 fish passage barrier. Future implementation of culvert replacement project which meets established Study objectives would result in the restoration of Tryon Creek from the Willamette River through Tryon Creek State Natural Area Park. Restoration would open up approximately 8 miles of stream to year-round passage of fish and other aquatic species, improving in-stream and riparian habitat for fish and wildlife.





Secondarily, the preferred design should also address the complex and overlapping transportation and infrastructure issues related to this nexus of interests. Recreational, vehicular, and railway transportation modes all intersect within this geologically constrained project area. Numerous planning efforts by Partnership members that are completed or in process must be integrated into this process.

Finally, redevelopment of this intersection creates significant aesthetic opportunities for the City of Lake Oswego. A ‘gateway’ to the community and the adjoining redevelopment areas is consistent with all Partnership planning efforts, and specifically for the City, the Willamette Shoreline Trolley Consortium, the Tryon Creek State Natural Area Park, and the Oregon Department of Transportation.

PUBLIC PROCESS INTEGRATION

Continuing the Partnership’s interest after this Study, an executive committee could be created from the Partnership members of those members most who are most affected by the successful implementation of the project. Upon the completion of the Study, a goal of the Partnership is to integrate the recommendations presented herein into those Partnership planning efforts underway or proposed for the study area. Such planning efforts by Partnership members will provide opportunities for public input in shaping the vision for this complex study area. Integration of public comments will help the Partnership executive committee refine site planning and design efforts through further design development and project permitting.

Approval and adoption by the Partnership’s members will help to ensure that projects are well coordinated and would not be in conflict with overall planning guidance for the study area, and could serve to generate funding opportunities and assure future implementation.





INTRODUCTION

PRESERVING OUR URBAN NATURAL RESOURCES

“Where water flows, the positive benefits of open space are the clearest. If we follow its path we at once secure the prime lands and the lands which give linkage and continuity” ~ William H. Whyte.

Some residents of Lake Oswego remember catching fish in Tryon Creek and many of its tributaries. This historic memory is a valuable and motivating element for gathering public support for the Partnership’s restoration efforts. Today, a culvert beneath Hwy 43 impedes fish and wildlife passage from the confluence of Tryon Creek with the Willamette River east of Hwy 43 to the upland watershed within the approximately 650 acres of the Tryon Creek State Natural Area Park west of Hwy 43. Oregon’s Department of Fish & Wildlife as well as the cities of Portland and Lake Oswego have placed a high priority on this culvert for analysis and replacement to reconnect this essential habitat.

In 2002, the City of Lake Oswego partnered with Metro and the City of Portland to acquire approximately 10 acres of private property on the north side of the Tryon Creek confluence with the Willamette River. With this purchase, the lower reach of Tryon Creek is largely in public ownership, which, including the Tryon Creek State Natural Area Park is a significant portion of the watershed. Purchase of this property has made possible an unprecedented opportunity to take advantage of public and political support for comprehensive planning of this area, as well as to explore funding opportunities within the Partnership.





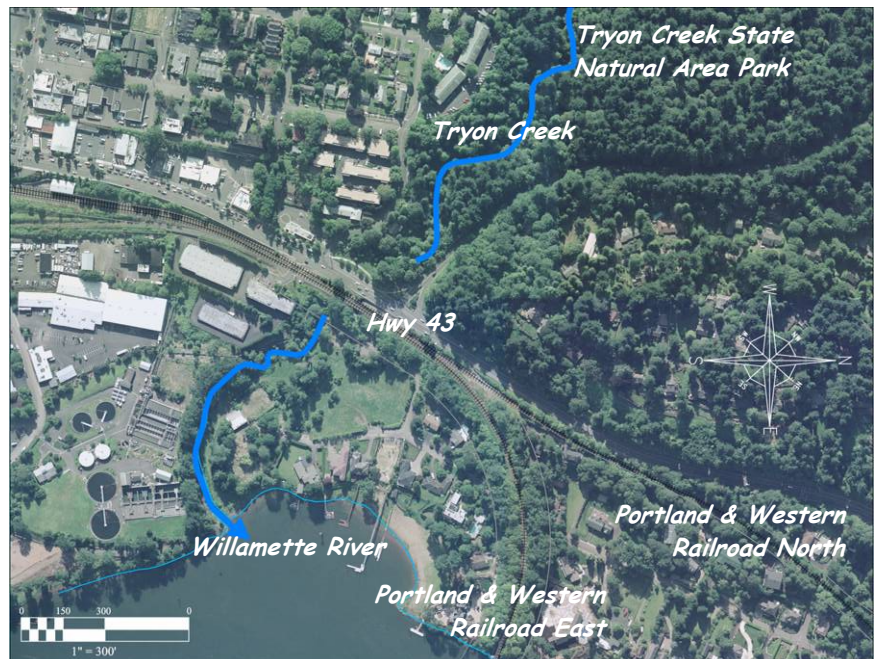
As our communities grow, the preservation of linkages which constitute the continuity of the water cycle becomes ever more critical to our lives and where we live. From the rainfall which refreshes our groundwater, from small streams to great rivers, and onward to the sea, this continuity is the ribbon of life for countless and diverse species.

Once natural resource areas were thought to be only areas for exploration and exploitation, we now know that these areas cleanse and maintain our environment. Wetlands, creeks, and streams retain and gradually release large volumes of water providing flood control important to our urbanized lands. Associated native vegetation trap sediments, consume water-borne pollutants, and most importantly offset the build-up of CO₂ in our air releasing great volumes of oxygen much as rain forests do.

Preserving natural resource areas in our developing urban areas, preventing the isolation of key elements of this cycle, requires forward planning by our communities in balancing economic development with a quality of living and environmental vitality.

EXISTING WATERSHED CONDITIONS

Tryon Creek's watershed is approximately 4,200 acres in extent - 3,300 acres within the City of Portland's urban service boundary and 900 acres within the City of Lake Oswego's urban service boundary. Watershed boundaries to the northeast are the Palatine Hills, to the



north and west by Portland's West Hills, and to the southwest by Mt. Sylvania. Tryon Creek's watershed basin begins at Mt. Sylvania (elev. 970 feet) and flows to its confluence with the Willamette River (elev. 10 feet). One of the most significant features of the watershed is the Tryon Creek State Natural Area Park, a 640-acre Oregon State Park within the cities of Portland and Lake Oswego.





Tryon Creek’s watershed has been subjected to urban development, invasive species encroachment, deforestation, stream channelization, channel incision, floodplain filling, storm water runoff, and alterations further disconnecting stream flows from historic flood prone areas. Other changes have included hardening of stream embankments, and culverting stream flows beneath a network of local and regional roads including Hwy 43, and the adjacent Portland & Western rail lines.

Despite urbanization impacts to Tryon Creek and its tributaries, there remain indigenous fish species in the stream with eagles and osprey perching over the channel. Along the northern edge of lower Tryon Creek, within the project area, there are several large specimen trees of black cottonwood, Pacific willow, Oregon ash, and red alder. Several of these trees have been pruned back providing large snags for several species of raptors, including osprey, and adult and juvenile bald eagles. Deer and beaver are often observed within the project site as well. In Tryon Creek’s riparian area, a variety of bird life has been observed, including great blue heron, kingfishers, and a cornucopia of other species.

Tryon Creek fish passage and biological studies include:

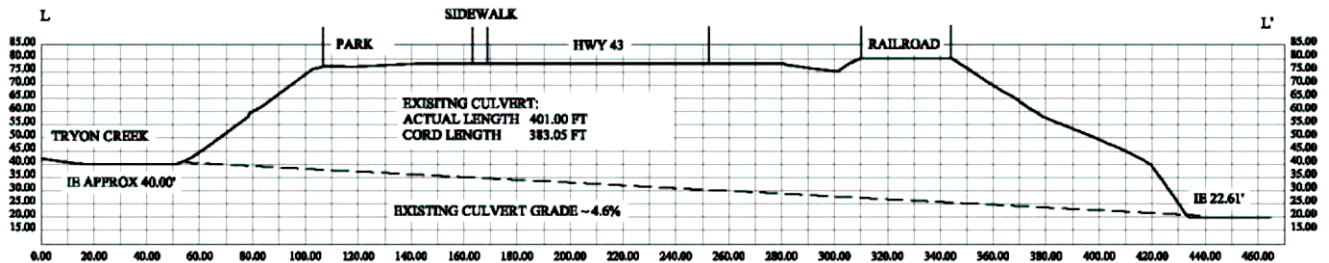
- ❧ *Habitat Characterization and Biological Communities Characterization for Tryon and Fanno Creek Basins; Status Report* - City of Portland Bureau of Environmental Service
- ❧ *Lower Tryon Creek Fish Passage: Analysis of Alternative Design Concepts*- City of Portland Bureau of Environmental Service
- ❧ *Tryon Creek Habitat Inventory* - Oregon Department of Fish and Wildlife
- ❧ *Distribution of Fish in Portland Tributary Streams*, Annual Report, 2001-2002. Oregon Department of Fish and Wildlife
- ❧ *Assessment of Restoring Fish Passage in Tryon Creek* -US Fish and Wildlife Service





HISTORY OF THE CULVERT AND VICINITY

In the late 1920's, lower Tryon Creek was channeled into an approximately 400-foot long concrete culvert beneath new fill for the Hwy 43 roadway and the Portland & Western double-track rail line approximately 1,200 feet west (upstream) of the creek's confluence with the Willamette River.



Longitudinal Profile of existing Tryon Creek culvert beneath Hwy 43 and the Portland & Western rail lines (see Appendix VI, Fish Passage Restoration Conceptual Design)

Between the Hwy 43 culvert and the Willamette River, Tryon Creek's stream channel is entrenched with flows disconnected from the floodplain and limited in-channel habitat. Tryon Creek's southern embankment is steep with fill and abundant invasive plant species.

For much of the past 80 years, fish have been unable to pass through the culvert to the upper watershed because of water depth and water velocity within the culvert. In recent studies, coho salmon and steelhead and cutthroat trout have been found upstream of the culvert, but other Endangered Species Act (ESA) species of concern such as Pacific lamprey and chinook salmon have exclusively been found immediately below confirming that the culvert is a fish barrier to some species. Wildlife connectivity between the Willamette River shore, lower Tryon Creek and upper Tryon Creek forested and riparian habitat is also largely severed by the Hwy 43 fill as well as fill associated with the adjacent Union Pacific / Portland & Western rail lines.

Tryon Creek's historic corridor, if restored, would again become an important greenway for wildlife and a critical link for fish habitat protection. Indigenous species population recovery within Tryon Creek, and the restoration of rearing and refugia habitat for Willamette River fish species, places a high priority within the Partnership for this project.





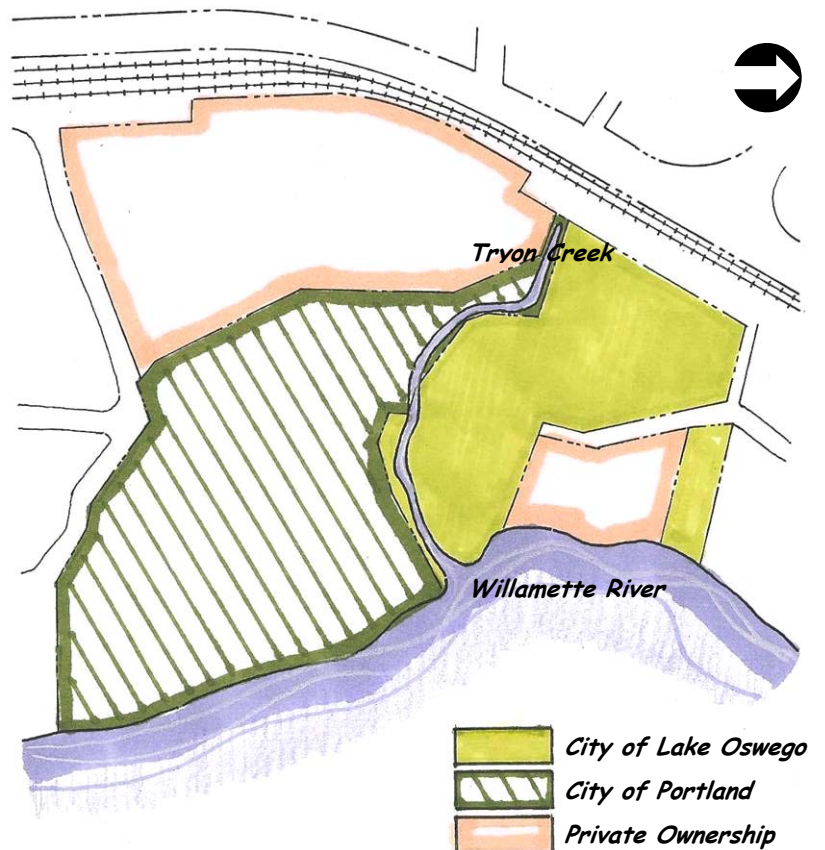
COMMUNITY LINKAGES

By comparison to other small metropolitan communities, the City of Lake Oswego has succeeded in retaining, repurchasing and protecting a significant ratio of natural resource areas per capita. One of the primary community objectives is the integration of community parks and recreational opportunities with conservation of natural resource areas.

Parks and Trails

Ownership of the lands adjacent to the Tryon Creek @ Hwy 43 intersection is complex. Infrastructure right-of-ways by the Oregon Department of Transportation, Great Western Railroad (Union Pacific / Portland & Western), and the City of Lake Oswego occur at this nexus. With limited exceptions, Tryon Creek's entire lower reach is in public ownership from the Willamette River confluence upstream through the Tryon Creek State Natural Area. Downstream of Hwy 43 to the Willamette River, adjacent lands are both publicly and privately owned.

Privately-owned parcels have been purchased by the City of Lake Oswego, the City of Portland, and Metro for the protection of the stream and potential development of the Tryon Cove Park. City of Portland has ownership of the southern embankment of Tryon Creek to the Willamette River where they manage a Water Quality Treatment Facility.





