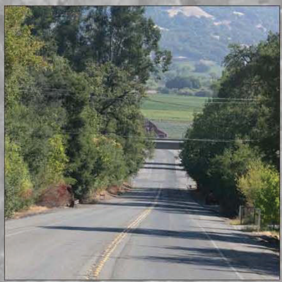
Project Feasibility Report




Feasibility Study for Dry Creek Bypass Pipeline Project

Sonoma County Water Agency

March 15, 2011

HDR

Project Feasibility Report

Dry Creek Bypass Pipeline Feasibility Study

Sonoma County Water Agency

PRELIMINARY
FOR REVIEW ONLY

March 15, 2011

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Executive Summary

Sonoma County Water Agency (Water Agency) provides water to nine cities and water districts, serving approximately 600,000 residents in Sonoma and Marin counties. Warm Springs Dam (WSD), owned by the US Army Corps of Engineers (Corps), is part of the Russian River Flood control system and provides water for habitat, recreational, and municipal uses. The WSD is a major water supply reservoir for the Water Agency.

A Dry Creek Bypass Pipeline Feasibility Study is required by the *Biological Opinion (BO) for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District in the Russian River watershed*. The BO was released by National Marine Fisheries Service (NMFS) in September 2008.

Background

The BO found that some aspects of flood control and water supply operations threaten to jeopardize steelhead and coho salmon. The BO also concluded that existing critical habitat for steelhead and coho salmon is not sufficient to serve the intended conservation role for these species. Current and expected flow releases from WSD during the low-flow season create high velocities in the channel, which would degrade the 14 miles of coho and steelhead rearing habitat in Dry Creek.

The BO states that there are three basic approaches to minimizing adverse effects of high summer flow releases in Dry Creek, which include: 1) reduction of water releases from WSD, 2) modifications to Dry Creek to accommodate higher flows as well as provide good quality habitat, and 3) bypass summertime high flow releases for water supply around Dry Creek with a pipeline. Approach 2 is currently being evaluated by the Water Agency under a separate study. This study evaluates the feasibility of approach 3, and includes a feasibility analysis of the inlet works at WSD, pipeline routes to bypass Dry Creek, and outlet sites and facilities to discharge the bypassed water back to the Russian River.

The BO states that:

> "SCWA will investigate the feasibility of constructing a pipeline to deliver water from Lake Sonoma to the mainstem of the Russian River in order to reduce the adverse effects of relatively high flow releases from WSD on rearing habitat for coho salmon and steelhead. An assessment of bypass pipeline alternatives will enable SCWA to identify the best method to ensure water deliveries while meeting salmonid habitat needs in Dry Creek in the unlikely event that habitat enhancement efforts in Dry Creek are unsuccessful in supporting successful growth and survival of juvenile steelhead and coho salmon."

The BO also states that the Corps will install a new emergency water supply pipeline to the Don Clausen Fish Hatchery (DCFH) at the base of WSD and complete construction of additional rearing facilities for the coho salmon broodstock program. The Water Agency sent a letter of intent expressing an interest in partnering with the Corps to evaluate design alternatives for the emergency water supply that would incorporate the needs of a bypass pipeline project.

The Corps is proceeding with 60-percent designs for the emergency water supply system alternatives. One alternative proposes the installation of pumps in the control structure to send water to the hatchery in a 36-inch pipeline. A second consists of an integrated pipeline project, in which a 72-inch diameter pipeline is installed in a tunnel from the control structure. The integrated alternative allows flow to be split between the hatchery and the potential future bypass pipeline.

This report is prepared with the understanding that a bypass pipeline may be constructed only in the event that habitat enhancement efforts in Dry Creek are unsuccessful. This report may need to be updated in the future as new information becomes available. The next step is an Engineering Report that continues the development and analysis of the preferred alternative from the Feasibility Report.

Purpose

The Water Agency is evaluating the feasibility of a raw water bypass pipeline for Dry Creek that accomplishes the following goals:

- Serve as a conduit to convey raw water flows that cannot be sustainably managed in Dry Creek alone, and
- Ensure that inlet and outlet structures route flows in a manner that is protective of the environment and which does not modify existing in-stream flow patterns in a negative way.

Therefore, the purpose of this Feasibility Study Report is to:

- Identify uncertainties and potentially significant issues associated with the raw water bypass pipeline,
- Identify alternatives or suggestions to facilitate design and/or construction, and
- Identify the preferred project alternatives.

Stakeholder Involvement

The development of this Feasibility Report involved communication with key stakeholders throughout the process. Meetings and presentations were held with the Regional Water Quality Control Board, National Marine Fisheries Service, the Department of Fish and Game, the Dry Creek Advisory Group, the Santa Rosa Board of Public Utilities, and the general public.

The purpose of these meetings and presentations was to provide opportunities for the stakeholders to understand the process and project status and provide input on key aspects.

Study Area

The study area includes the Dry Creek Valley and pipeline routes along Dutcher Creek Road, Canyon Road, Dry Creek Road to the Russian River, and Westside Road to the Water Agency's Mirabel facility.

Alternatives Development and Evaluation

The facilities required for the bypass pipeline include an inlet at WSD, a large diameter bypass pipeline, and an outlet structure to reintroduce the bypass water back into Dry Creek or the Russian River. Opportunities to include a hydropower facility with the bypass pipeline project were also included with each alternative.

A multi-step process was used to develop, screen, and evaluate a range of alternatives for the bypass pipeline project. The process involved establishing key planning criteria, development of and initial screening of facility concepts for the inlet, route, outlet and hydropower, and finally, evaluation of alternatives.

Key Planning Criteria

In order to develop and evaluate the feasibility of the project components (inlet, alignment, outlet, and hydropower), the following planning criteria were defined:

- Initial Hydraulic Head Conditions at WSD
  - Average Water Elevation at WSD: 439 ft AMSL
  - Low Water Elevation at WSD: 400 ft AMSL
  - Turbine Elevation for New Hydropower Facility at WSD: 250 ft AMSL
  - Maximum Elevation in Existing Stilling Basin: 220 ft AMSL
- Flow Requirements
  - Bypass Flow Range: 80 to 180 cfs
  - Flow to the Hatchery: 60 cfs
- Bypass Pipeline Diameter: 48-inch, 60-inch and 72-inch
- Operations Strategy: Continuous delivery of reservoir releases via the bypass pipeline under gravity-flow conditions.

Description and Screening of Facility Concepts

The facility options for each of the project components, as well as the results of screening analysis are briefly summarized below.

Inlet Options and Screening Results

Four inlet facility options were identified and are shown in Figure ES-1:

- **Option 1, Head Box Adjacent to the Stilling Basin.** For this option, the existing stilling basin would be modified with a gate to divert water into a head box on the bypass pipeline. The water surface elevation in the existing stilling basin would be raised to 220 feet. Hydropower would be generated using the existing generator in the control structure.

- **Option 2, Siphon Over the Existing Dam.** This option would include an inlet structure (e.g., concrete vertical intake pipe), piping running up and over the dam, and an outlet structure on the downstream side of the dam following hydropower generation or energy dissipation. A pump facility at the top of the dam is required to fill the pipes and create the siphon. Hydropower would be generated at new generators at the outlet of the siphon pipes.

- **Option 3, New Outlet Works through Left Abutment.** This option includes an intake temperature control structure, a conveyance system through the left abutment, and an outlet through a new power generation facility.

- **Option 4, Integrated Facility – New Corps Tunnel to Existing Control Structure.** This option includes partnering with the Corps on their alternative to construct a new tunnel with a 72-inch pipeline for the emergency water supply line to the DCFH. In constructing the tunnel and pipeline, the "emergency water supply" would be used as the main water supply and the existing facilities within the control structure is used as the "emergency water supply." There is an opportunity for the Water Agency to work with the Corps on the design and capacity of these facilities to meet the needs of the hatchery as well as the Dry Creek bypass flow requirements. New hydropower facilities is needed.

Inlet options were screened based on two criteria, design and construction, and facility operability. As a result of the screening process, the head box and integrated facility inlets were advanced to the alternatives development and evaluation step.

Route Options and Screening Results

Three general route corridors were identified for the bypass pipeline, including:

- **Northern Route**, WSD to the Russian River, near Geyserville or Cloverdale
- **Central Route**, WSD to the confluence of the Russian River and Dry Creek, and
- **Southern Route**, WSD to the Water Agency's facilities in the Mirabel/Wohler area.

For each of these general routes, alignment options were identified considering the possible alignment corridors in which a large-diameter water transmission pipeline could be located. Figure ES-2 illustrates each of the alignment options that were considered and identifies those that were screened out.

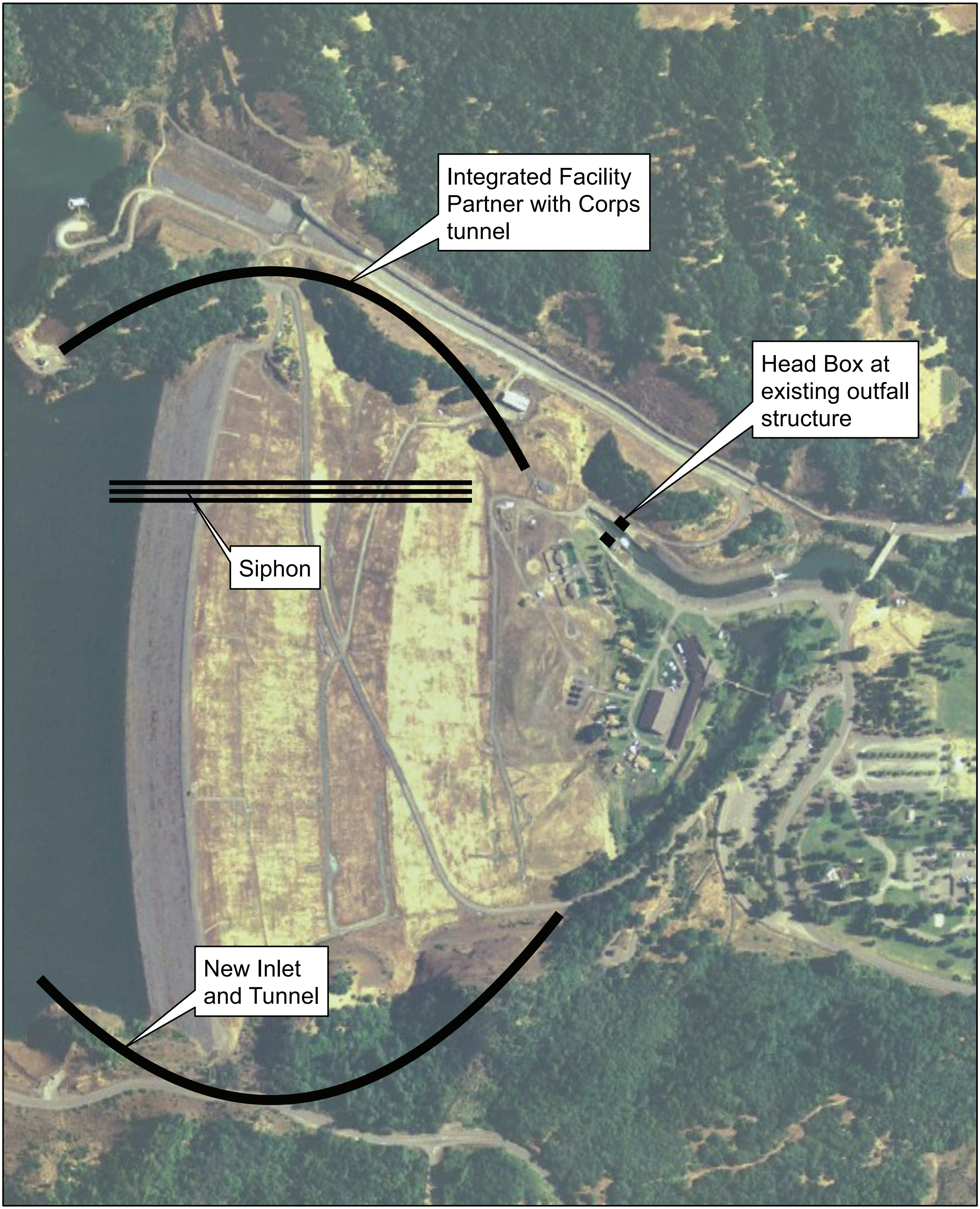

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Figure ES-1
Inlet Works Options
Dry Creek Bypass Pipeline Feasibility Study