Several Partnership member planning efforts, past and ongoing, identify Tryon Creek's west-east stream alignment as an opportunity to connect existing and proposed public recreational trails within the lower Tryon Creek and Foothills District redevelopment area to the Tryon Creek State Natural Area Park. Similarly, several Partnership members are planning regional trail connections between the cities of Portland and Lake Oswego along the Hwy 43/Willamette River corridor. These studies include:

- ∞ *Foothills Design District Project Summary*- City of Lake Oswego.
- ∞ *Redevelopment Agency East End Redevelopment Plan Update*- City of Lake Oswego
- ∞ *City of Lake Oswego Comprehensive Plan*
- ∞ *Foothills District Refinement Plan: Alternatives Evaluation and Refinement Report*- City of Lake Oswego
- ∞ *Trails and Pathways Master Plan*- City of Lake Oswego
- ∞ *Regional Trails and Greenways: Connecting Neighborhoods to Nature*- Metro
- ∞ *Regional Transportation Plan* - Metro
- ∞ *Portland to Lake Oswego Transit and Trail Alternatives, Background Report*- Metro
- ∞ *Lake Oswego to Portland Transit and Trail Study (DRAFT 2007)* -Metro
- ∞ *Tryon Creek State Natural Area Park Trails Master Plan (DRAFT 2007)*- Oregon State Parks

The City of Lake Oswego has been exploring a pedestrian trail option of connecting the regional trail through Foothills Park north across Tryon Creek to provide public access into the future Tryon Cove Park and linking with other regional trail connections. With this trail extension, recreational and transportation trails can then be safely connected northwards towards Portland along alignments being studied in Metro's proposed Portland to Lake Oswego Transit and Trails Alternatives (January 2006). The City's proposed trail across Tryon Creek would also connect to trail systems presented in Tryon Creek State Natural Area Park Trails Master Plan (DRAFT 2007).





Community Gateway

As the Lake Oswego community considers redevelopment of the Foothills District, Tryon Cove Park, and the Tryon Creek @ Hwy 43 intersection, it presents the opportunity to develop this area additionally as a ‘gateway’ to the community. Redevelopment of the Foothills District would connect downtown Lake Oswego to the Willamette Riverfront. Consistent with previous planning efforts for the Foothills District, Partnership discussions, particularly with representatives of the Oregon Department of Transportation (ODOT), support the gateway concept. An increase in public transportation options (street car, trail, bus, etc.) between the cities of Portland and Lake Oswego is highly desirable at this gateway. Aesthetics can be effectively addressed through selected structural materials, details, and signage all of which can readily be incorporated into the design development for public and private elements planned at this nexus.

Transportation Planning Integration Opportunities

Partnership members acknowledge that evaluation and resolution of the Hwy 43 culvert alternates should not be limited only to fish and wildlife passage improvements. It is broadly recognized that undertaking improvements of the existing culvert conditions presents opportunities to evaluate and integrate recreational trail, transit, and community aesthetics into the Partnership’s preferred design. Conversely, it is hoped that plans and projects that affect the study area will be developed and implemented in ways that support, rather than conflict with, implementation of the Partnership’s preferred design alternate.

100-Year Planning Horizon

Numerous overlapping planning efforts for the Tryon Creek @ Hwy 43 nexus and surrounding redevelopment area present complex planning needs. At the same time, each of these efforts also provides an opportunity to move toward the realization of a culvert replacement project. Partnership members have directed that this Study consider a 100-year planning horizon as far as reasonable in its evaluation of culvert alternates. The various planning efforts will provide many opportunities for the public to provide input and help shape the future vision of the Study area.

Foothills District Redevelopment

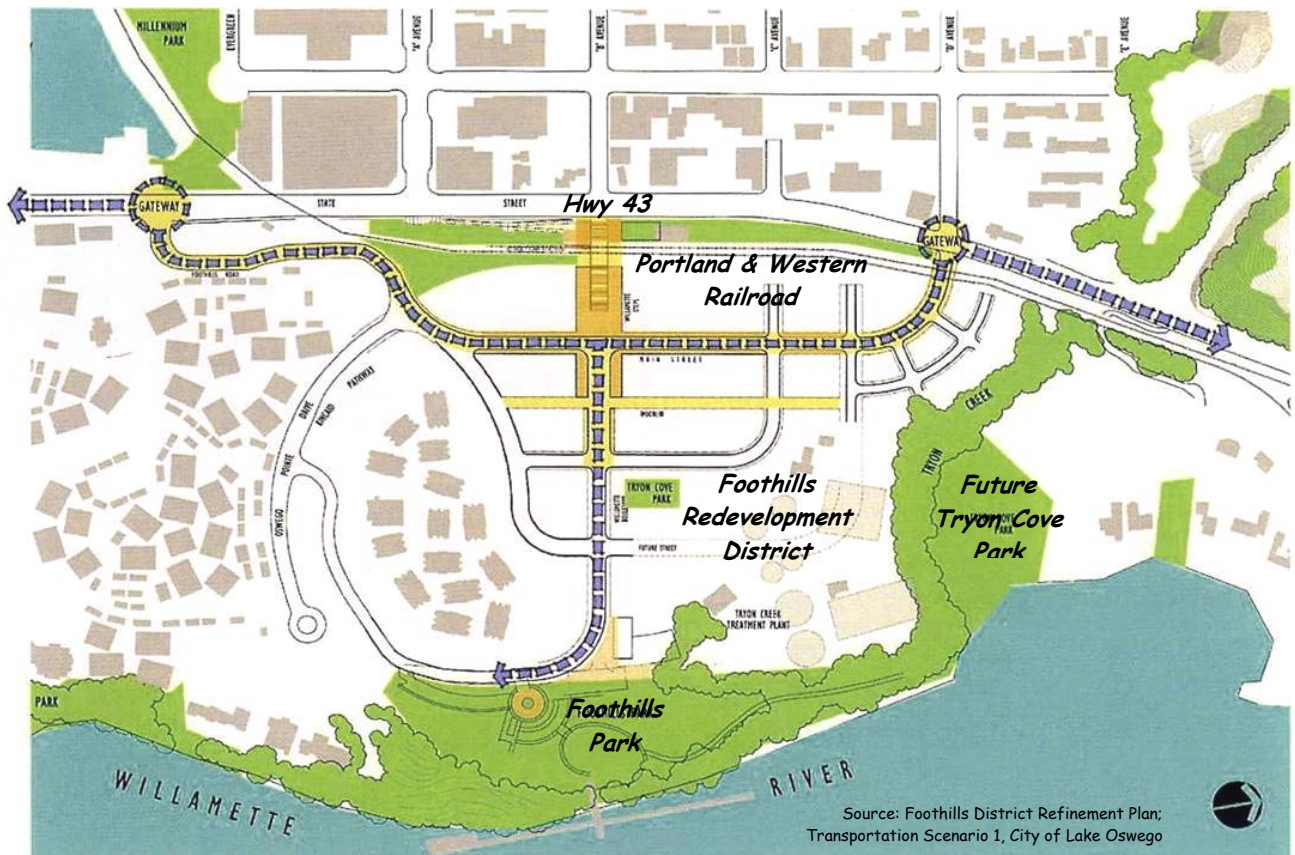
Community planning efforts for the redevelopment of the Foothills District are summarized in the City of Lake Oswego’s Foothills Design District Project Summary (June 2002) and the Foothills District Refinement Plan (June 2003).





Of relevance to this Study, redevelopment of the Foothills District proposed several scenarios for the northward extension of Foothills Road into this Study's planning area. Scenarios include a new light-controlled intersection of Foothills Road with Hwy 43 south of Tryon Creek, or bridging across Tryon Creek to create a new four-way intersection with Hwy 43 perpendicular to Terwilliger Blvd.

Portland & Western Railroad has suggested that a modification of the Hwy 43 intersection south of Tryon Creek where an existing at-grade vehicular crossing exists is highly preferable to the creation of a new at-grade crossing at the Terwilliger intersection for the northward extension of Foothills Road. Similarly, minimizing crossings of Tryon Creek's existing or restored open channel at the Stampher Road southward realignment, is preferred by the resource conservation and regulatory members of the Partnership.



In any redevelopment scenario for the Foothills District for the extension of Foothills Road, connecting a new alignment of Stampher Road to Foothills Road with a common intersection at Hwy 43 is a clear benefit to public safety. Resolution of this intersection is an important secondary objective for the Partnership's evaluation of culvert alternates.





HWY 43 CULVERT ALTERNATES

CONCEPTUAL CULVERT ALTERNATES EVALUATION

Partnership members evaluated several conceptual design alternates for repair or replacement of the Hwy 43 culvert (see Appendix I, Conceptual Alternatives Evaluation Matrix). Concepts include a ‘no-build’ option, enhance fish passage structures within the existing culvert and channel immediately below the culvert (Alternate A), replace the culvert with a large concrete span arch and restore the channel beneath (Alternate B), or replace the culvert with a steel span bridge and restore the channel beneath (Alternate C). Both Alternates ‘B’ and ‘C’ would also provide pedestrian trail opportunities alongside the restored stream channel. Partnership members reviewed several versions of these concepts and proposed that options A, B, and C be further evaluated. Those refined options were further analyzed to determine how they met the evaluation criteria previously established by the Partnership, including:

- ∞ Fisheries / Wildlife / Environmental Considerations
 - Meets passage requirements for targeted fish species (salmonids and lamprey)¹
 - Improves habitat for wildlife species and increases wildlife corridor connectivity
 - Meets hydrological requirements for 10, 25, and 100 Year storm event
 - Provides benefits to in-stream structure and aquatic species habitat
 - Provides benefits to associated wetlands and riparian habitat
 - Addresses Section 7 ESA Consultation considerations
 - Considers ACOE/ODSL Joint Application permitting requirements
- ∞ Transportation / Recreational Access Considerations
 - Improves Terwilliger Blvd. @ Hwy 43 intersection
 - Improves Stampher Road access to Hwy 43
 - Improves existing rail access/safety through project area
 - Creates safe pedestrian / bicycle trail opportunity / connectivity between Tryon Cove Park and Tryon Creek State Natural Area Park
- ∞ Integration with Current and Future Planning
 - City of Lake Oswego Comprehensive Plan (Title 3; Goal 5)
 - City of Lake Oswego Foothills Redevelopment Plan
 - City of Lake Oswego Trails and Pathways Master Plan
 - City of Lake Oswego Surface Water Management Plan
 - Tryon Creek State Natural Area Park Trails Master Plan
 - Metro’s Portland to Lake Oswego Transit and Trails Plan
 - Tri-Met 'Street Car' Line development planning
- ∞ Community Gateway Aesthetics
 - Establishes/enhances Gateway to City of Lake Oswego aesthetics

¹ Partnership members assume that by addressing passage needs for salmonids and lamprey, connectivity and accessibility will be improved for other indigenous aquatic species as well.



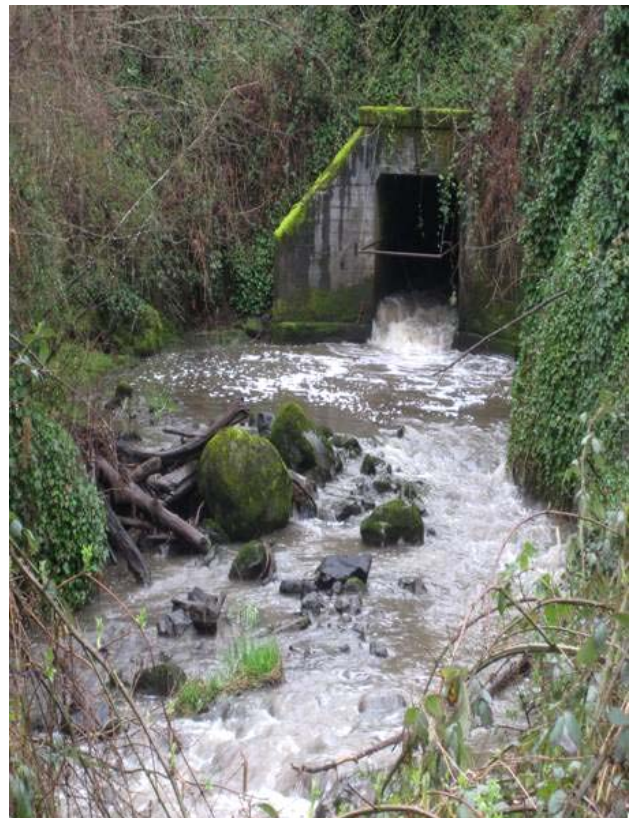


ALTERNATE A: 2007 FISH PASSAGE AND CHANNEL ENHANCEMENT PROJECT

Prior to this Study, a subset of the Partnership has been working to improve the most urgent problems associated with the Hwy 43 culvert. In the summer of 2007, ODOT and the City of Portland Bureau of Environmental Services (BES) plan to enhance approximately 120 feet of the Tryon Creek channel immediately downstream of the Hwy 43 culvert as well as to remove existing but damaged and inadequate fish passage ‘baffles’ and to re-install new baffles to improve through-culvert fish passage. Biologists from the US Fish and Wildlife Service (USFWS), Oregon Department of Fish and Wildlife (ODFW), and BES have conducted surveys of adult and juvenile indigenous fish species, adult and juvenile, and their ability to migrate from the Willamette River into lower Tryon Creek, then through the existing culvert into upper Tryon Creek watershed and its tributaries. Improving fish passage alone could help restore fish runs into the entire Tryon Creek watershed.

In these studies, coho salmon, steelhead and cutthroat trout were found upstream of the Hwy 43 culvert, but other ESA-listed species and species of concern such as Pacific lamprey and chinook salmon have been only found downstream of the culvert confirming the culvert as a fish barrier to critical species.

As an interim measure only, this project may provide short-term improvement of existing passage opportunities until a longer-term and more comprehensive solution can be implemented. The 2007 stream enhancement design objectives are to create a minimum of 12-inches flow depth at the culvert outlet to allow adult and juvenile salmonids to migrate through the culvert during summer and early-fall low-flow conditions. Reduction of erosive forces during high stream flows is designed to be achieved through limited channel integration of natural materials that emulate natural stream structures.

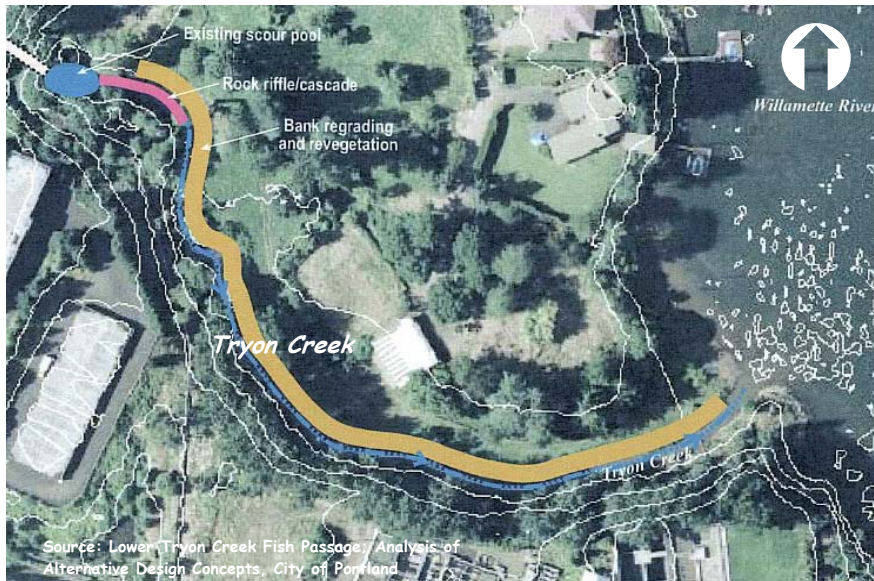


Hwy 43 Tryon Creek Culvert Outfall presents barrier to salmonid and lamprey migration into the upper Tryon Creek watershed.





Stream enhancement proposed by BES and ODOT(see below) will provide fish passage by raising the stream water level at the downstream end of the culvert carrying Tryon Creek to help fish enter the passage. Presently, the jump at the Hwy 43 culvert outfall may be too steep for some fish species, especially Pacific lamprey, to enter. A raise in the stream grade is proposed to help fish enter the culvert and access the great fish habitat within Tryon Creek State Natural Area. Downstream, approximately 120 feet of streambed will be raised to more closely match the grade of the culvert. Inadequate fish baffles inside the culvert



will be replaced to improve passage once fish enter the culvert. The project also includes removing invasive weed species and re-vegetating with native plants.

“A long term solution to improve fish passage is to replace the (Hwy 43) culvert with a bridge. As an interim however, this project will improve fish passage until funds can be allocated for a bridge.”

ODOT Communications, 2007

Evaluation of Alternate Benefits

Enhancement of the existing culvert provides limited fish passage improvement opportunities. General consideration within the Partnership is that this alternate;

- ☞ at best improves fish passage for the near-term, but does not meet current NOAA Fisheries or ODFW culvert fish passage criteria
- ☞ creates no wildlife corridor connectivity
- ☞ has no impact upon the existing Portland & Western rail line nor the Willamette Trolley Consortiums rail line
- ☞ does not connect existing or planned pedestrian trail access through this nexus
- ☞ enhances existing culvert in place, rather than replacement, with no improvement to hydraulic capacity consistent with City storm water management objectives
- ☞ does not present opportunities for the development of community gateway aesthetics.

Evaluation of Alternate Costs

ODOT’s project budget for implementation of this project in the summer of 2007 is an estimated range between \$350,000 - \$425,000 (see Appendix I, Conceptual Alternates Analysis Matrix; and Conceptual Alternates Costing Analysis).





ALTERNATE B: CONCRETE SPAN ARCH

A concrete span arch could be constructed beneath Hwy 43 at grade with Tryon Creek upstream and downstream. This type of structure (see image) would be similar to a fish passage structure the City of Portland installed on Kelley Creek beneath Foster Road in southeast Portland,. Pre-cast sections of concrete arch are placed and secured sequentially to provide the desired span width. A large span arch, with an interior height of approximately 20 feet and interior opening (length) of 54 feet could readily accommodate a reconstructed channel of Tryon Creek. Additionally, this arch would provide for an adjacent 12- to 14-foot pedestrian trail/wildlife passage opportunity from the Foothills District through the proposed Tryon Cove Park into the Tryon Creek State Natural Area Park trail system upstream of Hwy 43.



Positive Design Aspects

A concrete span arch offers material durability and cost efficiencies due to the modular nature of pre-cast arch sections. Additional arches are installed to increase the width of the area beneath fill. This alternate would significantly reduce the fill above the replaced culvert. A similar arch, either independent or conjoined, could support the Portland & Western and Willamette Trolley Consortium rail lines over Tryon Creek.





Negative Design Aspects

A potential conflict, which can occur when a stream (creek, river, etc.) passes beneath a structure that also provides transit (vehicular or pedestrian) opportunities, is the requirement for interior lighting. Public safety interests will require that the passage be lit. However, biologists are concerned that such lighting may impede migration of fish and wildlife through this same passage. Many wildlife species are nocturnal, and are known to migrate or move between habitats during the evening or early morning hours. Lamprey are been documented to move at night within streams. Because a primary objective of this Study is to analyze alternates to improve fish passage between lower and upper Tryon Creek, it is essential that no replacement structure to the Hwy 43 culvert limits potential passage and connectivity through this nexus. Partnership members believe that while the lighting issue is important, there may be designs which can address lighting requirements for both public safety and wildlife passage.

Establishing significant native riparian vegetation within the concrete span arch is not practicable due to spatial restriction and light limitations. However, increasing light penetration to the stream corridor would at a minimum create opportunities for some natural vegetation on the exterior faces of an arch, or arches. An option is to construct separate concrete span arches for Hwy 43 and the adjacent rail lines, removing the fill and daylighting the stream channel between these arches. Filtering light between these spans would reduce the 'tunnel effect' for the recreational, reduce the structure costs, and improve air flow and light penetration to the Tryon Creek channel beneath.

A concrete span arch, or arches, do not necessarily provide aesthetic enhancement opportunities as could be seen from the roadway or railway surface. While these arches can be faced with natural materials to provide improved aesthetics, they would primarily be viewed from the adjoining pedestrian trail. However, the Partnership's interest is in establishing this nexus as a gateway to Lake Oswego could still be achieved by surface monuments, plantings, signage, etc.

Stream Channel Design Objectives

The stream channel design objectives would be to create a maximum restored channel slope of 1.5% by installing boulder grade control structures (vortex weirs) creating step pools between weirs (see Appendix VI; Fish Passage Restoration Conceptual Design). An average of 6-inches jump height between controlled stream surface grades would allow adult and juvenile salmonids to migrate within the channel during summer and early fall low-flow conditions. Reduction of erosive forces during high stream flows would partially be achieved through limited integration of natural materials that emulate natural stream structures within the channel. Pacific lampreys, which do not 'jump', would additionally require smooth natural boulder surfaces or adequate orifices between placed boulders in order to transit between step pools. Lampreys are unable to negotiate sharp angles that, in combination with high flow velocities (e.g. greater than 4 cubic feet per second) that effectively restrict upstream passage.





Evaluation of Alternate Benefits

Replacement of the existing culvert with a large concrete span arch and installation of in-stream grade controls provides significantly improved fish passage opportunities and would meet NOAA Fisheries and ODFW culvert fish passage criteria. Hydraulic capacity consistent with City storm water management objectives would exceed 100-year peak flow requirements. Substantial width of the arch would create limited wildlife corridor connectivity between the lower and upper reaches of Tryon Creek. An adjacent pedestrian trail would serve to safely connect existing and planned pedestrian recreation trail access through this nexus. Community gateway aesthetics could be reasonably incorporated into this alternate though public street level visibility of the span arch would be minimized.

Evaluation of Alternate Costs

Estimated costs in 2007 dollars for implementation of this alternate would range between \$6,000,000 - \$6,500,000 (see Appendix I, Conceptual Alternates Costing Analysis; and Appendix II Contech Bridge Solutions Preliminary Estimate of Costs).





ALTERNATE C: STEEL TRUSS BRIDGE

An open-span Hwy 43 bridge could reasonably be constructed over the restored channel of Tryon Creek. A similar bridge structure could support the rail lines over the creek channel. Assuming an approximately 120-foot span length at the existing Hwy 43 road grade, this alternate could have a minimum 82-foot width necessary to incorporate four 12-foot travel lanes, a 12-foot center vegetated median, two five-foot bike lanes, and two six-foot pedestrian sidewalks. A steel truss bridge, with a span height of approximately 30 feet and span length of 120 feet would ideally accommodate the restored Tryon Creek channel, an adjacent 12- to 14-foot pedestrian trail, restored stream embankments, and associated native riparian habitat.



Positive Design Aspects

Steel truss bridges can offer both durability and aesthetics, are typically modular in construction limited primarily by the length of span rather than needed width. Additional bridge width can be achieved as necessary to provide for vehicular and pedestrian transit. A narrower independent bridge would support the Portland & Western and Willamette Trolley Consortium rail lines over Tryon Creek. Because of the bridge structures span height and general openness, the conflict between lighting for public safety interests and potential impediment of migration of fish and wildlife beneath is largely avoided. Any remaining minor lighting issues adjacent to the stream can be easily addressed through further design and Partnership guidance.

Gateway aesthetic opportunities are prevalent through this type of structure. Bridges are commonly designed with visual aesthetics in mind and are viewed from both roadway and rail surface as well as beneath on the adjoining pedestrian trail connection between Tryon Cove Park and the Tryon Creek State Natural Area Park. A bridge clearly meets the Partnership's interest in establishing this nexus as a gateway to Lake Oswego providing appropriate surface monuments, plantings, signage, etc.





Negative Design Aspects

Steel truss bridges are more costly to construct than concrete span arches. Additionally, excavation and removal costs of the Hwy 43 and railroad berm material would considerably add to overall project costs.

Stream Channel Design Objectives

Restoration objectives and conceptual design for the Tryon Creek channel would generally not differ widely from channel restoration beneath a concrete span arch. Design intent would, again, be to create a maximum slope of 1.5% by installing boulder grade control structures (vortex weirs) creating step pools between weirs, with an average of 6-inches jump height between controlled stream surface grades. These are proven structures that would create appropriate stream gradient to allow adult and juvenile lampreys and salmonids to migrate during summer and early fall low-flow conditions.

Again, due to their inability to 'jump', Pacific lampreys would additionally require smooth natural boulder surfaces or adequate orifices between placed boulders in order to transit between step pools.

Integration of large wood, boulders, and other natural materials within the stream channel and adjacent floodplain would provide refugia for fish and other aquatic species. Reestablishing native riparian vegetation along the entire open width of the restored Tryon Creek flood plain, the entire riparian zone, and outward to adjacent upland habitat would significantly increase the habitat function within this reach while reducing the potential for stream incision, erosion, and embankment failure.

Evaluation of Alternate Benefits

Replacement of the existing culvert with a steel truss bridge and installation of in-stream grade controls provides optimum fish passage opportunities. Hydraulic capacity consistent with City storm water management objectives would exceed 100-year peak flow requirements. Wildlife corridor connectivity between the lower and upper reaches of Tryon Creek would only be constrained by the natural width of the Tryon Creek floodplain. An adjacent pedestrian trail would serve to safely connect existing and planned pedestrian recreation trail access through this nexus. Community gateway aesthetics are also optimized through this alternate.

Evaluation of Alternate Costs

Estimated costs in 2007 dollars for implementation of this alternate would range between \$11,500,000 - \$12,500,000 (see Appendix I, Conceptual Alternates Costing Analysis; and Appendix III Contech Bridge Solutions Preliminary Estimate of Costs).

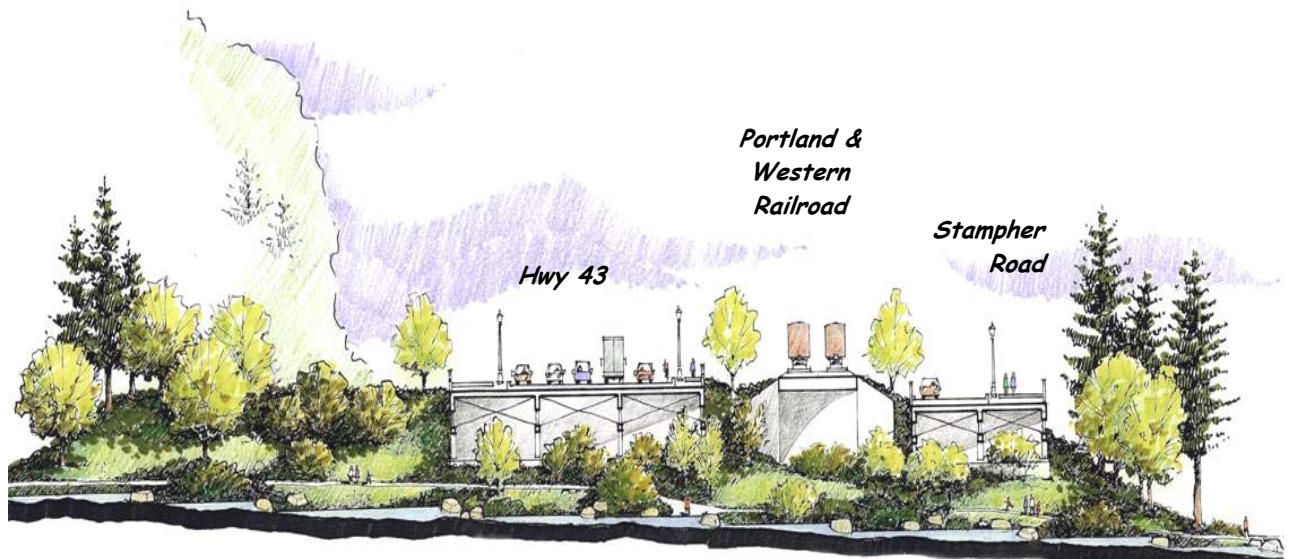




PREFERRED CONCEPTUAL DESIGN

Evaluation of Hwy 43 culvert alternates has shown that *Partnership members unanimously prefer replacement of the existing culvert and daylighting the Tryon Creek channel beneath a steel truss bridge or similar bridge structure.* While the second preferred alternate of a concrete span arch provides a number of fish passage and pedestrian access improvements, the bridge alternate meets all of the Partnerships primary objectives.

Rather than one massive bridge, the Partnership's preferred design includes two steel truss bridges, separated by a concrete arch span for the adjacent Portland & Western rail lines. Rather than a steel truss bridge, the potential loading weight of the two rail lines with trains above are best supported by the concrete span arch rather than a steel truss bridge.