SONOMA COUNTY WATER AGENCY

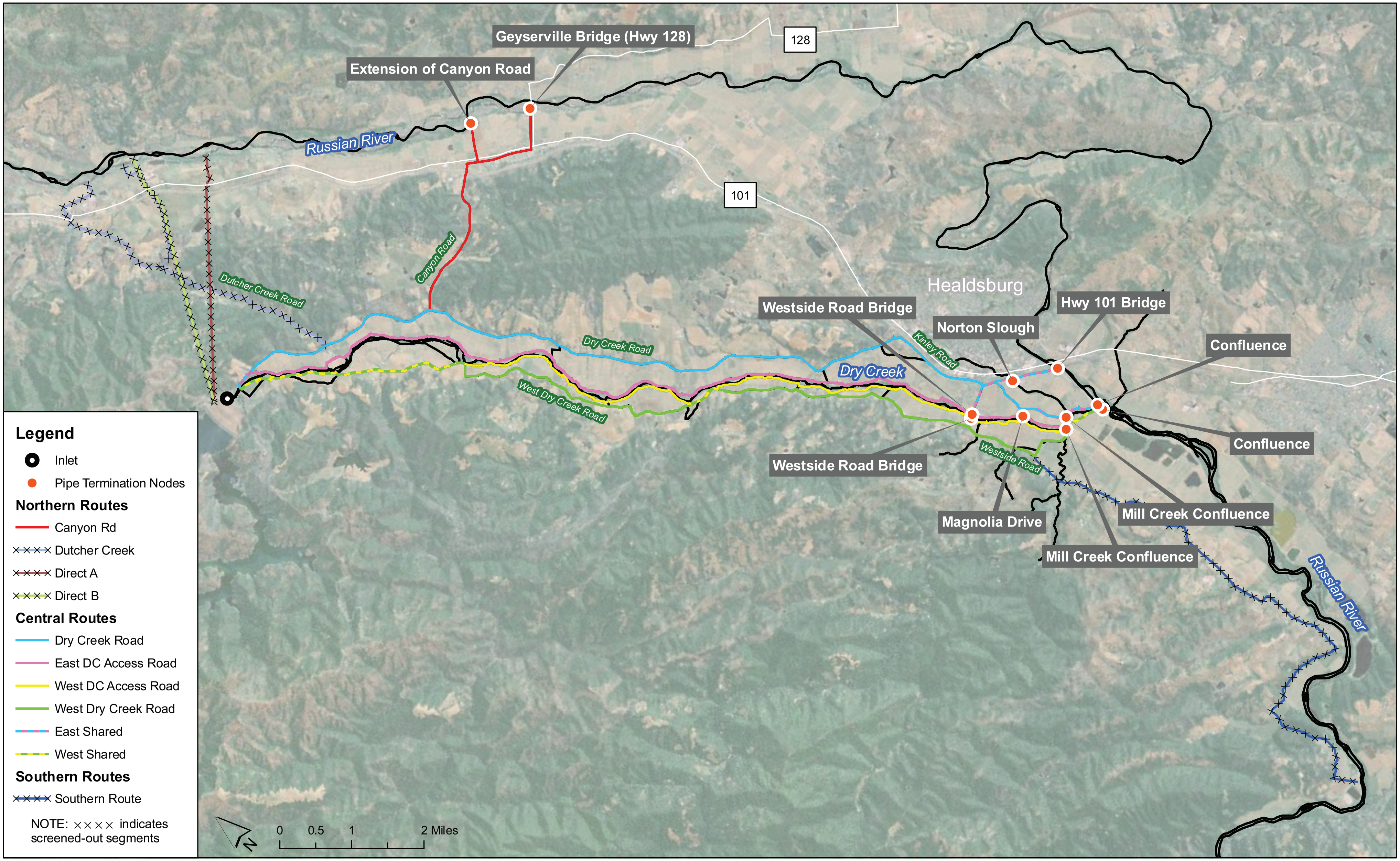

Figure ES-2
Alignment Options and Screening Results
Dry Creek Bypass Pipeline Feasibility Study

The head box inlet does not provide sufficient hydraulic head for the Northern Route alignments. Only the integrated facility inlet provides sufficient hydraulic head to limit the pipeline bury depth along the Northern Routes. Furthermore, some alignments in the Central and Southern Routes, if combined with the head box inlet, would require either trenchless construction or an alignment adjustment in order to avoid high points for which traditional open trench construction is not feasible.

As a result of the screening process, the direct alignment options and the Dutcher Creek Road alignment options were eliminated. The Northern Route Canyon Road alignment and all of the Central Route alignments were advanced to the alternative development and evaluation step. The Southern Route alignment was eliminated during the screening of outlet locations due to the technical infeasibility of this route.

Outlet Location Options and Screening Results

General outlet locations were identified for each pipeline route terminus (refer to Figure ES-2). Outlet locations associated with the Central Route are bounded by the Westside Road Bridge to the north, the Highway 101 Bridge on the east side, and the area around the confluence. For the Northern Route, discharge locations were evaluated where the extension of Canyon Road intersects the Russian River and near the Highway 128 Bridge.

Based on discussions with the Water Agency, it was determined that a discharge near the confluence of Dry Creek and the Russian River was preferred to downstream locations closer to or at the Water Agency's facilities at Mirabel and Wohler based on potential water quality issues and coordination between the outlet works and water supply facilities. Therefore, the Southern Route was not carried forward for this analysis and an outlet location was not identified.

Suitable discharge locations were identified for each of the pipeline termination nodes, as listed in Table ES-1.

Table ES-1. Discharge Locations

Route	Pipeline Route Terminus	Suitable Discharge Locations
Northern Route	Upper Russian River	Extension of Canyon Road
		Near Geyserville Bridge (Hwy 128)
Central Route	Russian River	Hwy 101 Bridge
		Russian River near Dry Creek Confluence
	Dry Creek	Westside Road Bridge
		Magnolia Drive
		Mill Creek Confluence
		Norton Slough
		Dry Creek near confluence with Russian River

Outlet Facility Options and Screening Results

The options for direct discharge facilities vary considerably in appearance and function. Four outlet facility types, shown in Figure ES-3, were initially evaluated and defined as follows:

- **Riverbank outfalls**. A structure or facility located on the bank of a river, through which water is discharged directly into the surface flow.
- **Diffusers (in-river discharge)**. An in-river diffuser consists of a pipe fitted with well-defined openings through which water flows to discharge.
- **Diffusers (in-bed discharge)**. In-bed diffusers discharge water through either well screens or perforated pipes buried in river bottom (alluvium).
- **Diffusers (in-bank discharge)**. Discharge is accomplished through a perforated pipe constructed in the bank.

For the purposes of developing and evaluating the feasibility alternatives, a screened riverbank outfall was used. Once a specific site is identified as the most feasible, an Engineering Report will be developed to continue the evaluation of outfall types.

Hydropower Location

Opportunities for power generation vary based on the combination of inlet facility, pipeline alignment, and outlet location because power generation is the result of residual hydraulic head available after head losses. A coarse analysis of hydropower generation was performed to determine the preferred location, whether upstream at the inlet or downstream near the outlet, for a new hydropower facility. Based on the results of that analysis, the preferred location for a hydropower facility, based on inlet type and route, is shown in Table ES-2.

Table ES-2. Discharge Locations

Inlet Facility	Route	Location / Description
Integrated Facility	Northern Route	New generator near the outlet
	Central Route	New generator at the dam
Head Box	Central Route	Existing generator at the dam

Alternatives Formulation

The screening process resulted in identifying two feasible inlet options, five general alignments and their respective outlet facilities on the Russian River and Dry Creek. The alignments are predominantly located in Canyon Road, Dry Creek Road, the access roads paralleling Dry Creek, and West Dry Creek Road. Feasible outlet sites were identified on the upper Russian River at the extension of Canyon Road and near the Geyserville Bridge, on the Russian River near the confluence with Dry Creek and at the Highway 101 Bridge, and finally on Dry Creek near the Westside Road Bridge.