In evaluating between the conceptual design alternates, the Partnership considered not only the design and implementation costs of each alternate, but importantly took the 'long-view' of the transportation nexus in consideration of community and regional access planning, resource preservation and enhancement, structural element aesthetics, and community redevelopment. For these reasons as well as optimizing the primary Study objective of fish passage improvements, Partnership members chose the steel truss bridge alternate (Alternate 'C') modified by the inclusion of a concrete arch span (Alternate 'B') for supporting the Portland & Western rail lines.





Combining the strengths from Alternates ‘B’ and ‘C’, this design concept has several advantages: 1) it allows natural light to reach the creek between the separated steel truss bridge, concrete arch span, and steel truss bridge alignments, 2) an increased riparian area adjacent to Tryon Creek can be established with tall trees between these spans, 3) prefabricated bridge and concrete arch spans can be utilized which reduces overall project costs, and 4) installation of these prefabricated spans can be sequenced to limit construction delays to transportation as well as to shorten the overall project construction period.

It is anticipated by Partnership members that this project will require several years to implement. Projecting costs of the implemented future project from these concepts is necessarily ‘order-of-magnitude’ estimation based upon reasonable costs at the time of this Study. Cost estimates presented herein are based upon either the design engineer’s cost estimate as in Alternate ‘A’, or upon provided estimates from a national bridge supplier who reviewed concept designs for Alternates ‘B’ and ‘C’. Costs for alternates B and C were also reviewed by ODOT’s Bridge Design Group for reasonable accuracy at this initial conceptual design definition.

In order for the Partnership to further develop project budgets or to pursue funding for the implementation of this project, it is necessary to anticipate the costs associated with the delay in construction. While it is impossible to guarantee future construction costs for the Partnership’s preferred alternate design, extrapolated design and construction in 5, 10, and 15 years are presented in Appendix IV, Preferred Alternate Estimated Cost 5-, 10-, 15-Year Projection.

FISHERIES AND WILDLIFE PASSAGE RESTORATION

A well-designed restored channel and floodplain, as previously described provides Tryon Creek with an optimum stream meander pattern, longitudinal grade profile, and channel dimension characteristics. The new stream would reestablish a stable and non-erosive channel in consideration of existing watershed morphology and projected surface water hydrology. Controlling grades through in-stream step pool structures can provide minimum hydraulic jumps as well as no-jump migration options (smooth control-grade boulders). This site presents unprecedented opportunities for re-introduction of indigenous salmonid and lamprey species in the metropolitan region. Careful design of hydraulic jumps and natural boulder structures at these grade controls could potentially be utilized to provide passage for desirable indigenous species while limiting accessibility to non-native species.

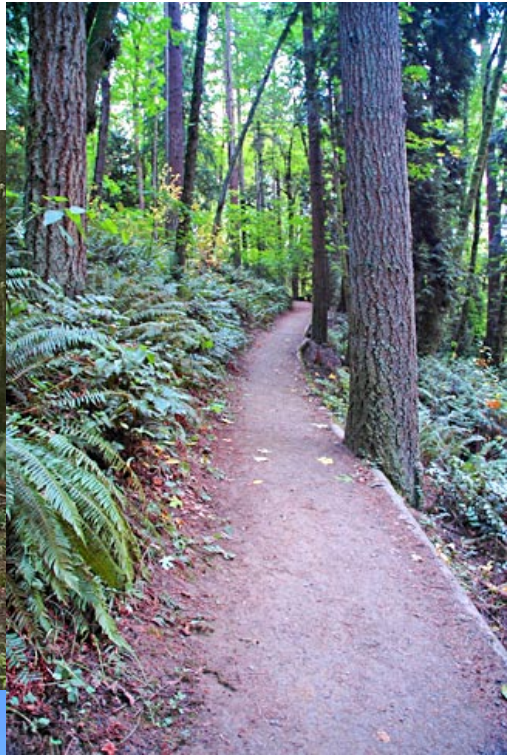
Creating the opportunity for the natural migratory re-introduction of indigenous species will reopen the stream and its tributaries within the 4,200-acre Tryon Creek watershed. An open Tryon Creek channel and associated floodplain will significantly enhance wildlife migratory connectivity between the Willamette River and lower Tryon Creek into the Tryon Creek watershed.





PUBLIC RECREATIONAL TRAIL SYSTEM

While either the concrete span arch or steel truss bridge alternate would provide safe pedestrian trail access between Tryon Cove Park and the Tryon Creek State Natural Area Park, the bridge alternate would also provide open habitat and natural vistas along the channel for public enjoyment. Wildlife presence would likely be increased and viewing opportunities enhanced with the open bridge span and associated increase in riparian habitat.





Planning Consistency and Community Linkage

It has long been a desire of the Lake Oswego community to better connect citizens and visitors with the Willamette River. Metro's Open Spaces Plan, City of Lake Oswego's Parks and Recreation Master Plan, City of Lake Oswego's Trails Master Plan, Tryon Creek State Natural Area Park all recommend that public trails be integrated into the City's proposed Tryon Cove Park, as well as the existing Foothills Park and other Willamette River Greenway pedestrian trails (Rohr's Park to George Rogers Park to the City of West Linn). Additional goals of the different plans are protecting and restoring native habitat, connecting public parks with environmentally sensitive pedestrian trails, providing trail users a positive experience with nature and water, and providing transportation alternatives.

Proposed trails in the project area are all regional trails and are eligible for regional transportation funds. Regional trails provide a transportation function and must be appropriately constructed to support multiple users during all times of the day and night. Trail requirements include: widths between 12-15 feet wide, directional signage, asphalt or cement surfaces, lighting for high use areas, and they must meet ADA standards.

The Partnership's preferred design alternate over Tryon Creek would alleviate some of the concerns usually associated with trails in sensitive environmental areas. In this case the bridges would allow the trails to be located away from the stream and reduce the need to light the trails. Recommended trail guidelines from the City's prior planning documents should apply:

- ☞ place trails as far away from the stream as possible
- ☞ reduce, where possible, trails parallel to the stream
- ☞ directional signage should be required to keep people out of the resource areas
- ☞ avoid at-grade road and rail line crossings where possible
- ☞ trail construction should incorporate storm water treatment in design
- ☞ trails should be placed out of the floodplain elevation to allow year around use

Recommended environmentally sensitive Green Trails guidelines² include:

- ☞ maintain habitat connectivity and locate trails along habitat edges
- ☞ keep trails at a minimum through natural areas and away from core habitat areas
- ☞ use existing disturbance corridors for trail alignments
- ☞ keep trails away from sensitive species habitat
- ☞ avoid impacts to streams, wetlands, and floodplains

² Metro, undated. Green Trails, Guidelines for Environmentally Sensitive Trails. Portland, Oregon. Available on-line at <http://www.metro-region.org>





Public Safety Lighting vs. Fisheries and Wildlife Passage

Conflicts can occur between public safety lighting interests and the potential for lighting impacts on the movement and migration of aquatic and wildlife species. All care should be taken in planning and design of pedestrian trails to eliminate or minimize such lighting impacts while providing for public safety. High overhead lights should be avoided if possible, any lights that are used should be low to the ground, directed at the trail, and be turned off between 11PM and 5AM.

Educational and Directional Signage

With improved public access from the adjacent neighborhood and park visitors via the proposed regional pedestrian trails, there exists excellent opportunities for environmental education signage. Views along Tryon Creek can be created and enhanced. Directional signage will enhance the trail experience and will direct visitors away from potential resource impacts. Public resource education should be clearly integrated into all community and regional pedestrian trail planning efforts undertaken by the Partnership.



INTEGRATION OF ASSOCIATED TRANSPORTATION IMPROVEMENTS

Neither the concrete span arch nor steel truss bridge alternates alone resolve the secondary vehicular transportation concerns expressed in existing and ongoing Partnership design studies, which at a minimum are:

- ☞ extension of Foothills Road from the Foothills Redevelopment District north towards Tryon Cove Park and a new intersection with Hwy 43
- ☞ re-align Stampher Road southward to the extended Foothills Road for significantly improved and safe access to Hwy 43
- ☞ extend Metro's regional trail southward across or through (beneath) the earthen berm of Portland & Western's rail line crossing the Willamette River
- ☞ potential extension of Stampher Road northward through the earthen berm, under the east/west railroad line, to connect to Fielding Road and the lighted intersection of Hwy 43

Any of these extended or realigned roadways can be readily accommodated by either stream crossing alternate. ODOT, the City of Lake Oswego, and the Portland & Western Railroad are pivotal stakeholders in the design resolution of this complex intersection of private and public interests. Neighborhood comment, particularly from the Stampher Road and Fielding Road communities, on the secondary road alternates will help to guide further design of these integral transportation components.

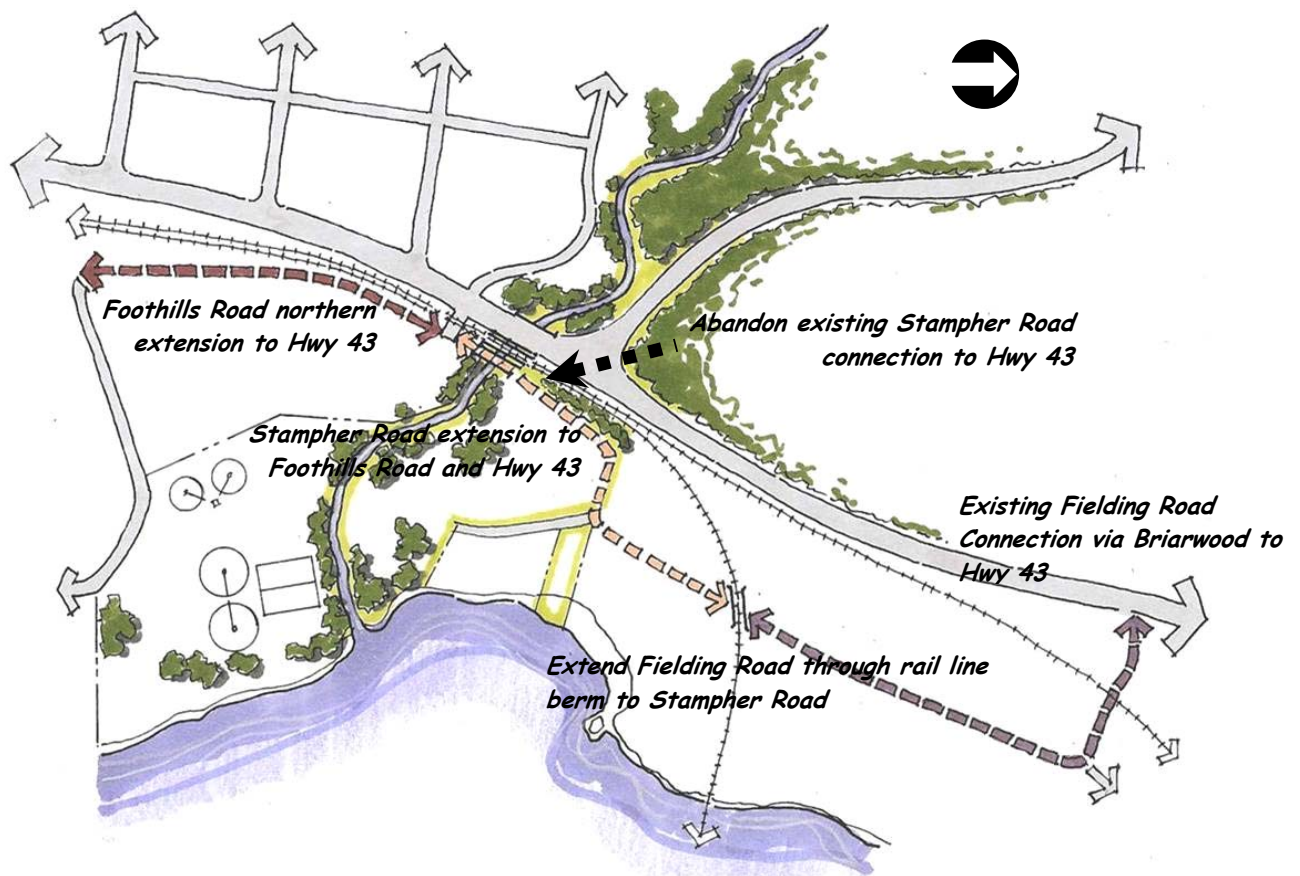




Integration of transit and trail planning efforts from the City of Lake Oswego's Foothills District Master Plan, City of Lake Oswego's Trails Master Plan, Metro's Portland to Lake Oswego Transit and Trail Master Plan, and Tryon Creek State Natural Area Park's Master Plan update will benefit resolution of public pedestrian and recreational trail planning through this transportation nexus.

Stampher Road

Community residences east of Hwy 43 and north of Tryon Creek utilize Stampher Road to access Hwy 43. This area has also been the focus of public investment by the cities of Portland and Lake Oswego to secure the Tryon Creek corridor and adjacent lands for potential redevelopment as the Tryon Cove Park and associated public recreational trail system. Stampher Road is a narrow, partially unpaved road which passes beneath a bridged portion of the Portland & Western rail line to an inadequate landing for egress onto Hwy 43. Access to and from this intersection is broadly acknowledged as dangerous to public safety.





Resolution of this intersection is an important secondary objective for the Partnership's evaluation of culvert alternates. One potential re-alignment of Stampher Road could cross Tryon Creek southward to the existing unlighted intersection at Hwy 43 where an 'at-grade' crossing of the Portland & Western rail lines exists. For reasons of public safety, Portland & Western Railroad is actively eliminating 'at-grade' crossings (pedestrian and vehicular) of its rail lines. Several options were studied by the Partnership.