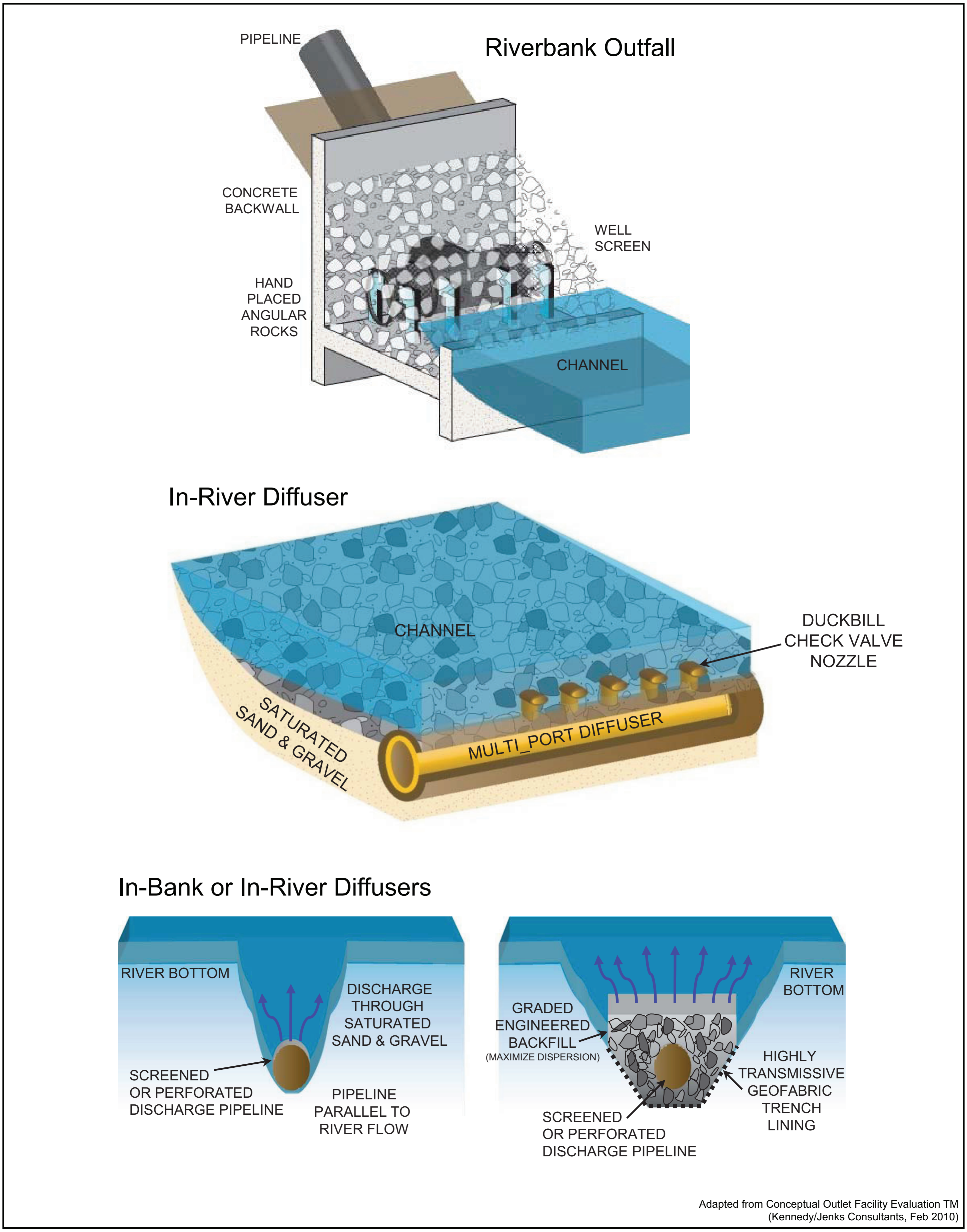

Figure ES-3
Outlet Facility Options
Dry Creek Bypass Pipeline Feasibility Study

The feasible outlet sites between the Westside Road Bridge and the Russian River confluence were not specifically included in the alternatives analysis. Based on the facilities described above, there are 21 possible combinations of screened facilities. These combinations, which are shown in Table ES-3, make up the alternatives for the Dry Creek Bypass Pipeline.

Table ES-3. Definition of Alternatives for Evaluation

Pipeline Alignment	Inlet Facility	Alignment Description	Discharge Location	Alt. ID
Canyon Road	Integrated Facility	Dry Creek Road to Canyon Road	Extension of Canyon Road	1a
			Near Geyserville Bridge	1b
Dry Creek Road	Integrated Facility	Dry Creek Road to Kinley Road and Westside Road	Westside Road Bridge	2a
		Dry Creek Road to Kinley and Magnolia	Confluence	2b
		Dry Creek Road to Kinley Road	HWY 101 Bridge	2c
	Head Box (with microtunnels)	Dry Creek Road to Kinley Road and Westside Road	Westside Road Bridge	3a
		Dry Creek Road to Kinley and Magnolia	Confluence	3b
		Dry Creek Road to Kinley Road	HWY 101 Bridge	3c
	Head Box (without microtunnels)	Dry Creek Road/Ag Land to Kinley Road and Westside Road	Westside Road Bridge	4a
		Dry Creek Road / Ag Land to Kinley and Magnolia	Confluence	4b
		Dry Creek Road / Ag Land to Kinley Road	HWY 101 Bridge	4c
East DC Access Road	Integrated Facility or Head Box	East DC Access Road To Westside Road Bridge	Westside Road Bridge	5a
		East DC Access Road to Confluence	Confluence	5b
West DC Access Road	Integrated Facility or Head Box	West DC Access Road to Westside Road Bridge	Westside Road Bridge	6a
		West DC Access Road to Confluence	Confluence	6b
West Dry Creek Road	Integrated Facility	West Dry Creek Road to Westside Road	Westside Road Bridge	7a
		West Dry Creek Road to Westside Road and private roads	Confluence	7b
	Head Box (with microtunnels)	West Dry Creek Road to Westside Road	Westside Road Bridge	8a
		West Dry Creek Road to Westside Road and private roads	Confluence	8b
	Head Box (without microtunnels)	West Dry Creek Road/Ag Land to Westside Road	Westside Road Bridge	9a
		West Dry Creek Road/Ag Land to Westside Road and private roads	Confluence	9b

Evaluation of Alternatives

Evaluation criteria, summarized in Table ES-4, were developed with the input of the Water Agency and the Dry Creek Advisory group, and include both engineering and environmental criteria. An economic evaluation was also conducted. Some criteria are common to all elements of the Bypass Pipeline, whereas others are specific to only one element (i.e., inlet facility, pipeline alignment, or outlet facility).

Table ES-4. Evaluation Criteria

Inlet Facility	Pipeline Alignment	Outlet Facility
	Engineering	
Reliability	Reliability	Reliability
Constructability	Constructability	Constructability
Operations	Operations	Operations
Right of Way Acquisition	Right of Way Acquisition	Right of Way Acquisition
Liquefaction and Hazard Potential	Liquefaction and Hazard Potential	Liquefaction and Hazard Potential
	Hydropower	River Channel Stability
	Special Crossings	
	Environmental	
Wetlands and Other Waters of the US	Wetlands and Other Waters of the US	Wetlands and Other Waters of the US
Sensitive Habitats and Species	Sensitive Habitats and Species	Sensitive Habitats and Species
Hazardous Materials	Hazardous Materials	Hazardous Materials
Cultural Resources	Cultural Resources	Cultural Resources
	Potential Loss of Trees	Water Quality and Fisheries

Preferred Alternative

Based upon the evaluation of the individual criteria, points were assigned and alternatives were ranked. The top nine alternatives and associated capital and present value costs are listed in order of lowest capital cost in Table ES-5.

Table ES-5. Top 9 Ranked Alternatives and Present Value Cost

Alternative	Evaluation Score	Evaluation Rank	Capital Cost	Present Value Cost	Key Difference from Alternative 4c
Alternative 4c (Preferred)	125.4	6	$141.5	$124.0	Head Box Inlet, Dry Creek Road and Private Road (Ag Land) to avoid microtunnel, HWY 101 Bridge Outlet
Alternative 4a	125.6	5	$146.3	$128.8	Westside Bridge Outlet
Alternative 4b	123.4	8	$146.7	$129.2	Confluence Outlet
Alternative 3c	126.8	2	$158.4	$140.9	Microtunnel to keep pipe in Dry Creek Road ROW
Alternative 3b	123.8	7	$163.4	$145.9	Microtunnel, Confluence Outlet
Alternative 2c	126.1	4	$166.8	$147.4	Integrated Inlet
Alternative 2a	126.2	3	$171.4	$152.0	Integrated Inlet to Westside Road
Alternative 2b	123.1	9	$171.8	$152.4	Integrated Inlet to Confluence Outlet
Alternative 3a	126.9	1	$176.8	$159.3	Microtunnel, Westside Bridge Outlet

The evaluation scores for the top nine alternatives range between 126.9 and 123.1 or about 3%. This is within the accuracy of the scoring evaluation and therefore, all alternatives are essentially equal and are equally viable as route alternatives. Within the top 9 route alternatives, the least cost alternative is Alternative 4c and is preferred because of its favorable evaluation score and cost. Alternative 4c uses a head box inlet, with a route along Dry Creek Road and Kinley Road to an outlet near the Highway 101 Bridge. To reduce pipeline construction cost, the alignment uses private roads within agricultural property to avoid microtunnel construction in Dry Creek Road, while maintaining gravity flow conditions. The next two alternatives, Alternatives 4b and 4a, consist of the same head box inlet and alignment, but have a different outlet location. Alternatives 3a through 3c all use microtunnel pipe installation to keep the pipeline in Dry Creek Road at the high points; therefore these alternatives have a higher cost. Alternative 2a through 2c use the integrated inlet, and if the Corps share of the construction cost were to increase, these is higher ranked and cost competitive with Alternative 4c and the other least cost alternatives.

The preferred alternative is 4c; however, the Water Agency should monitor the Corps progress and cost. If the Corps moves ahead with the emergency water supply line to the fish hatchery and if the economics of partnering with the Corps is favorable to the Water Agency, the additional hydraulic head provided by the integrated inlet facility would facilitate a gravity pipeline constructed entirely within Dry Creek Road using open cut trench technology. Under these conditions, Alternative 2c should be considered, which is ranked slightly higher because the entire route remains in Dry Creek Road. The Water Agency could also consider Alternative 3c as an alternate to Alternative 4c. Alternative 3c uses microtunnel technology to keep the pipeline in the Dry Creek Road right of way and therefore, ranked higher, but is more costly than Alternative 4c.

Preferred Alternative

Based upon the results of both the evaluation results and the cost estimates, the preferred Alternative 4c includes the head box inlet, the existing hydropower facility, an alignment in Dry Creek and Kinley Roads, and an outlet at the Highway 101 Bridge.

Inlet Structure

The head box consists of a concrete box inlet to the bypass pipeline and a gate installed in the existing stilling basin which would increase the water elevation in the stilling basin such that it can be diverted into the bypass pipeline. The maximum water surface elevation of the head box is estimated to be approximately 220 ft. This elevation should be revisited during design to determine the extent of backwater effects and to determine if a higher elevation is feasible, since it could reduce or eliminate hydraulic constraints for the pipeline alignment.

Alignment

The preferred alignment follows Dry Creek Road except where the hydraulic head would require a bury depth greater than 25 ft. To avoid deep bury depths, the alignment was rerouted into adjacent private roads within agricultural property.

In addition to the hydraulic constraints, the alignment in Kinley Road must be carefully designed due to the presence of the City of Santa Rosa's 42-inch diameter reclaimed water pipeline, as well as a high pressure natural gas line and sewer pipelines. It is expected that some utilities would need to be relocated to accommodate a 72-inch diameter bypass pipeline.

Outlet Facility

The outlet for the Central Route would be located at or near to the Highway 101 Bridge, on the Russian River (refer to Figure ES-2).

Hydroelectric Facilities

With the head box inlet, the preferred project would continue to use the existing hydropower facility at WSD. The existing facility has a capacity of 2.6 MW and is projected to have an annual energy production of approximately 12.9 million kWh/year.

Preferred Alternatives Cost Summary

The estimated cost for the preferred alternative, Alternative 4c, is presented for a 72-inch diameter pipeline in Table ES-6.

Table ES-6. Estimated Cost of Preferred Alternatives

Item	Basis	Preferred Alternative
		72-inch Pipe
Route		$ 61,450,000
Outlet		$ 4,090,000
Construction Subtotal		$ 65,540,000
Contractor's Field Overhead and Mob/Demob	9%	$ 5,900,000
Sales Tax on Materials and Rentals	2%	$ 1,310,000
Contractor's Fee (Office Ovhd and Profit)	15%	$ 9,830,000
Contractor's Bonds and Insurance	1%	$ 830,000
Undefined Scope of Work Estimated Cost	25%	$ 20,850,000
Route+Outlet Subtotal		**$ 104,260,000**
Inlet		$ 2,584,000
Construction Value Total		**$ 106,844,000**
Environmental Mitigation and Permitting		$ 1,050,000
EIR and Legal		$ 2,500,000
Subtotal		**$ 110,394,000**
Right-of-Way and Easements		$ 976,000
Right-of-Way Acqusition and Legal		$ 244,000
Subtotal		**$ 111,610,000**
Engineering	10%	$ 10,680,000
Construction Legal	5%	$ 5,340,000
Construction Administration	8%	$ 8,550,000
Owner Administration	5%	$ 5,340,000
Total Project Costs		**$ 141,520,000**

Chapter 1 - Introduction

Sonoma County Water Agency (Water Agency) provides water to nine cities and special districts, serving over 600,000 residents in Sonoma and Marin counties. Warm Springs Dam (WSD), owned by the US Army Corps of Engineers (Corps), is part of the Russian River Flood control system and provides water for habitat, recreational, and municipal uses. The WSD is a major water supply reservoir for the Water Agency.

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Background

The BO found that some aspects of flood control and water supply operations threaten to jeopardize steelhead and coho salmon. The BO also concluded that existing critical habitat for steelhead and coho salmon is not sufficient to serve the intended conservation role for these species. Proposed flow releases from WSD during the approximately six-month long, low flow season, create high velocities that greatly limit the value of 14 miles of Dry Creek as a rearing habitat for coho and steelhead.

The BO states that there are three basic approaches to minimizing adverse effects of high summer flow releases on rearing habitat for coho salmon and steelhead, which include: 1) reduction of water releases from WSD, 2) modifications to Dry Creek to accommodate a higher flow that sustains good quality habitat, or 3) bypass summertime high flow releases around Dry Creek using a pipeline. Approach 2 is being evaluated by the Water Agency in a separate study. This study evaluates the feasibility of approach 3, and includes a feasibility analysis of the inlet works at WSD, pipeline routes to bypass Dry Creek, and outlet sites and facilities to discharge the bypassed water back to the Russian River.

Summer flows in Dry Creek have historically ranged from 40 to175 cfs and current summer flows are typically 105 cfs. Although flow limits for Dry Creek have not been established, the bypass pipeline capacity may range between 80 and 180 cfs to accommodate the potential bypass needs.

The BO also states that the Corps will install a new emergency water supply pipeline to the Don Clausen Hatchery at the base of WSD and complete construction of additional rearing facilities for the coho salmon broodstock program. The Water Agency sent a letter of intent expressing an interest in partnering with the Corps to evaluate design alternatives for meeting the goals of the emergency water supply pipeline and bypass pipeline needs.

The Corps is proceeding with 60 percent designs for the emergency water supply system alternatives, which include the installation of pumps in the control structure to pump water to the hatchery in a 36-inch diameter pipeline and the integrated alternative that partners with the Water Agency to install a 72-inch diameter pipe in a tunnel to the standpipe within the control structure. The integrated alternative allows flow to be split between the hatchery and potential bypass flow.

Purpose

The Water Agency is evaluating the feasibility of a raw water bypass pipeline for Dry Creek that accomplishes the following goals:

- Serve as a conduit to convey raw water flows that cannot be sustainably managed in Dry Creek alone,
- Ensure that inlet and outlet structures route flows in a manner that is protective of the environment and which does not modify existing in-stream flow patterns in a negative way, and

Therefore, the purpose of this Feasibility Report is to:

- Identify uncertainties and potentially significant issues associated with the raw water bypass pipeline,
- Identify other alternatives or suggestions to facilitate design and/or construction, and
- Identify the preferred project alternatives.

Previous Documents

This Feasibility Report is the result of a series of technical memoranda (TM) that were developed to document interim analyses, findings and recommendations. Each are these TMs is described briefly below:

- *TM 1 - Bypass Flow and Operations Strategy.* Describes the range of bypass flows and operation strategy that would be used as the basis for development of alternatives for the inlet structure, pipeline, outlet structure and hydropower generation. The result was that the facilities should be designed to handle a range of flows to support the Water Agency's current water rights, including 80 cfs, 100 cfs, and 180 cfs. These flows and natural ground slope result in pipelines of 48, 60, and 72-inches in diameter.
- *TM 2 - Evaluation Methodology.* Presents evaluation methodology and defined the criteria used for both screening facilities options and evaluating project alternatives. The result was a set of screening and evaluation criteria.

- *TM 3 - Screening Results for Inlet Works, Pipeline Route, and Outlet Works.* Presents the methodology and results of the facilities screening process for the inlet works, pipeline routes, outlet sites and facilities, as well as the general location of hydropower facilities. The result of the screening analysis was 21 project alternatives.
- *TM 4 - Evaluation Results for Project Alternatives.* Presents the methodology and results of the alternatives evaluation. The result of the alternatives evaluation was a list of ranked project alternatives.
- *TM 5 - Opinion of Probable Cost and Present Value Calculation.* Presents the estimated cost of construction, estimated operation and maintenance costs, and present value for each of the alternatives identified in TM 3.

The technical memoranda described above were prepared to form the Feasibility Report, such that each technical memorandum would represent a distinct section or chapter in the report. The technical memoranda were supplemented by exhibits and attachments which included detailed data and analyses, the results of which were included in this Feasibility Report.

Stakeholder Involvement

The development of this Feasibility Report involved communication with key stakeholders throughout the process. Meetings and presentations were held with the Regional Water Quality Control Board, National Marine Fisheries Service, the Department of Fish and Game, the Dry Creek Advisory Group, the Santa Rosa Board of Public Utilities, and the general public.

The purpose of these meetings and presentations was to provide opportunities for the stakeholders, Corps of Engineers and NMFS to understand the process and project status and provide input on key aspects. Meeting minutes and presentations are contained in Appendix A.

A meeting with the North Coast Regional Water Quality Control Board was held to introduce them to the project, see meeting minutes contained Appendix B. Permits required by the Regional Board include a stormwater construction permit and a Section 401 water quality certification. An NPDES permit is not being contemplated at this time. The Regional Board requested a work plan showing the specific analysis, modeling, and evaluation to be performed during the development of an Engineering Report in support of the EIR.

On August 23, 2010, the Corps held a kickoff meeting for the 60% design of the Emergency Water Supply Line project for the Don Clausen Fish Hatchery.

Report Organization

This Feasibility Report provides a summary of the assumptions, the development and evaluation of alternatives, and the preferred alternatives.

This Feasibility Report is organized into nine chapters. The chapters follow the logical progression of the work completed for the project.

- Chapter 1 – Introduction
- Chapter 2 – Basis of Planning
- Chapter 3 – Facility Concepts
- Chapter 4 – Screening and Evaluation Criteria
- Chapter 5 – Facilities Screening
- Chapter 6 – Project Alternatives
- Chapter 7 – Alternatives Evaluation
- Chapter 8 – Economic Evaluation of Alternatives
- Chapter 9 – Preferred Alternative

An Executive Summary precedes Chapter 1 for use in communicating the results of the Feasibility Study.

Abbreviations

AFY	acre feet per year
AMSL	above mean sea level
ASTM	American Society of Testing and Materials
BO	Biological Opinion
CCI	Construction Cost Index
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	cubic feet per second
Channel	general term for the structure of Dry Creek or the Russian River
CNDDB	California Natural Diversity Database
Corps	United States Army Corps of Engineers
DC	Dry Creek
DCFH	Don Clausen Fish Hatchery
DO	dissolved oxygen
EIR	Environmental Impact Report
ESA	Environmental Site Assessment
ft	feet
ft/s	feet per second
GIS	Geographic Information System
HGL	hydraulic grade line
MSL	mean sea level
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
O&M	operation and maintenance
RCCP	reinforced concrete cylinder pipe
RCP	reinforced concrete pipe
REC	Recognized Environmental Condition
ROW	Right of Way
RWQCB	Regional Water Quality Control Board
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Water Agency	Sonoma County Water Agency
WSD	Warm Springs Dam

Chapter 2 - Basis of Planning

Study Area

The study area includes the Dry Creek Valley and potential pipeline routes along Dutcher Creek Road, Canyon Road, Dry Creek Road to the Russian River, and Westside Road to the Water Agency's facility at Mirabel, see Figure 2-1. Conveyance of water in pipes from WSD along these routes with a discharge to the Russian River or Dry Creek at the confluence meets the requirements of the BO.

Initial Hydraulic Head Conditions

These following subsections review the hydraulic head conditions and flow ranges leading to pipe sizing. Pipe size and capacity are based on the hydraulic head available at the pipe inlet at WSD, the distance to the discharge, and elevation at the point of discharge.

Table 2-1 presents the water surface elevations which govern operations of the dam.

Table 2-1. Lake Sonoma Elevation Information[(a)]

Lake Elevation (ft MSL)	Notes
519	Dam Crest
495	Spillway Crest
> 451	Corps Controls Releases
451	Top of Water Supply Pool
< 451	Water Agency Controls Releases
427	Historic Minimum Pool
315	Bottom of Water Supply Pool
292	Minimum Pool
(a) Corps communication during site visit, 2009	

Since construction of WSD was completed relatively recently in 1983, the historical record of water surface elevations is limited. Therefore, to determine the appropriate water surface elevation that should be used for the screening analysis, the Water Agency provided the results of a water supply model (Lr_075k_d16, Water Agency) that simulates daily inflows, releases, and the water storage volume in Lake Sonoma. The data for a 50-year period, representing conditions in 1955 through 2005, was evaluated using a statistical analysis to determine the average, 10th percentile, and 1st percentile volumes of water stored in Lake Sonoma. The results of the analysis are summarized in Table 2-2.

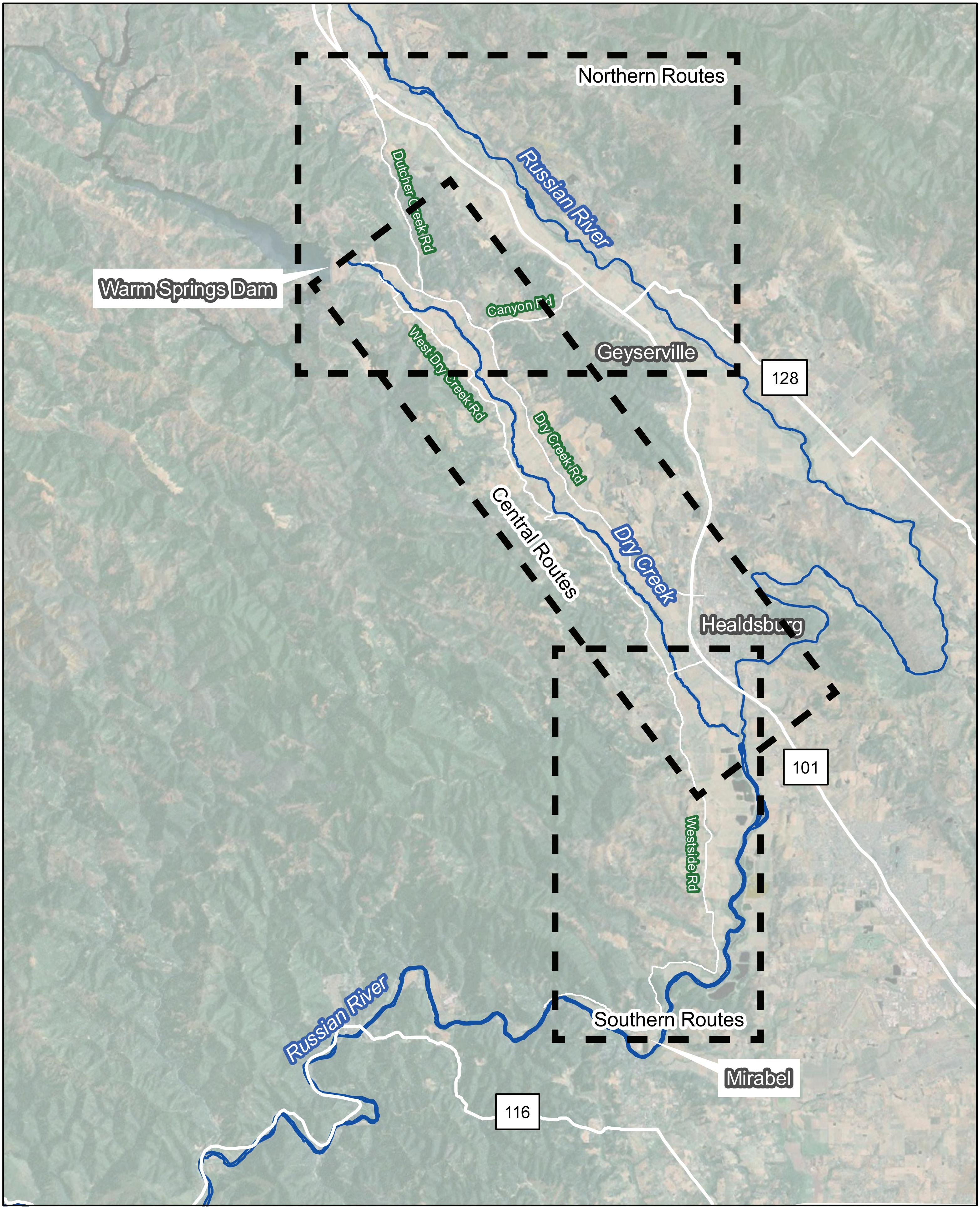

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Figure 2-1
Study Area
Dry Creek Bypass Pipeline Feasibility Study