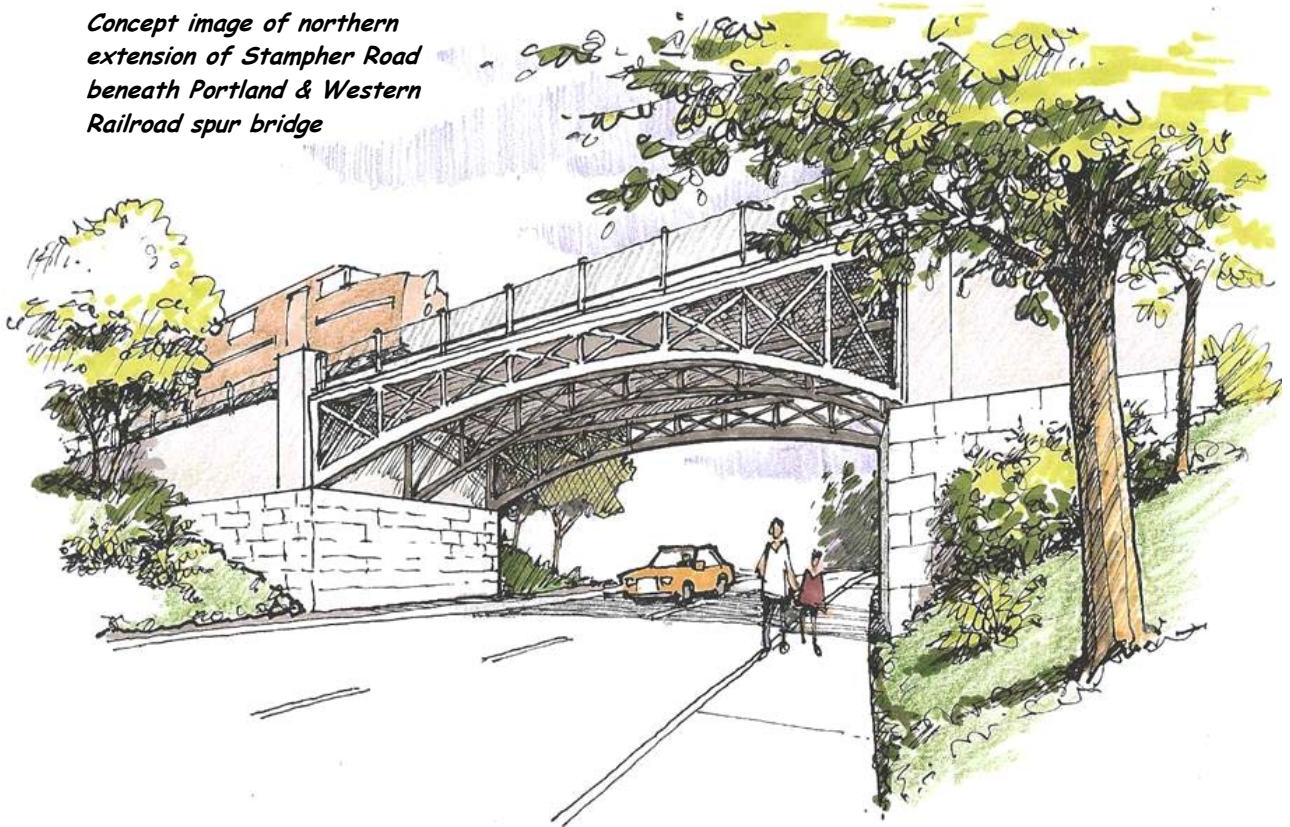
One option would extend Stampher Road south across Tryon Creek to the existing at-grade crossing of Portland & Western's rail lines to the Hwy 43 intersection. Increasing fill over the stream channel or adding additional stream crossings may be a potential conflict with resource protection Study objectives. Partnership members uniformly recommend minimizing crossings of and associated impacts to Tryon Creek.





A second option for realignment of Stampher Road away from its present intersection with Hwy 43 would be to direct traffic northward. An extension of Stampher Road beneath the Portland & Western rail lines (spur across the Willamette River) would connect with Fielding Road to the north (which then connects with Briarwood) to Hwy 43 at a light-controlled intersection. Independently, Metro's Portland to Lake Oswego Transit and Trails Alternatives study evaluated a pedestrian 'tunnel' through the rail line's earthen fill berm to accommodate a proposed recreational trail along the existing railroad right-of-way that would connect Portland to Lake Oswego. From this location, regional trails can extend west into the Tryon Creek State Natural Area Park or southward into the Foothills District and then along the City's trail system along the Willamette River.

Concept image of northern extension of Stampher Road beneath Portland & Western Railroad spur bridge





While the extension of Stampher Road northward to Fielding Road resolves some localized transportation-related issues, a corresponding increase in vehicular and pedestrian traffic through these residential neighborhoods to the proposed Tryon Cove Park presents other potential conflicts. Though Fielding Road has a light-controlled intersection, the road itself is not conducive to even moderate increases in vehicular traffic. Additionally, neither the Stampher Road nor Fielding Road residents are likely to welcome this increased public access to their neighborhoods.

Either of these alternates have significant implications of design, permitting, and funding outside of the scope of this Study that must be further developed. Partnership members agree however that their preferred alternate for the Tryon Creek @ Hwy 43 culvert must at a minimum address this public safety issue in recommendation of one or both of these secondary objectives.

In considering these secondary associated transportation objectives, the Partnership recommends that at a minimum:

- ☞ the Stampher Road intersection with Hwy 43 be realigned away from its present intersection for reasons of public safety
- ☞ a traffic study be conducted to inform future road alignments
- ☞ extend Stampher Road southward across Tryon Creek via a bridge to a light-controlled at-grade crossing intersection with Hwy 43
- ☞ future study of the Foothills Road / Stampher Road / Hwy 43 intersection be included in the Foothills Redevelopment District refinement process
- ☞ explore extension of Stampher Road northward beneath the Portland & Western rail line fill to Fielding Road with adequate width to accommodate Metro's desired pedestrian trail connection from Portland to Lake Oswego





PLAN IMPLEMENTATION CONSIDERATIONS

While implementation of the Partnership's preferred conceptual design and recommendations presented in this Study may be years away, during the development of this Study, several issues were identified for further design consideration.

POTENTIAL TRANSIT SERVICE IMPACTS

Hwy 43 Transit

Pedestrian, vehicular and emergency services transit through the Tryon Creek @ Hwy 43 intersection during reconstruction is an important aspect of project planning and sequencing of transportation routing for public safety. Ideally, Hwy 43 improvements would only require two of the existing four lanes to be closed at any time through construction. Lane closures must necessarily be considered through design development of the Partnership's preferred design alternate.

Railroad

Portland & Western's rail line is a reasonably active commercial track. Closure of these tracks during construction of a new rail span over Tryon Creek as proposed will be a significant challenge to project planning efforts. Further, with the potential decommissioning of the existing Stampher Road intersection with Hwy 43, the existing rail bridge over this roadway would likely be decommissioned as well.

UTILITY CONFLICTS AND SURFACE WATER TREATMENT

Project implementation conflicts with main utility lines through this nexus are anticipated. Utilities paralleling the south-north alignment of Hwy 43 would need to be upgraded for exposure and hanging from the steel truss bridge, possibly being aesthetically-integrated within the bridge's linear support beams. Integration of the City of Portland's existing sanitary sewer main from the upper Tryon Creek service area eastwards to the treatment plant in the Foothills District, could be readily incorporated beneath the alignment of the new west-east pedestrian trail under the bridges. Failing storm water outfalls to Tryon Creek could also be improved within the study area.





CONSTRUCTION MATERIALS STAGING AREA

Often not integrated into conceptual planning efforts is the very real need of planning for an accessible staging area for construction materials. Project costs will directly respond to the proximity of this area to the construction site. For the Hwy 43 reconstruction effort, the City of Lake Oswego's planned Tryon Cove Park and adjoining open space is ideally suited to serve for material storage during construction. Potential impacts to the proposed park and Tryon Creek must be avoided through integration of construction Best Management Practices.

SUSTAINABLE MATERIALS

The City of Lake Oswego has adopted Sustainability goals for all public construction projects. At a minimum, a variety of opportunities exist for this project's utilization of sustainable materials in stream restoration, roadway decommissioning, and roadway surfacing. With increasing awareness of the benefits of sustainable material utilization, and the possibility that this project may not be implemented for several years, further exploration and design integration of sustainable materials is highly recommended by the Partnership members.

Tryon Creek Channel Restoration

- ☞ salvage and re-use stream channel materials
- ☞ design should specify locally-available streambed materials for channel restoration
- ☞ salvage and integrate all appropriate boulders and rock from project-related roadway/railway decommissioning or new construction
- ☞ salvage and integrate all appropriate large woody debris from project-related roadway/railway decommissioning or new construction

Hwy 43 and Associated Roadways Decommissioning and Re-Construction

- ☞ locate construction material and safety areas as adjacent to project as feasible
- ☞ salvage and integrate all needed fill material from project-related roadway/railway decommissioning
- ☞ integrate roadway center and shoulder storm water capture, treatment, and re-infiltration features into new roadway designs
- ☞ integrate permeable roadway surface (e.g. concrete paver sections) into new Hwy 43 and associated roadway surfaces for aesthetics and storm water re-infiltration





PARTNERSHIP RECOMMENDATIONS AND FURTHER ACTIONS

PARTNERSHIP RECOMMENDATIONS

In evaluating alternates for replacement of the existing Tryon Creek culvert beneath Hwy 43 and the Portland & Western rail lines, the Partnership considered how this study integrated prior planning efforts for this transportation nexus, and recommends the following:

- ☞ establish Partnership leadership to move community and regional interests forward
- ☞ integrate and coordinate prior and ongoing community/regional planning efforts
- ☞ resolve pathways of future multi-modal transportation connections, funding, and project schedules from Partnership members
- ☞ develop an ‘integrated’ Master Plan for the Tryon Creek and Foothills District that includes a long-term vision for fish and wildlife protection and restoration

FURTHER ACTIONS

- ☞ create a bibliography/central database to support development of a composite picture (biological, geological, survey, transportation, land use, etc.) of the Tryon Creek and Foothills District development planning areas
- ☞ develop a simple matrix of planning elements and schedules requiring integration and coordination between Partnership members
- ☞ expand planning from this study to integrate with the Foothills District, Tryon Cove Park, and Stampher Road neighborhood planning efforts (e.g. realignment of Stampher Road, northward extension of Foothills Road, reconstruction of existing at-grade crossing of Portland & Western’s rail lines at the Hwy 43 intersection, lighting of the proposed Foothills Road intersection with Hwy 43, etc.)
- ☞ evaluate and refine Partnership’s preferred alternate’s value-engineering opportunities, project costs, funding opportunities, implementation phasing/sequencing needs, transit impact limitations, and scheduling
- ☞ identify environmental compliance triggers/permits appropriate for design and permitting of the Partnership’s preferred alternate
- ☞ confirm that adequate fisheries and wildlife documentation exists for purposes of future project permitting and federal Section 7 Endangered Species Act consultation with NOAA Fisheries and the US Fish and Wildlife Service
- ☞ develop regional wildlife habitat protection and corridor connectivity overview for Plan integration
- ☞ prepare Regional Master Plan integrating Partnership planning and interests
- ☞ research what funding options exist for fish passage improvements





RELEVANT BIBLIOGRAPHY

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APPENDIX I

CONCEPTUAL ALTERNATES ANALYSIS

Tryon Creek @ Hwy 43 Culvert Alternates Analysis





Conceptual Alternates Analysis Matrix

Project Name: City of Lake Oswego Alternates Analysis Study for Tryon Creek @ HWY 43 Culvert Removal
 Contract Period: February 26th - June 15th, 2007

Evaluation Ranking: 0-3; 0=none 1=low (poor) 2=moderate 3=high (good)

Conceptual Design Alternates Evaluated	Alternate A - Refurbish Existing Culvert Fish Passage	Alternate B - Replace Existing Culvert with Concrete Arch Span Culvert	Alternate C - Replace Existing Culvert with Concrete Span Bridge
Fisheries / Environmental Considerations			
Meets passage requirements for targeted fish species (salmonids and lamprey)	1	2	3
Meets passage requirements for wildlife species / wildlife corridor connectivity	0	2	3
Meets hydrological requirements for 10, 25, and 100 Year storm events	2	3	3
Benefits in-stream structure and aquatic species habitat	0	2	3
Benefits associated wetlands and riparian habitat	0	1	3
Addresses Section 7 ESA Consultation considerations	1	2	3
ACOE/ODSL Joint Application permitting likelihood	2	2	3
Transportation / Recreational Access Considerations			
Improves Terwilliger Blvd. @ Hwy 43 intersection	0	1	1
Improves Stampher Road access to Hwy 43	0	3	3
Improves existing rail access/safety through project area	0	2	2
Creates safe pedestrian/bicycle trail opportunity / connectivity between Tryon Cove Park and Tryon Creek State Natural Area Park	0	2	3
Integration with Current and Future Planning			
City of Lake Oswego Surface Water Management Plan	1	2	3
City of Lake Oswego Comprehensive Plan (Title 3; Goal 5)	0	2	3
City of Lake Oswego Tryon Cove Park Master Plan	0	2	3
City of Lake Oswego Foothills Redevelopment Plan	0	3	3
City of Lake Oswego / Metro / Tryon Creek State Natural Area Park Trails Master Plan	0	2	3
Tri-Met 'Street Car' Line development planning	0	2	2
Community 'Gateway' Aesthetics			
Establishes / enhances 'Gateway' aesthetics to City of Lake Oswego	0	1	3
Alternates Analysis Ranking Summary	7	36	50