SONOMA COUNTY WATER AGENCY

Table 2-2. Analysis of Simulated Lake Sonoma Storage Volume and Water Elevation

Probability	Storage Volume[(a)] (acre-feet)	Lake Sonoma Water Elevation[(b)] (ft MSL)
Average Water Level	219,000	439
10th Percentile	183,000	420
1st Percentile	159,000	412

(a) Based on statistical analysis of simulated storage volume results from the Water Agency hydraulic model (Lr_075k_d16).
(b) Calculated using the elevation storage curve provided by the Water Agency.

In general, the initial hydraulic head should be sufficient to drive the bypass flow to the outlet facility without the need for pumping. Due to the critical role the bypass pipeline would play for future water supply, as well as the uncertainty posed by climate change, it was determined that a conservative elevation of 400 feet should be defined as the minimum hydraulic head condition for the integrated facility inlet. An initial hydraulic head of 400 feet would require tunneling for the Northern Routes and result in excess head for the Central and Southern Routes. Therefore, for the Central and Southern Routes, hydropower could be generated at the dam. A preliminary analysis showed that an initial hydraulic head of 250 feet would be sufficient to overcome hills in the alignment without the need for tunneling. The initial hydraulic head design criteria are summarized in Table 2-3.

Table 2-3. Initial Hydraulic Head Conditions

Initial Hydraulic Head Condition (ft MSL)	Use	Inlet	Condition
439	Potential Power Production	Integrated Facility	Average Water Level
400	HGL for Northern Routes	Integrated Facility	Low Water Level
250	HGL for Southern Routes	Integrated Facility	With Hydropower at Dam
250	HGL for Central Routes	Integrated Facility	With Hydropower at Dam
220	Used for HGL and Pipe Bury Depth	Head Box	Head Box

As indicated in Table 2-3, the average water level in Lake Sonoma, 439 feet, was used to estimate hydropower potential and to determine the most beneficial location (i.e., at the dam or near the outlet) of a hydropower facility for each route. The values in Table 2-3 were used to evaluating pipeline hydraulics, bury depth, hydropower generation, and in the cost estimates.

Bypass Flow Analysis

The BO found that the summertime flows are too high for the juvenile steelhead and salmon native to Dry Creek. However, the BO also acknowledges a need for balance and flexibility and thus allows Water Agency to determine alternative minimum flow requirements that meet the goals of restoring habitat.

Additional studies are being conducted to determine if maximum in-stream flows can be increased through the implementation of stream restoration projects. Therefore, due to the current uncertainty of the future in-stream flow requirements, a range of maximum in-stream flow between 60 cfs (flow through the hatchery) and 175 cfs (flow in Dry Creek) has been chosen in order to determine the range of flows which must be accommodated by a bypass pipeline and its major facilities. The maximum flow expected in the bypass pipeline is 180 cfs.

Range of Pipe Sizes

The natural ground slope from the toe of the WSD to the potential discharge point at the confluence of Dry Creek with the Russian River is from about elevation 220 to 95 or about 125 feet of fall. The distance is approximately 12.5 miles or 66,000 feet. This yields a slope of approximately 0.002 ft/ft. Standard manufactured pipe sizes and the pipe capacity are listed in Table 2-4.

Table 2-4. Standard Manufactured Pipe Size and Pipe Capacity at a Slope of 0.002 ft/ft

Pipe Diameter (in)	Capacity (cfs)
72	200
66	160
60	125
54	95
48	70

For screening and evaluation purposes, pipe size is not a factor. The 72-inch pipe was used in the evaluation because if the largest pipe is feasible, then smaller pipe sizes are also acceptable. Smaller pipe sizes are easier to construct, but that is more a factor of cost, not of feasibility. Pipe size does not impact the order of the evaluation ranking or order of lowest to highest cost.

Operations Strategy

Two methods of operation are possible for the bypass pipeline. The first operation method would provide a constant flow (or base load flow) in the pipeline and divert the remaining fluctuating portion of the flow to Dry Creek. This method provides several key benefits. Diverting the fluctuating portion of flow to Dry Creek provides a varying flow in Dry Creek which is similar to natural stream flows. Furthermore, this method of operation maximizes the use of the bypass facilities, including hydropower production, and provides reliability of discharge at the outlet location.

The second method of operation would provide a constant flow in Dry Creek while diverting peaks to the bypass pipeline. The flow in Dry Creek would be managed to meet the instream flow requirements, such that flows above the maximum instream flow during the summer months would be diverted to the bypass pipeline. Since there are no maximum instream flow requirements during the winter months, it is possible that the pipeline could be drained during the winter months.

The feasibility analysis was based on the first method in which a constant flow would be conveyed by the pipeline provided that flows in Dry Creek are between the minimum in-stream flows and the maximum flows established to be protective of the river habitat.

Ultimately, the timing and volume of release may be altered to meet seasonal, temperature, and flow needs in Dry Creek versus the quantity of flow to be bypassed.

Key Assumptions

A number of key assumptions were made during the execution of this feasibility analysis. These assumptions are summarized in Appendix C.

Chapter 3 - Facility Concepts

The facilities required for the bypass pipeline include an inlet at WSD, a large diameter bypass pipeline, and an outlet structure to reintroduce the bypass water back into the Russian River. Opportunities to include a hydropower facility with the bypass pipeline project were also identified. The following subsections discuss the initial concepts that were identified for each facility component.

Inlet Options

Four inlet facility options were identified and screened see Figure 3-1. The inlet facilities considered are briefly described below.

- **Option 1, Head Box Adjacent to the Stilling Basin.** For this option, the existing stilling basin would be modified with a gate to divert water into a head box on the bypass pipeline see Figure 3-2. The water surface elevation in the existing stilling basin is 210 feet; however, a higher elevation is desired to facilitate gravity flow for the bypass pipeline, particularly for the Central and Southern Route alignments (routes are described in the following subsection). Due to backwater effects in the tunnel leading to the existing stilling basin and the discharge elevation of the existing generator, the maximum water surface elevation in the head box would be 220 feet. This elevation was set to be below the elevation of the outlet tunnel ceiling at approximately 233 feet and the actual discharge elevation of the hydropower turbine which is approximately 227 feet. A gate would need to be installed in the existing stilling basin to increase the water level and divert flow into the bypass pipeline.
- **Option 2, Siphon Over the Existing Dam.** This option would include an inlet structure (e.g., concrete vertical intake pipe), piping running up and over the dam, and an outlet structure on the downstream side of the dam following hydropower generation. A pump facility at the top of the dam is required to fill the pipes and create the siphon. New hydropower facilities would be needed to maintain electrical generation.
- **Option 3, New Outlet Works through Left Abutment.** This option would be comprised of three parts, an intake temperature control structure, a conveyance system through the left abutment, and an outlet through a new power generation facility. The intake would be a stand alone structure similar to the existing temperature control structure which provides water to the DCFH. There are many geotechnical and constructability issues that need to be investigated the conveyance through the abutment. New hydropower facilities would also be needed to generate electricity.

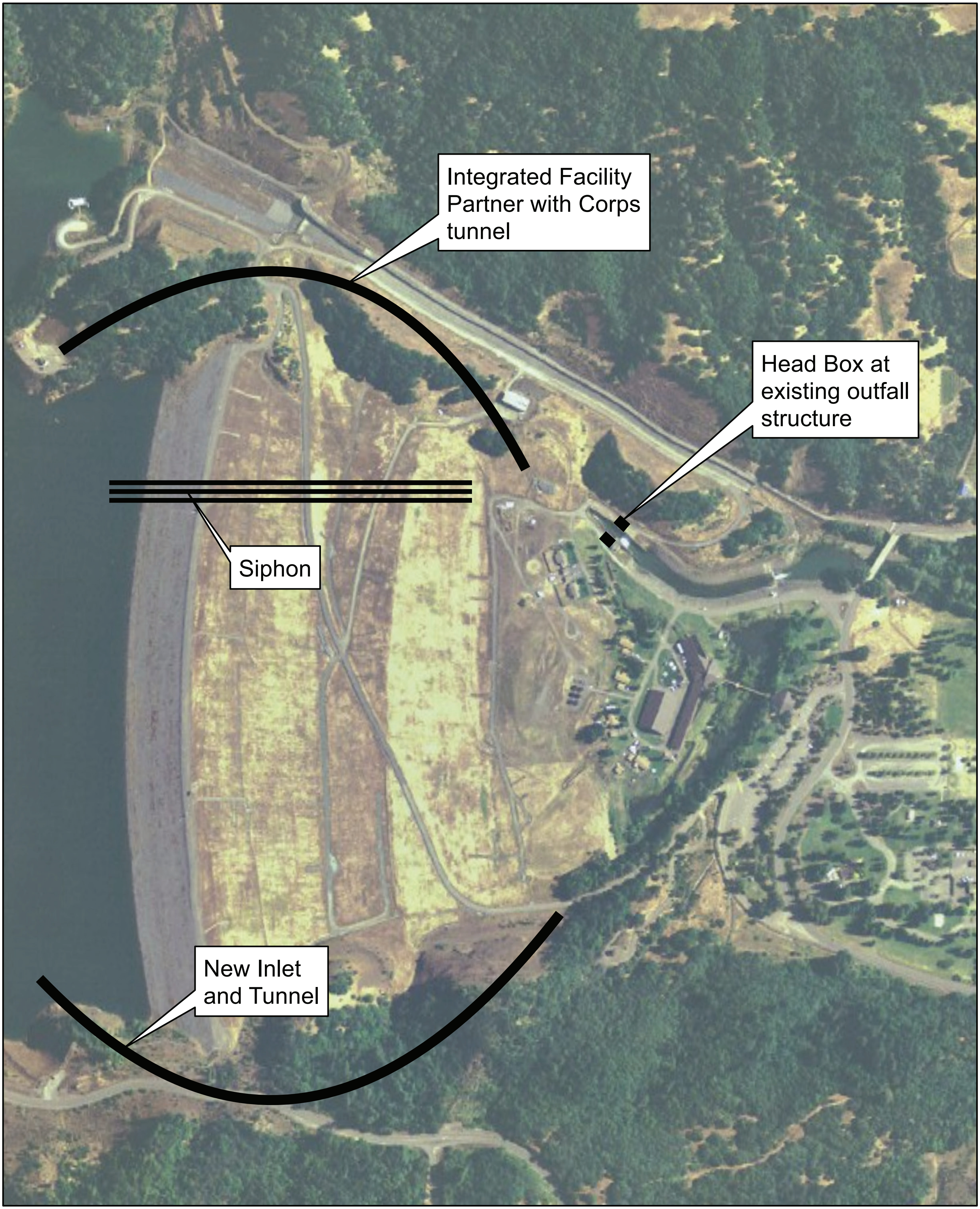

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Figure 3-1
Inlet Works Options
Dry Creek Bypass Pipeline Feasibility Study

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- **Option 4, Integrated Facility.** New Corps Tunnel to Existing Control Structure. The Corps is currently exploring an alternative to construct a new tunnel with a pipeline to intercept flow at the existing control structure to provide additional emergency water to the existing DCFH. There is an opportunity for the Water Agency to work with the Corps on the design and the capacity of these facilities to meet the needs of the hatchery as well as the Dry Creek bypass flow requirements. The new tunnel and pipeline would be used as the primary supply for the hatchery and the bypass pipeline, while the existing control structure would be used as the "emergency water supply." The pipe would connect to the existing standpipe in the control structure, shown in Figure 3-3, then out through a new tunnel and split at a manifold type structure to either the hatchery or the bypass pipeline. New hydropower facilities would be needed to generate power on the pipeline flow prior to the split between the hatchery, bypass pipeline, and potential discharge directly to Dry Creek.

Pipeline Route Options

Three general route corridors, shown in Figure 2-1, were identified for the bypass pipeline, including:

- **Northern Route**, WSD to the Russian River, near Geyserville or Cloverdale
- **Central Route**, WSD to the confluence of the Russian River and Dry Creek, and
- **Southern Route**, WSD to the Water Agency's facilities in the Mirabel/Wohler area.

For each of these general routes, alignment options were identified considering the possible alignment corridors in which a large-diameter water transmission pipeline could be located. Thus, with the exception of one, the alignment options were located in existing public roadways, private roadways, and access roads. The alignment options are listed in Table 3-1and illustrated in Figure 3-4. At the request of the Water Agency, two alignment options using the shortest distance from WSD to Asti were evaluated. Because of the terrain, installation of the pipe would require hard rock tunneling with the pipe installed in the tunnel following excavation.

Table 3-1. Pipeline Routes and Alignment Options

Route	Alignment Options
Northern Route	Dry Creek Road to Canyon Road and Black Dry Creek Road to Canyon Road and Hwy 128 Dry Creek Road to Dutcher Creek Road and Theresa Dry Creek Road to Dutcher Creek Road and Asti Direct Tunnel to Asti
Central Route	Dry Creek Road to Kinley Road East DC Access Road West Dry Creek Road West DC Access Road
Southern Route	West Dry Creek Road to Westside Road West DC Access Road to Westside Road

The illustration shows the proposed gate structure to raise the water level to 220 feet. For pipeline alignments on the west side of Dry Creek, the head box would be constructed on the west side of the stilling basin.

1. Outlet works stilling basin with discharge to the fish hatchery and Dry Creek
2. Proposed gate structure to increase stilling basin WSE to 220 ft.
3. Proposed pipe to connect stilling basin with proposed head box
4. Proposed head box with inlet and outlet control appurtenances
5. Proposed bypass pipeline

Figure 3-2. Head box constructed to the east of the existing stilling basin

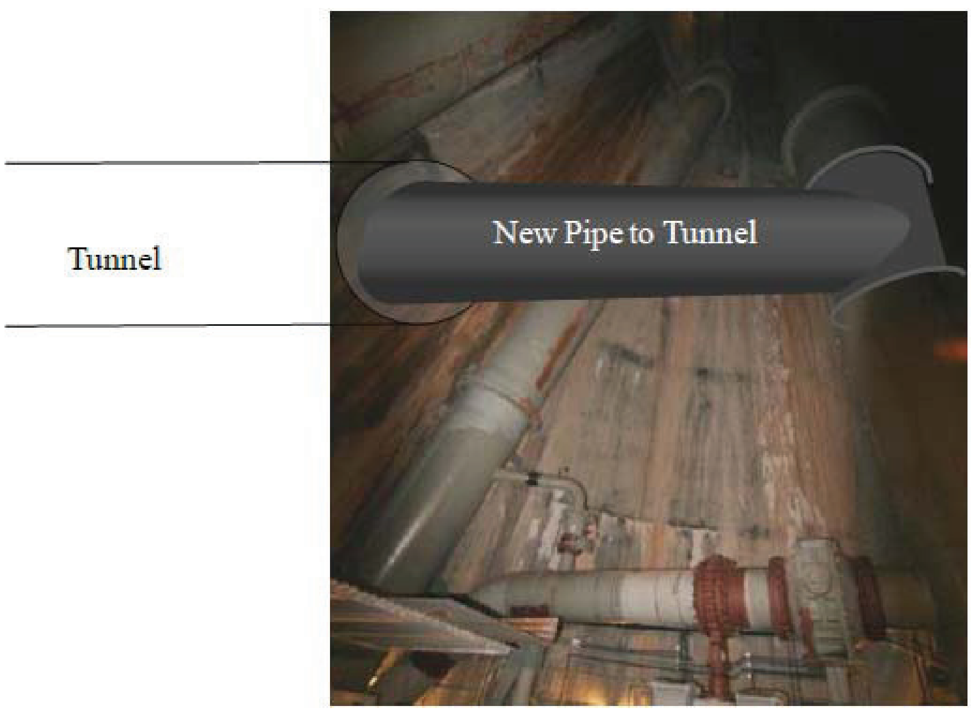

Figure 3-3. Photo and sketch of 72" pipe connection to standpipe

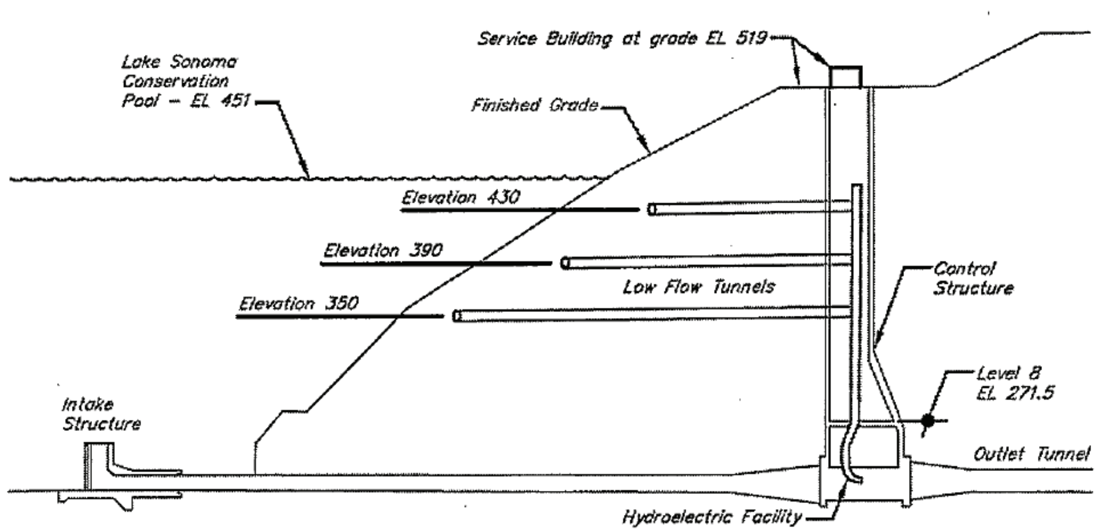

Figure 3-4. Section through Warm Springs Dam and Control Structure with Elevations of Water Draw-off Points. Tunnel pipe connection between EL 271.5 and EL 350.

Northern Route

Three alignments were considered for the Northern Route, one over Dutcher Creek Road, one over Canyon Road, and a direct route using a tunnel to contain the pipe. The first starts at WSD, follows Dry Creek Road southward and turns north on Dutcher Creek Road and either turns onto a private access road and crosses to the Asti Store Road and continues to the Russian River, or continues on Dutcher Creek Road to Theresa Drive and then to the Russian River near the Cloverdale Municipal Airport. The second option for the Northern Route starts at WSD, follows Dry Creek Road south and turns east on Canyon Road and continues to the Russian River near Geyserville. Once the alignment intersects Geyserville Avenue, it either crosses over and continues to the Russian River on Black Road, or turns southwest onto Geyserville Avenue and continues to the Russian River at the Highway 128 bridge. The direct route has a couple of options based on the strategy used to cross Highway 101 at Asti.

Central Route

Four general alignments were identified for the Central Route starting at the WSD and continuing south on the following roads to the intersection with Westside Road:

- Dry Creek Road to Kinley Road
- East DC Access Road
- West Dry Creek Road
- West DC Access Road

East Dry Creek (DC) Access Road (agricultural road paralleling Dry Creek on the east side) and West Dry Creek (DC) Access Road (agricultural road paralleling Dry Creek on the west side) are abbreviated to avoid confusion with the paved roads, Dry Creek Road and West Dry Creek Road.

For the purpose of coordinating the alignments with outlet locations, pipeline termination nodes were established to denote the location at which the alignment analysis ends and multiple options for outlet locations were evaluated. Pipeline termination nodes are essentially the point along the alignment where the pipe can be split to different outlet locations.

Southern Route

The alignment for the Southern Route follows the two western-most alignments for the Central Route down to the intersection with Westside Road, at which point the alignment turns onto Westside Road and continues down to the Water Agency's facilities at Mirabel and Wohler. Alternatively, if one of the two eastern alignments (e.g., Dry Creek Road to Kinley Road) for the Central Route was determined to be preferred over the western alignments, the pipeline could cross Dry Creek at the Westside Road Bridge; however, this option was not formally developed.

Outlet Options

The outlet facility includes both the location where the bypass water would be discharged back to the receiving water, as well as the type of outlet facility that would be employed for the discharge. The following subsections describe both the discharge location and the outlet facility options that were identified.

Discharge Locations

The general outlet options, listed in Table 3-2, are associated with the pipeline routes listed in Table 3-3. While a discharge to the Russian River meets the requirements of the BO, a discharge to Dry Creek would require improvements in Dry Creek to allow the discharge and increased flow in Dry Creek to meet the intent of the BO.

Table 3-2. Pipeline Routes and Associated Outlet Options

Route	Outlet Options
Northern Route	Upper Russian River at the extension of Theresa Road, Asti Road, and Canyon Road area
Central Route	To the Russian River To Dry Creek between the West Side Road Bridge and the confluence with the Russian River
Southern Route	To Water Agency facilities at Mirabel and/or Wohler.

General discharge locations were identified for each pipeline route terminus, as listed in Table 3-3 and as illustrated in Figure 3-5 and Figure 3-6. Discharge locations associated with the Central Route are bounded by the Westside Road Bridge to the north, Highway 101 Bridge on the east side, and the area around the confluence. For the Northern Route, outlet locations were evaluated where the extension of Canyon Road intersects the Russian River and near the Highway 128 Bridge.