Tryon Creek @ Hwy 43 Culvert Alternates Analysis





CONCEPTUAL Alternates Costing Analysis <small>May 15th, 2007</small>			
Project Name: City of Lake Oswego Alternatives Analysis Study for Tryon Creek @ HWY 43 Culvert Removal			
Contract Period: February 26th - June 15th, 2007			
<i>Conceptual Design Alternates Evaluated</i>	<i>Alternate A - Refurbish Existing Culvert and Downstream for Fish Passage</i>	<i>Alternate B - Replace Existing Culvert with Concrete Arch Span Culvert; Includes New Portland-Western Railway and Realigned Stampher Road</i>	<i>Alternate C - Replace Existing Culvert with Steel Truss Bridge; Includes New Portland-Western Railway and Realigned Stampher Road</i>
Estimated Alternate Implementation Costs			
<i>Structure Replacement Costs Only</i>			
<i>Culvert Replacement Structure</i>	N/A	\$1,250,000	\$2,050,000
<i>Portland-Western Railway Crossing of Tryon Creek</i>	N/A	\$400,000	\$400,000
<i>Stampher Road Crossing* of Tryon Creek</i>	N/A	\$300,000	\$580,000
<i>Stampher Road @ Foothills Road Intersection Upgrades</i>	N/A	\$500,000	\$500,000
<i>Site Work</i>			
<i>Traffic Control (LS)</i>	\$1,000	\$10,000	\$10,000
<i>Clearing & Grubbing (LS)</i>	\$3,000	\$8,000	\$8,000
<i>Utility Work (LS)</i>	\$0	\$100,000	\$250,000
<i>Stream Bypass (LS)</i>	\$12,000	\$20,000	\$20,000
<i>Mass Excavation and Disposal @ \$12/CY</i>	\$18,000	\$140,000	\$1,116,000
<i>Erosion and Sediment Controls Implementation/Maintenance (LS)</i>	\$2,000	\$12,000	\$24,000
<i>Channel Final Grading/Shaping @ \$50/LF</i>	\$8,000	\$25,000	\$25,000
<i>Install Streambed Boulders @ \$60/CY</i>	\$30,000	\$80,000	\$120,000
<i>Install Streambed Cobble @ \$38/CY</i>	\$4,000	\$16,000	\$16,000
<i>Install Streambed Gravel @ \$32/CY</i>	\$6,000	\$24,000	\$24,000
<i>Install New In-Culvert Fish Baffles @ \$100/LF</i>	\$40,000	N/A	N/A
<i>Install Large Wood In-Stream Habitat @ \$750/EA</i>	\$18,000	\$36,000	\$54,000
<i>Install Native Riparian Plantings @ \$100/LF</i>	\$15,000	\$15,000	\$60,000
SUBTOTAL IMPLEMENTATION COSTS	\$157,000	\$2,936,000	\$5,257,000
<i>Engineering Design and Permitting @ 10%</i>	\$15,700	\$293,600	\$525,700
<i>Design Contingency @ 30%</i>	\$47,100	\$880,800	\$1,577,100
<i>Gateway Aesthetic Material Upgrades @ 15%</i>	N/A	\$440,400	\$788,550
<i>Abutment Wingwalls, Roadway Surfacing, Misc. Appurtenances @ 20%</i>	N/A	\$587,200	\$1,051,400
<i>Construction Management @ 5%</i>	\$7,850	\$146,800	\$262,850
<i>Mobilization/Demobilization @ 10%</i>	\$15,700	\$293,600	\$525,700
TOTAL IMPLEMENTATION COSTS	\$396,350	\$5,946,400	\$11,447,300

* Stampher Road crossing of Tryon Creek only. Estimate does not include new alignment of roadway or utilities.

Tryon Creek @ Hwy 43 Culvert Alternates Analysis





APPENDIX II

ALTERNATE B: CONCRETE ARCH SPANS CONCEPTUAL COST ESTIMATE AND DESIGN



May 15th, 2007

Lisa Hamerlynck, Project Manager
City of Lake Oswego
380 A Avenue
PO Box 369
Lake Oswego, Oregon 97034

RE: COST ESTIMATES FOR REPLACEMENT OF THE TRYON CREEK CULVERT @ HWY 43

Following are estimates for decorative CONSPAN or BEBO concrete arch spans beneath Hwy 43, the Portland & Western rail lines, and for the future potential realignment of Stampher Road to the Foothills Road intersection over Tryon Creek. These estimates are based upon preliminary concepts developed through the City of Lake Oswego's 2007 Tryon Creek Culvert Replacement Alternatives Analysis Study.

TRYON CREEK CULVERT REPLACEMENT	HWY 43	RAILROAD	STAMPHER ROAD
Culvert Length (ft)	185	75	45
Material Costs	\$647,500.00	\$262,500.00	\$157,500.00
CIP Foundation Concrete Quantity (cy)	740	300	180
CIP Foundation Costs (\$450/cy)	\$333,000.00	\$135,000.00	\$81,000.00
Backfill Quantity (cy)	4550	1850	1110
Backfill Costs (@\$25/cy)	\$113,750.00	\$46,250.00	\$27,750.00
# of Units	31	13	8
Installed Units / Day	10	10	10
Total Install Days	4	2	1
Crane Rental/ day	\$15,000	\$15,000.00	\$15,000.00
Total Crane Costs (@\$15k/day/crane - 2 cranes)	\$120,000	\$60,000.00	\$30,000.00
Labor Costs / Day (@\$40/hr x 10 hr/day x 6 guys)	\$2,400.00	\$2,400.00	\$2,400.00
Total Labor Costs	\$9,600.00	\$4,800.00	\$2,400.00
Total Installation Costs	\$576,350.00	\$246,050.00	\$141,150.00
TOTAL ESTIMATED PROJECT COSTS	\$1,223,850.00	\$508,550.00	\$298,650.00



1. Estimates are based on Partnership conceptual designs and quantities and may not represent Engineered Design quantities.
2. Unit Costs are based on national average costs and may not reflect local unit costs for materials and labor.

Not Included in this Estimate

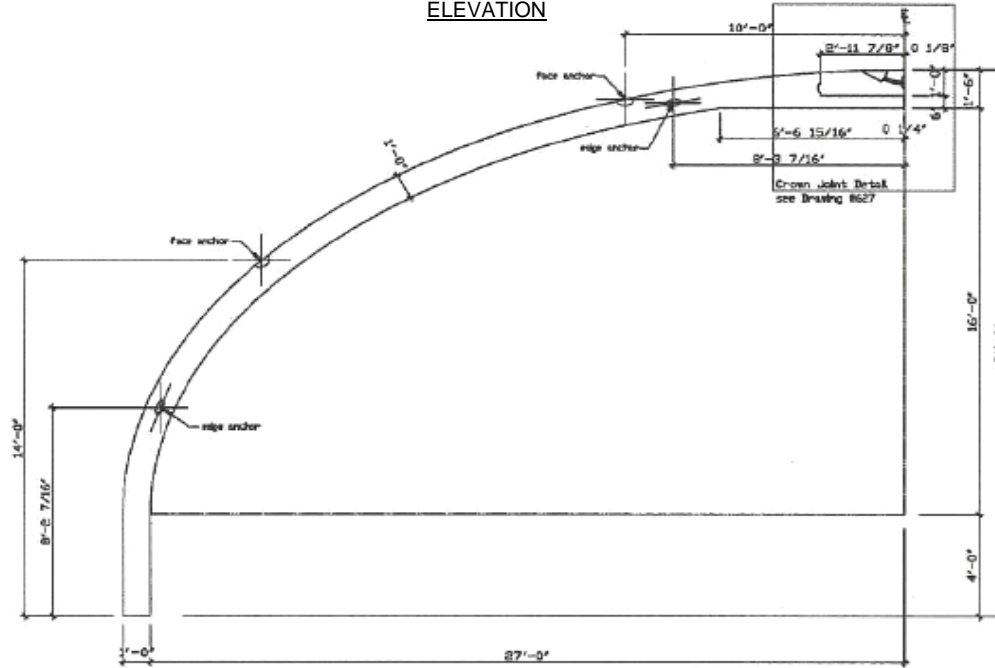
- Headwalls for each crossing
- Aesthetic headwall treatment (e.g. stone veneer, artwork, plantings, etc.)
 - Fill above the minimum cover of the structure (1' over the top)
 - Roadway surface paving
 - Utility relocation/repair
 - Surface capture and water treatment
 - PW Rail Road track repair
- Aesthetic treatment of roadway or pedestrian surfaces (e.g. plantings, separated bike/pedestrian lanes, etc.)
- Misc. Appurtenances (traffic signal lighting, at-grade crossing of PW tracks, street lighting, bridge railings, etc.)

Matthew D. Houser, PE
Oregon Regional Manager
CONTECH Bridge Solutions Inc.
12021 NE Airport Way
Portland, OR 97220



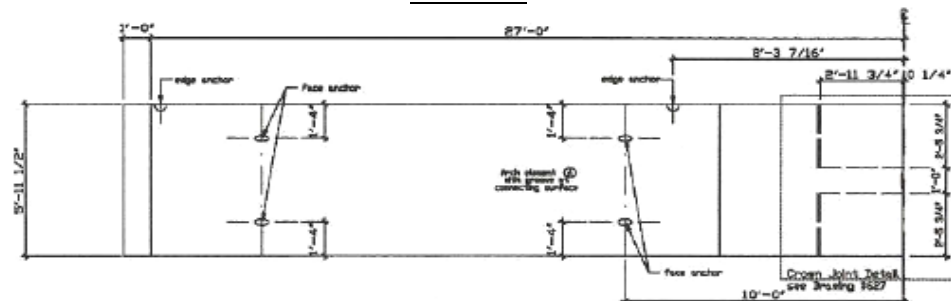


ELEVATION



**Conceptual Design Section for the
Hwy 43 Concrete Span Arch**

PLAN VIEW



GENERAL NOTES

- Concrete: MASHIT Class A 6,000 psi compressive strength (28 days)
- Reinforcing Steel: Deformed Bars AASHTO M31, Grade 60
Welded Wire Fabric AASHTO M53, Grade 65
- Concrete Cover: Inner surfaces 1 1/2"
Outer surfaces 2" (copied F10)
- Finish all edges with 3/4" bevel
- Weight of Arch Element: 35,285 lbs

Symbolic element with irregular covering surface

NOTE: Element (B) is mirror image of Element (A)





APPENDIX III

ALTERNATE C: STEEL TRUSS BRIDGE / CONCRETE ARCH SPAN CONCEPTUAL COST ESTIMATE AND DESIGN



May 15th, 2007

Lisa Hamerlynck, Project Manager
 City of Lake Oswego
 380 A Avenue
 PO Box 369
 Lake Oswego, Oregon 97034

RE: COST ESTIMATES FOR REPLACEMENT OF THE TRYON CREEK CULVERT @ HWY 43

Following are estimates for decorative steel-truss bridges at Hwy 43 and for the future potential realignment of Stampher Road to the Foothills Road intersection over Tryon Creek. These estimates are based upon preliminary concepts developed through the City of Lake Oswego's 2007 Tryon Creek Culvert Replacement Alternatives Analysis Study.

TRYON CREEK CULVERT REPLACEMENT	HWY 43	STAMPHER ROAD TO FOOTHILLS ROAD
Bridge Dimensions	140' x 100'	140' x 24'
Material Costs	\$1,233,250.00	\$295,980.00

CIP Foundation Concrete Quantity (cy)	710	171
CIP Foundation Costs (\$450/cy)	\$333,000.00	\$76,950.00
Pile Cost for Intermediate Bent in Place	\$80,000.00	\$20,000.00
Pile Cap Concrete Quantity (cy)	59	15
Pile Cap Costs (\$550/cy)	\$32,592.59	\$8,250.00
Backfill Quantity (cy)	800	192
Backfill Costs (@\$25/cy)	\$20,000.00	\$4,800.00
Total Install Days	16	8
Crane Rental/ day	\$15,000.00	\$15,000.00
Total Crane Costs (@\$15k/day/crane - 1 crane)	\$240,000.00	\$120,000.00
Labor Costs / Day (@\$40/hr x 10 hr/day x 6 guys)	\$2,400.00	\$2,400.00
Total Labor Costs	\$38,400.00	\$19,200.00
Total Concrete Deck Area (sf)	14,000	3,360
Concrete Deck in Place (@ \$12/sf)	\$168,000.00	\$40,320.00
Total Installation Costs	\$911,992.59	\$289,520.00
Total Costs	\$2,145,242.59	\$585,500.00

Due to weight-loading of the Portland & Western rail lines over Tryon Creek, CONTECH Bridge Solutions Inc. recommends that bridging these dual tracks over the creek utilize a CONSPAN or BEBO concrete arch span system in this location.

Following is an estimate for the future replacement of Portland & Western's rail berm over Tryon Creek with a concrete span arch. Again, this estimate is based upon preliminary concepts developed through 2007 Tryon Creek Culvert Replacement Alternatives Analysis Study.

PW RAILROAD BRIDGE	
Culvert Length (ft)	60
Material Costs	\$210,000.00
CIP Foundation Concrete Quantity (cy)	240
CIP Foundation Costs (\$450/cy)	\$108,000.00
Backfill Quantity (cy)	1520
Backfill Costs (@\$25/cy)	\$38,000.00
# of Units	10
Installed Units / Day	10
Total Install Days	1
Crane Rental/ day	\$15,000.00
Total Crane Costs (@\$15k/day/crane - 2 cranes)	\$30,000.00
Labor Costs / Day (@\$40/hr x 10 hr/day x 6 guys)	\$2,400.00
Total Labor Costs	\$2,400.00
Total Installation Costs	\$178,400.00
Total Costs	\$388,400.00

TOTAL ESTIMATED PROJECT COSTS

\$3,119,142.59

1. Estimates are based on Partnership conceptual designs and quantities and may not represent Engineered Design quantities.
2. Unit Costs are based on national average costs and may not reflect local unit costs for materials and labor.

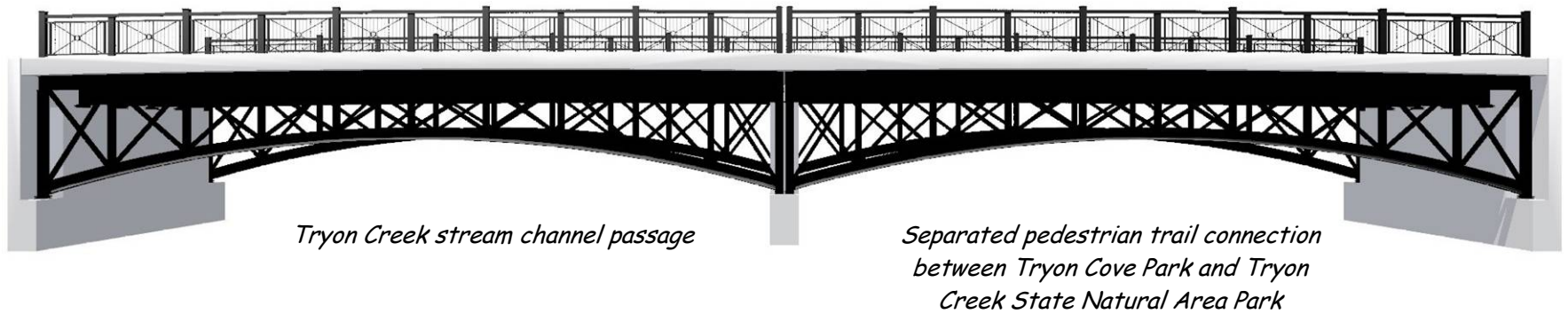
Not Included in this Estimate

- Headwalls for each crossing
 - Aesthetic headwall treatment (e.g. stone veneer, artwork, plantings, etc.)
 - Roadway surface paving
 - Utility relocation/repair
 - Surface capture and water treatment
 - PW Rail Road track repair
- Aesthetic treatment of roadway or pedestrian surfaces (e.g. plantings, separated bike/pedestrian lanes, etc.)
- Misc. Appurtenances (traffic signal lighting, at-grade crossing of PW tracks, street lighting, bridge railings, etc.)