Table 3-3. Discharge Locations

Pipeline Route Terminus	General Discharge Locations
Upper Russian River	Extension of Canyon Road
	Near Geyserville Bridge
Russian River	Confluence of Dry Creek and Russian River
	Hwy 101 Bridge
Dry Creek	Lower Norton Slough
	Magnolia Drive
	Mill Creek Confluence
	Norton Slough
	Upper Norton Slough
	Westside Road Bridge
Mirabel/Wohler	Water Agency Facilities

Another option is to discharge the bypass flow to the gravel pits adjacent to the Russian River. This option was discussed, but was not considered because the discharge to the gravel pits does not mimic the current conditions and the option does not meet the Water Agency's criteria set of operation that includes a more immediate response between the discharge and benefit to water supply. Discharge to the gravel pits and potential aquifer storage may be considered in conjunction with future groundwater planning.

Outlet Facility Options

The options for direct discharge facilities vary considerably in appearance and function. Four outlet facility types were initially evaluated and defined as follows:

- **Riverbank Outfalls**. A riverbank outfall is defined as a structure or facility located on the bank of a river, through which water is discharged directly into the surface flow, see Figure 3-7.
- **Diffusers (in-river discharge)**. An in-river diffuser consists of a pipe fitted with well-defined openings through which water flows to discharge, see Figure 3-8. Several configurations were examined for this project that in some manner improve mixing of water with the river beyond the mixing that could be achieved with a riverbank outfall. Diffusers can be configured in many ways to minimize the area where the discharge is partially mixed with river flow.
- **Diffusers (in-bed discharge)**. In-bed diffusers are defined here as any method of discharge through which water enters the river flow through either well screens or perforated pipes buried in river bottom (alluvium), see Figure 3-9.
- **Diffusers (in-bank discharge)**. In-bank diffusers are similar to in-bed diffusers (Figure 3-9) in that discharge is accomplished through a perforated pipe; however, an in-bank diffuser is constructed in the bank versus the bottom of the river.

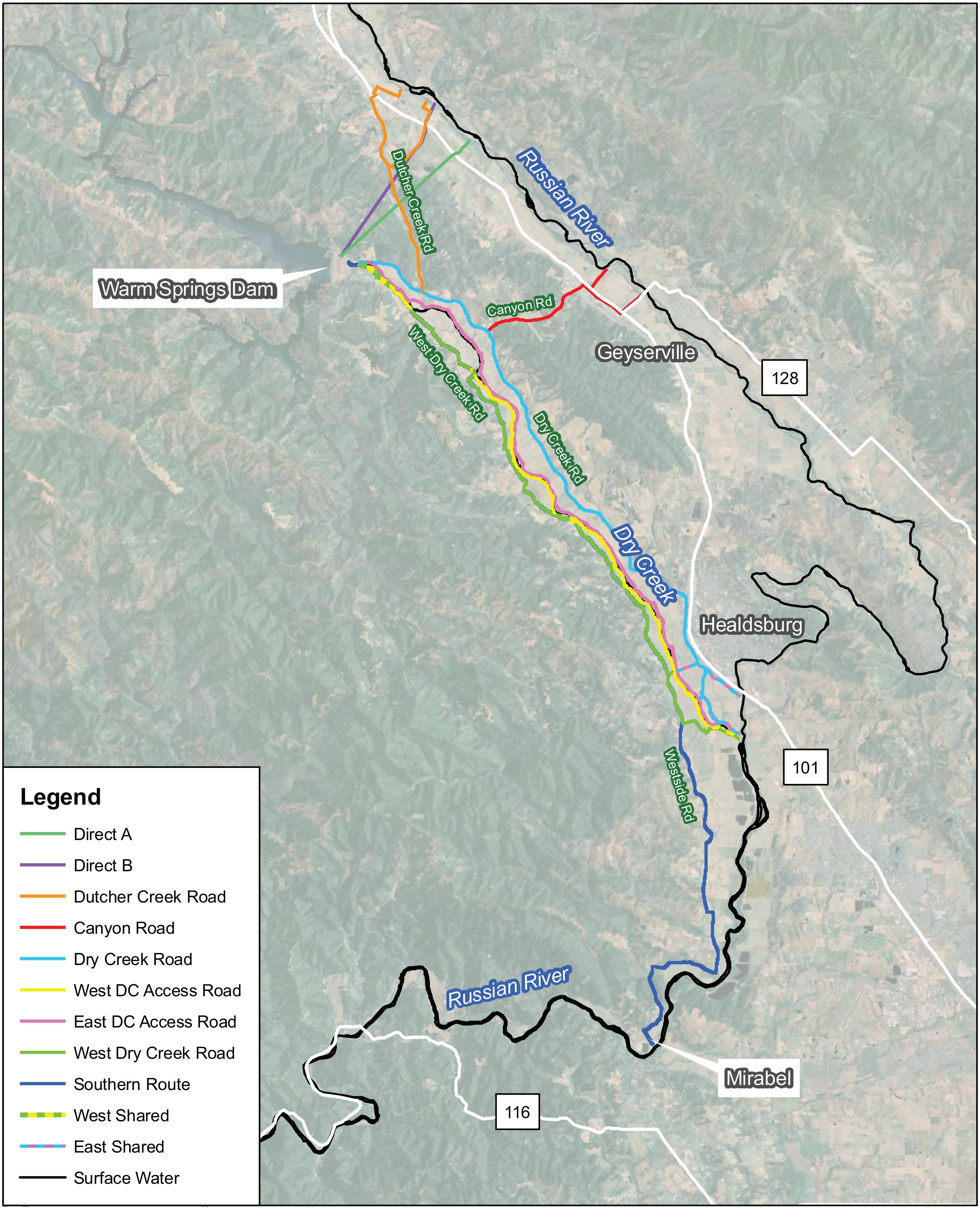

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Figure 3-5
Pipeline Alignment Options
Dry Creek Bypass Pipeline Feasibility Study

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Figure 3-6
Northern Route Discharge Locations
Dry Creek Bypass Pipeline Feasibility Study

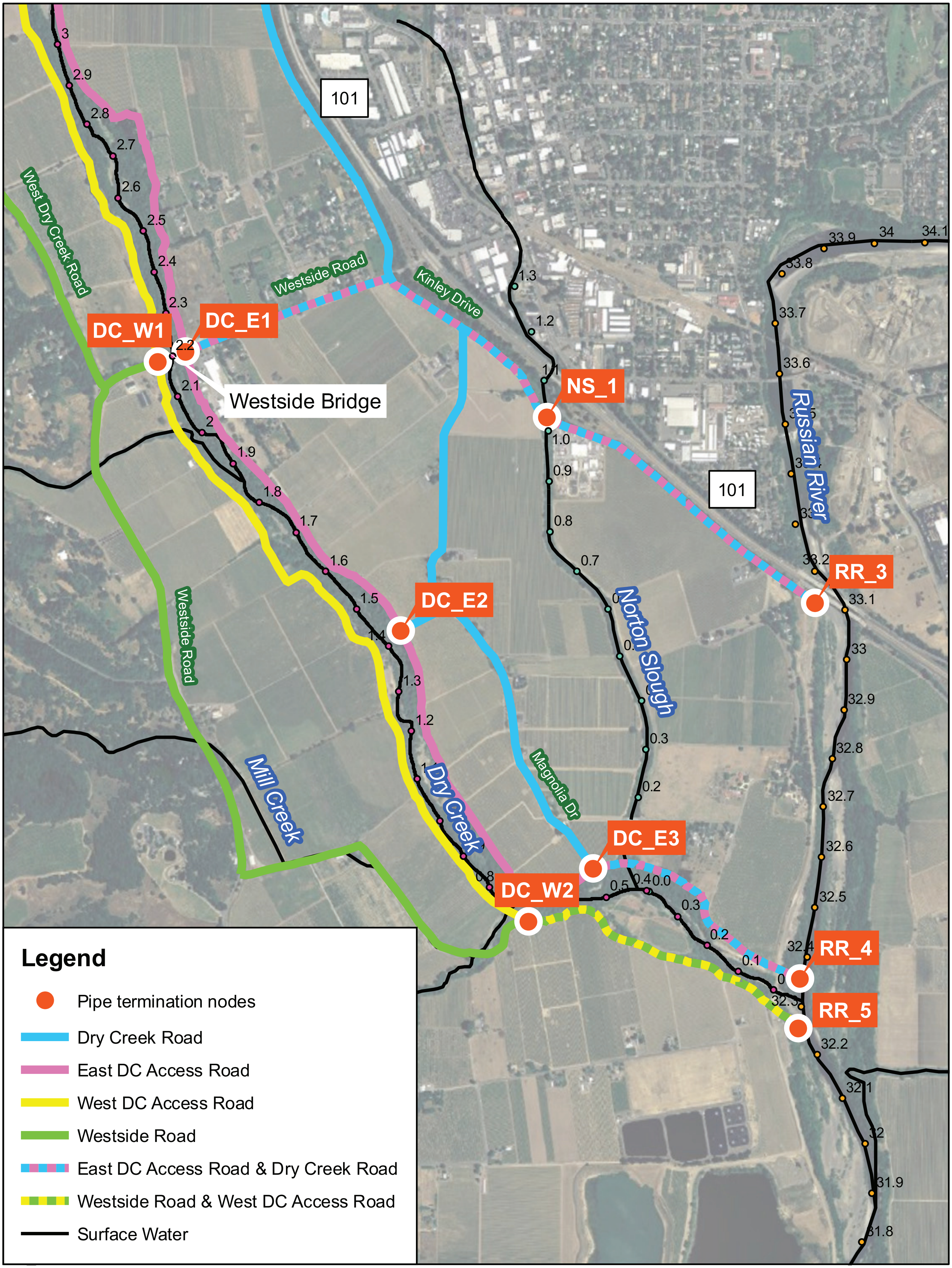

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Figure 3-7
Central Route Discharge Locations
Dry Creek Bypass Pipeline Feasibility Study

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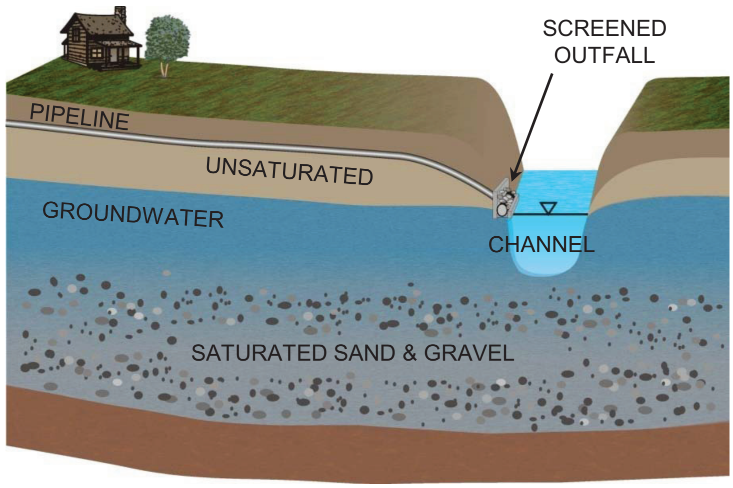