Matthew D. Houser, PE
Oregon Regional Manager
CONTECH Bridge Solutions Inc.
 12021 NE Airport Way
 Portland, OR 97220



**Conceptual Design Image for the
Hwy 43 Decorative Steel Truss Bridge**



*Double underhung bow truss structure
may require a center support at the
estimated 140LF bridge span width.*

Tryon Creek @ Hwy 43 Culvert Alternates Analysis





APPENDIX IV

PREFERRED ALTERNATE ESTIMATED COST 5-, 10-, 15-YEAR PROJECTION

TRYON CREEK CULVERT REPLACEMENT	HWY 43 PORTLAND & WESTERN RAILROAD STAMPHER ROAD REALIGNMENT
2007 ESTIMATED COSTS	\$11,500,000 - \$12,500,000
+5-YEAR (2012) ESTIMATED COSTS	\$14,680,000 - \$15,950,000
+10-YEAR (2017) ESTIMATED COSTS	\$18,750,000 - \$20,360,000
+15-YEAR (2022) ESTIMATED COSTS	\$23,910,000 - \$25,990,000

Above Projected Cost Estimates for the Partnership's Preferred Conceptual Design Alternate are based upon an annualized rate of inflation equal to 5% per year. Actual rate of material and labor inflation will vary. All exclusions noted previously in the cost estimations presented in this Study apply to these projected estimates.

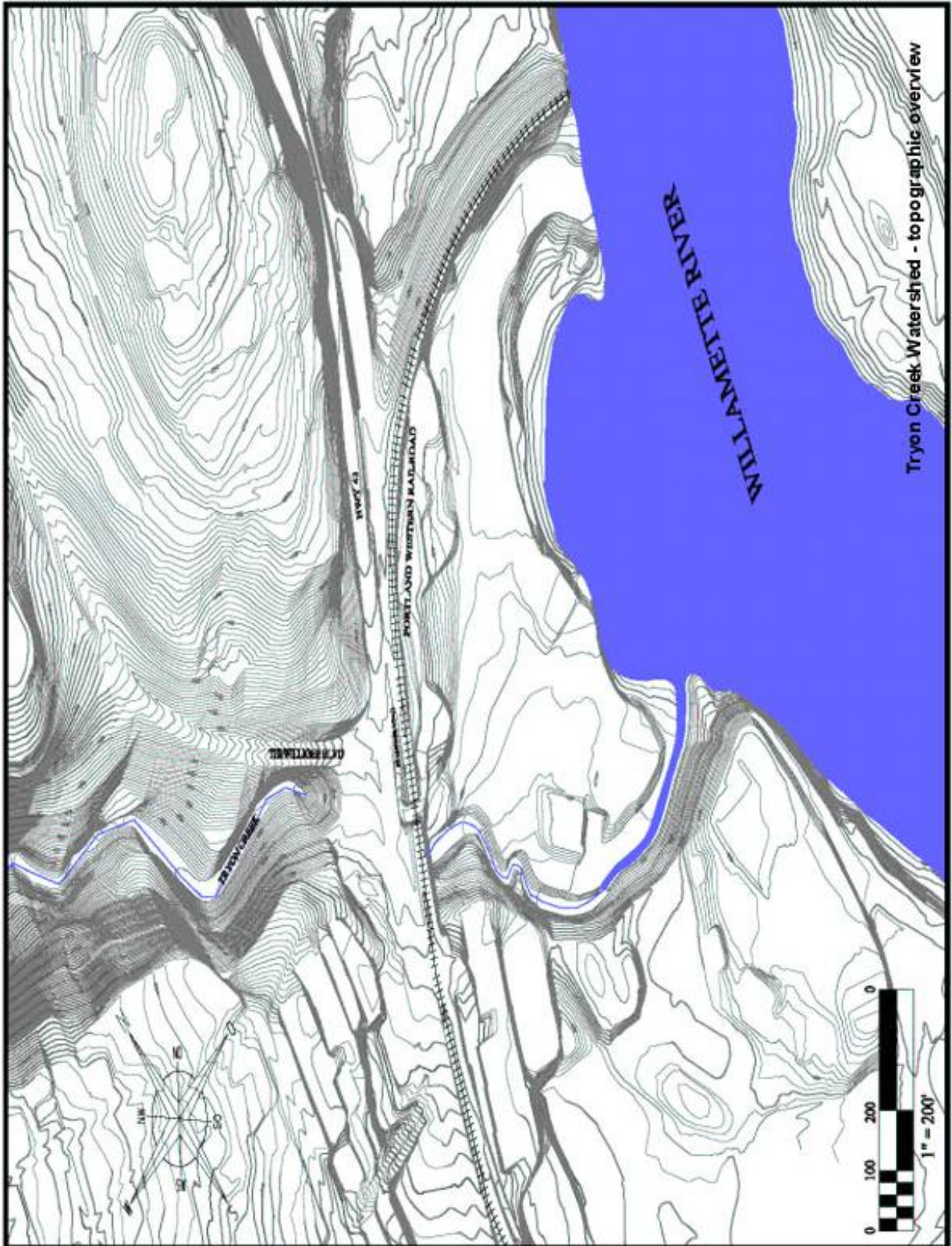




APPENDIX V

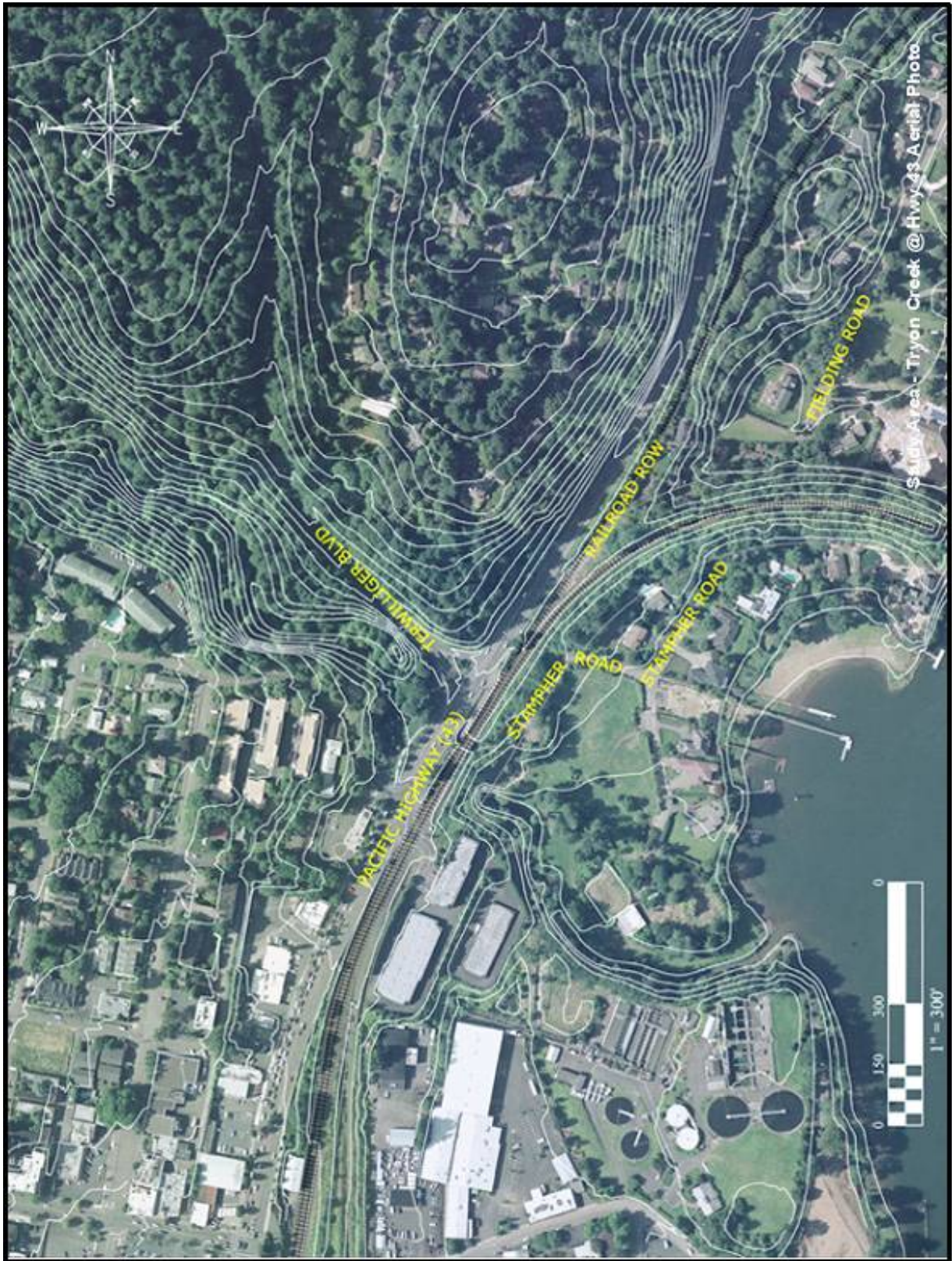
STUDY AREA OVERVIEW





Tryon Creek @ Hwy 43 Culvert Alternates Analysis





Tryon Creek @ Hwy 43 Culvert Alternates Analysis



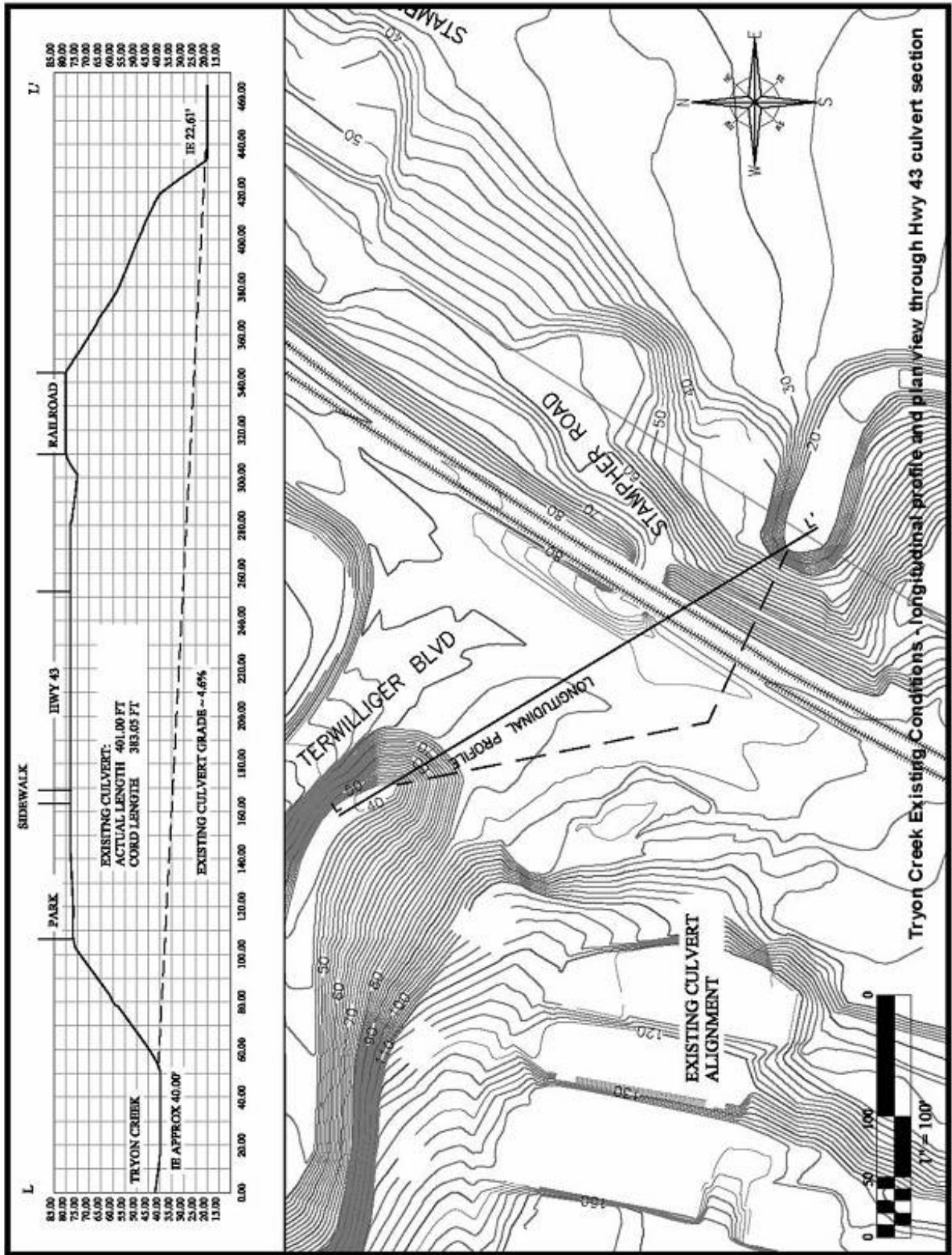


APPENDIX VI

FISH PASSAGE RESTORATION CONCEPTUAL DESIGN

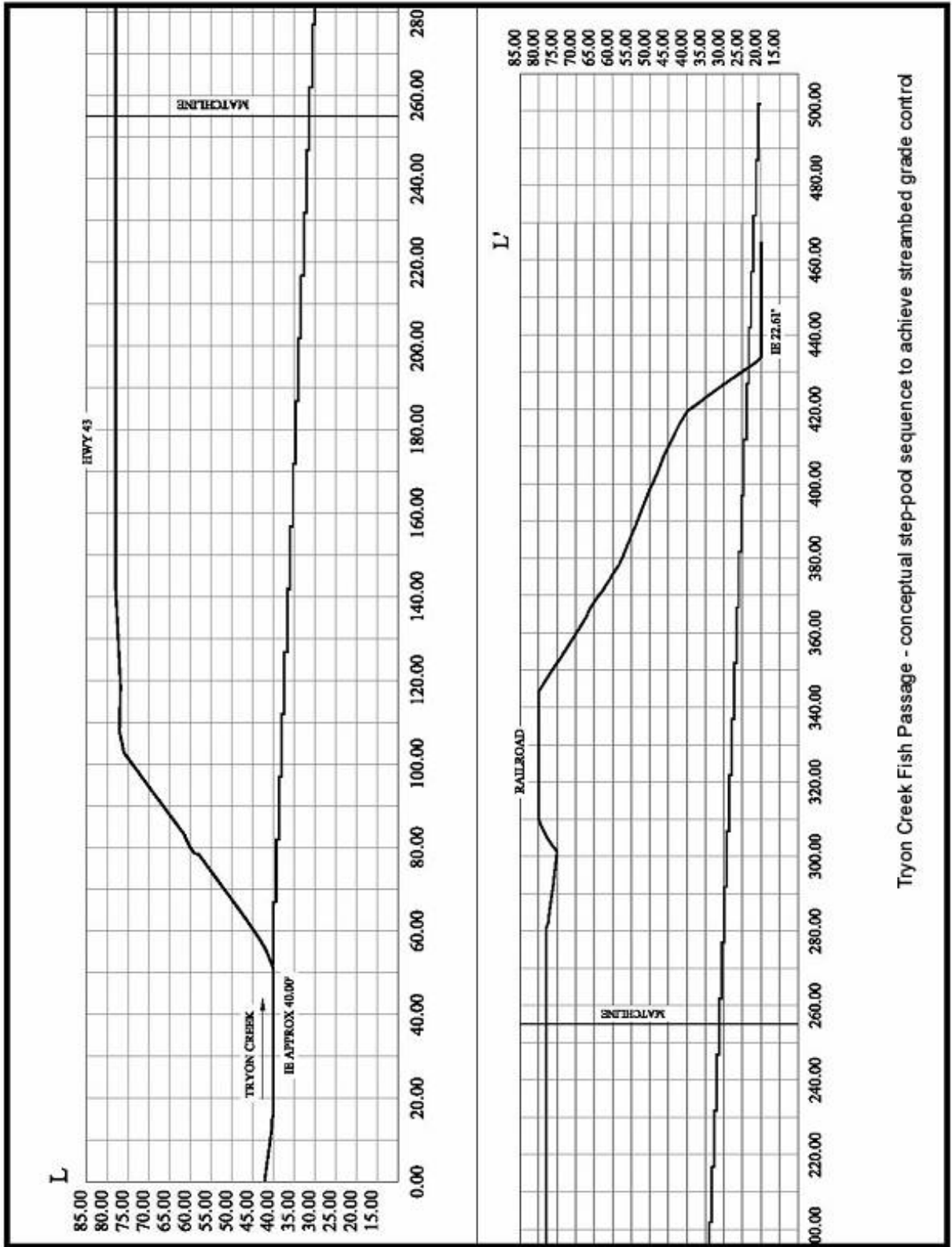
Tryon Creek @ Hwy 43 Culvert Alternates Analysis





Tryon Creek @ Hwy 43 Culvert Alternates Analysis



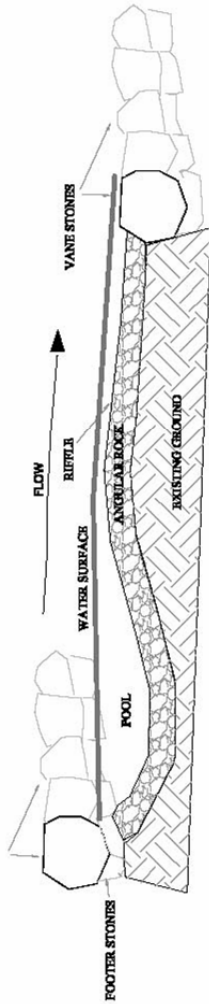


Tryon Creek Fish Passage - conceptual step-pool sequence to achieve streambed grade control

Tryon Creek @ Hwy 43 Culvert Alternates Analysis

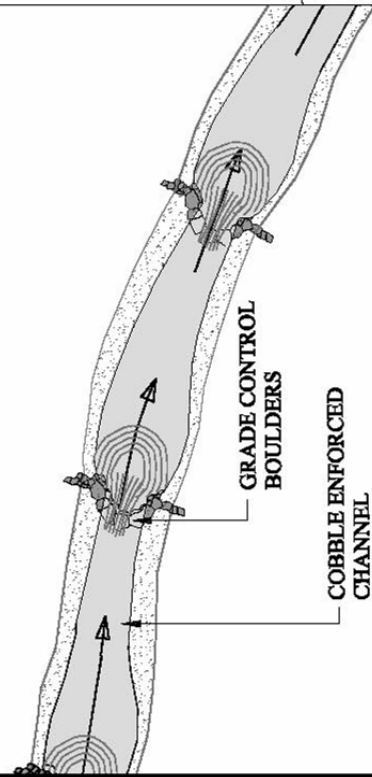


TYPICAL STREAM GRADE CONTROL LONGITUDINAL SECTION

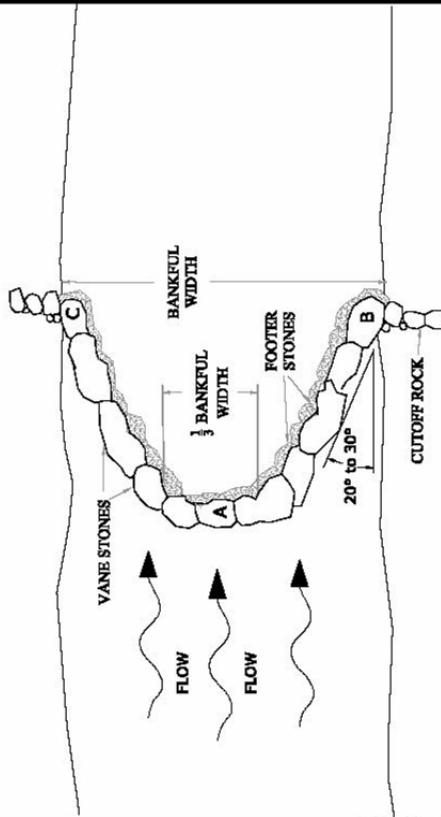


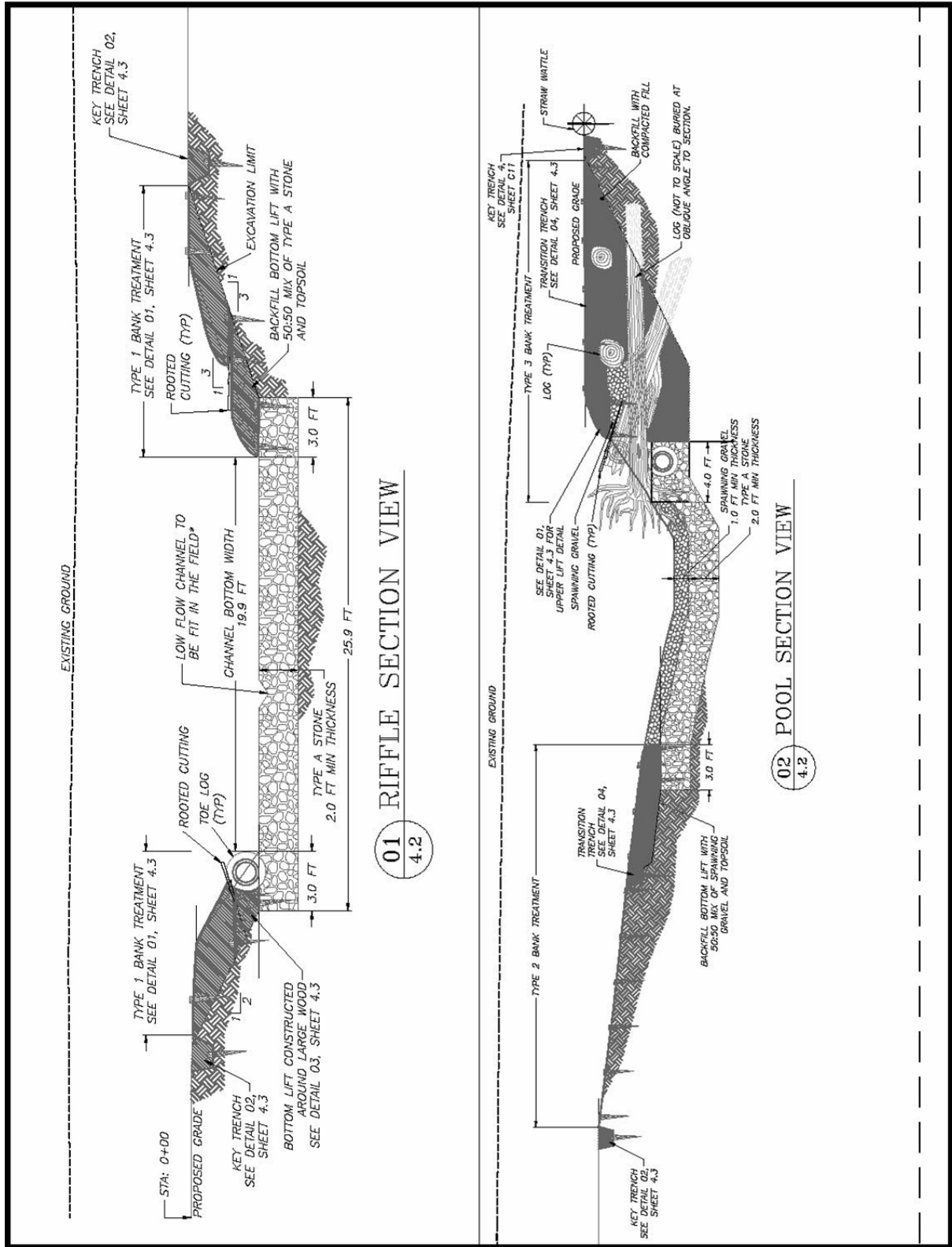
NOTE: VANESTONES TO BE 36" BOULDERS, TWO THIRDS OF BOULDER TO BE BURIED

TYPICAL STREAM GRADE CONTROL PLAN VIEW



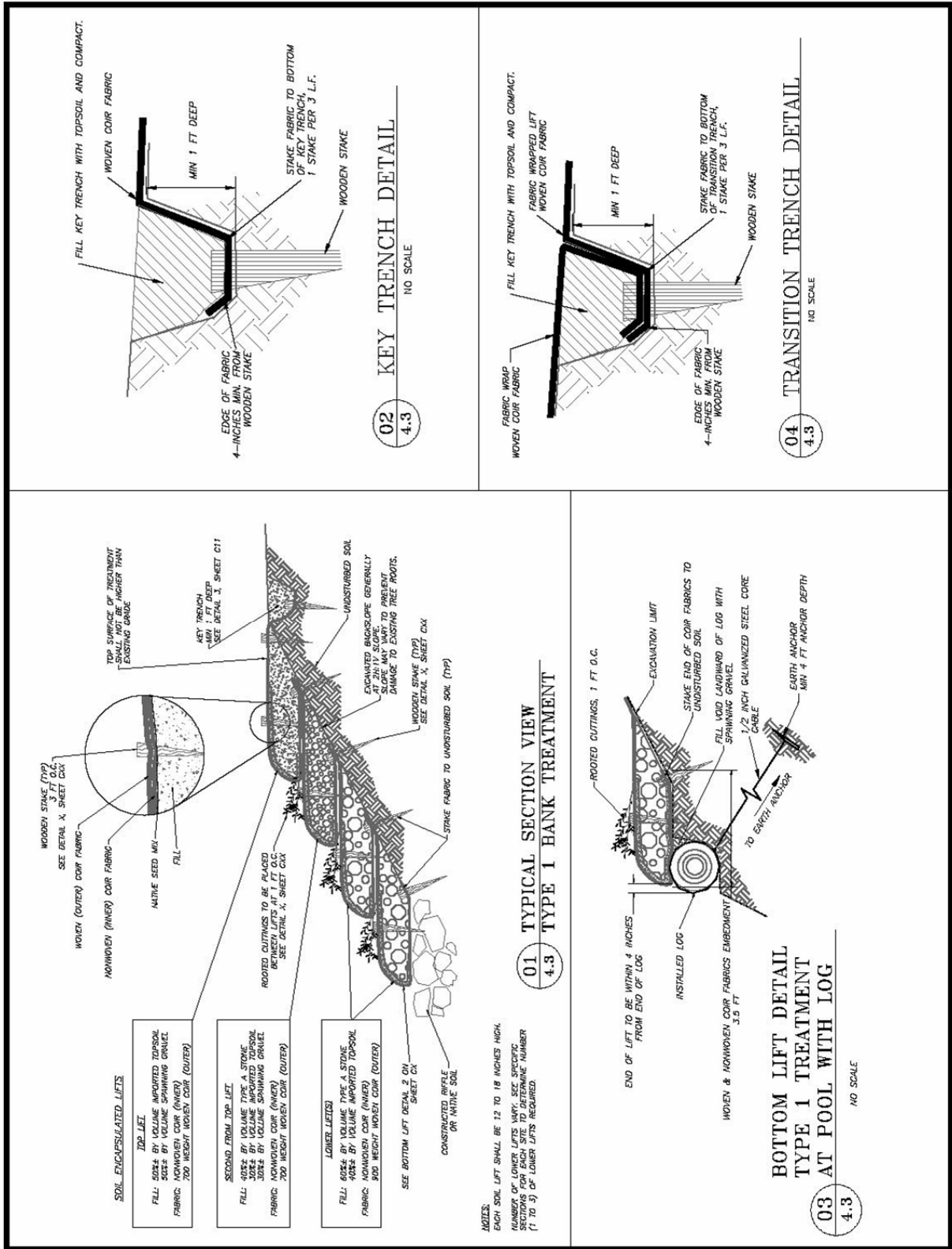
TYPICAL STREAM GRADE CONTROL STRUCTURE DETAIL





Tryon Creek @ Hwy 43 Culvert Alternates Analysis





Tryon Creek @ Hwy 43 Culvert Alternates Analysis