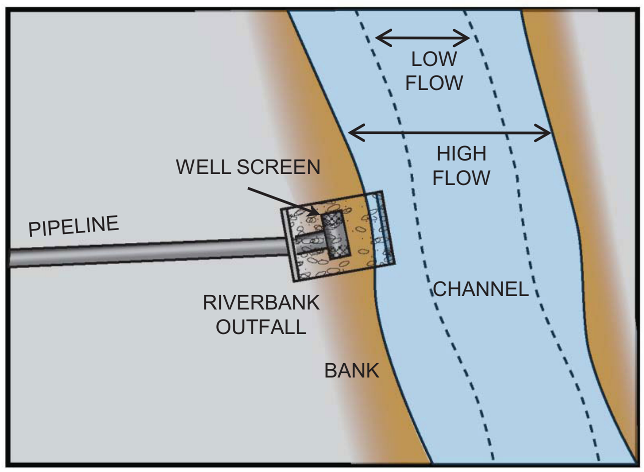

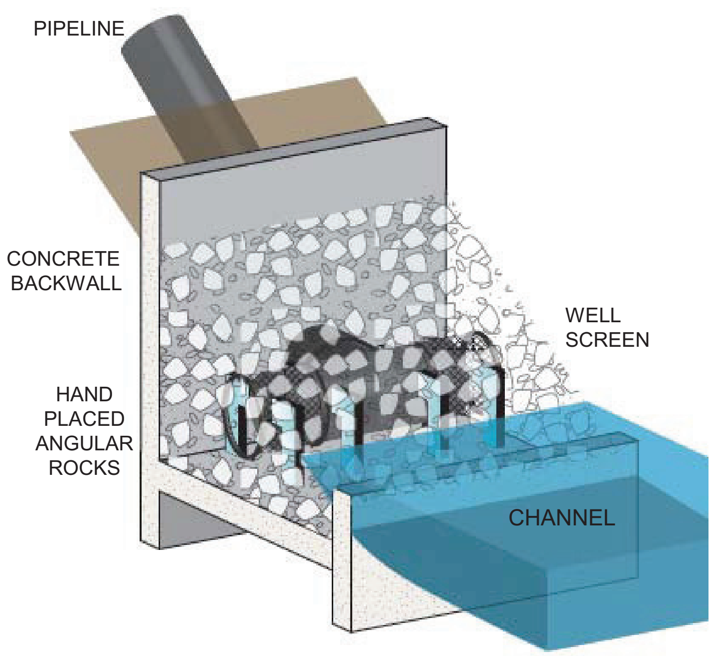

Adapted from Conceptual Outlet Facility Evaluation TM
(Kennedy/Jenks Consultants, Feb 2010)

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Figure 3-8
Riverbank Outfall-Screened Outfall
Dry Creek Bypass Pipeline Feasibility Study

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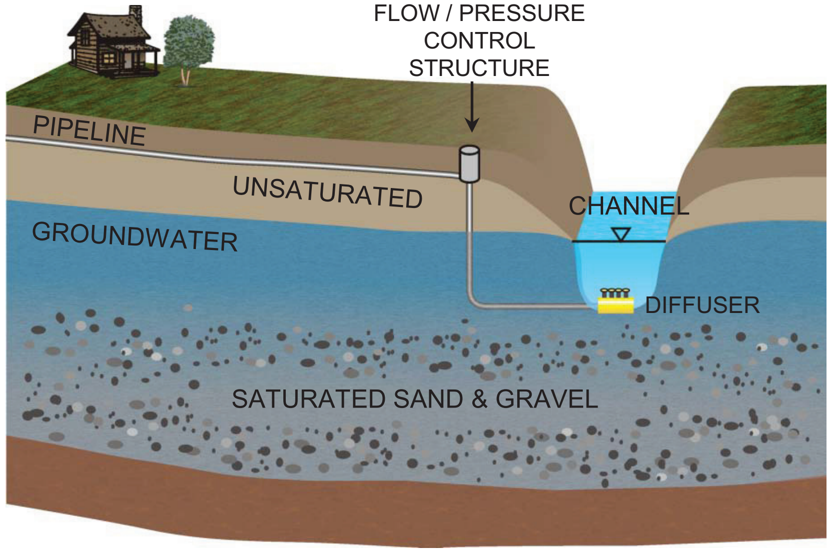

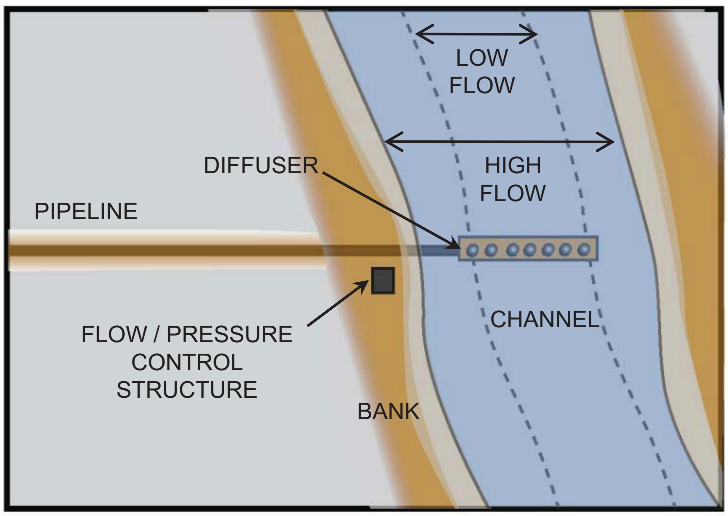

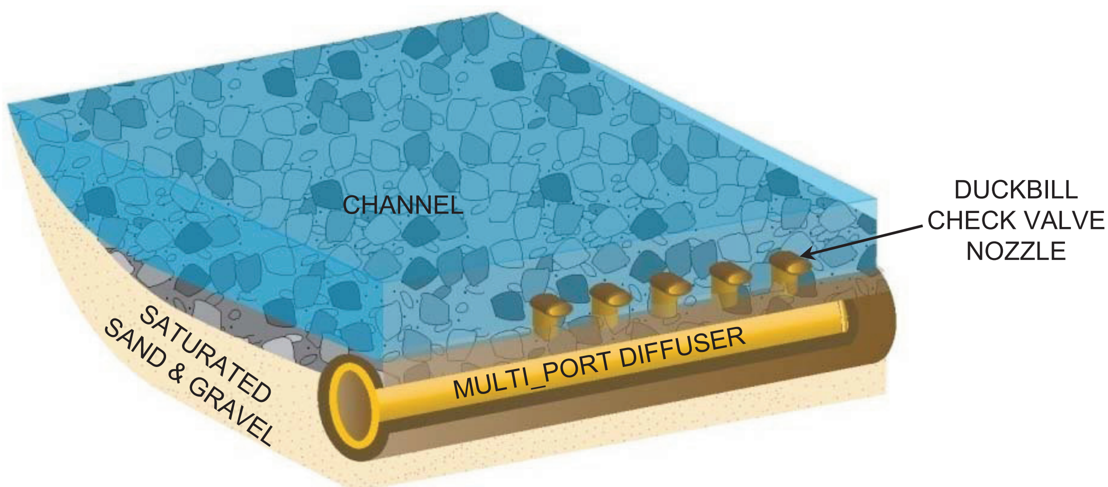

Adapted from Conceptual Outlet Facility Evaluation TM
(Kennedy/Jenks Consultants, Feb 2010)

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Figure 3-9
In-River Diffuser
Dry Creek Bypass Pipeline Feasibility Study

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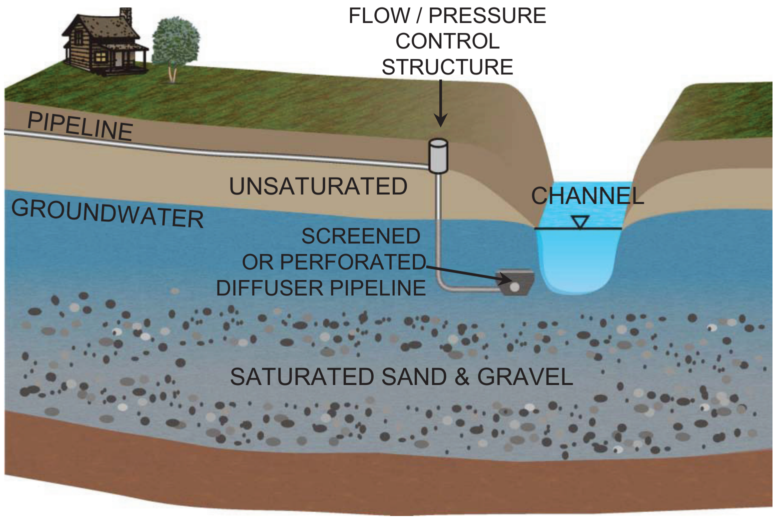
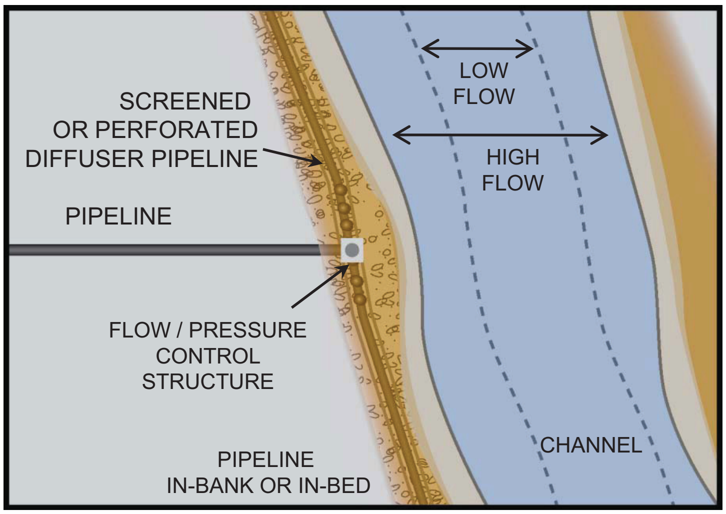
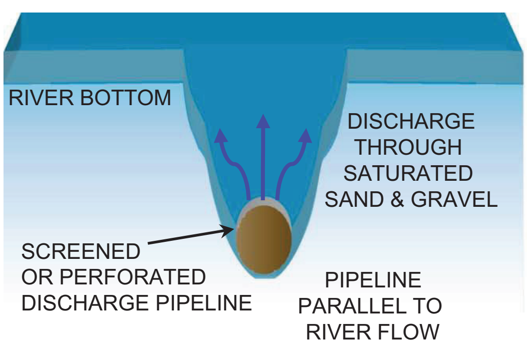
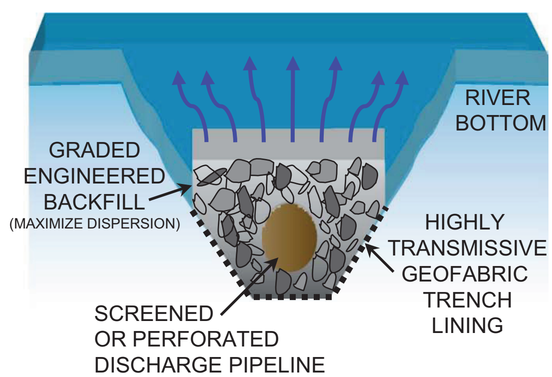






DIFFUSER IN NATURAL ALLUVIUM



DIFFUSER WITH ENGINEERED BACKFILL

Note: In-Bed and In-Bank diffusers would have similar screened or perforated pipelines but would be located in the Saturated Zone and Unsaturated Zones, respectively

Adapted from Conceptual Outlet Facility Evaluation TM
(Kennedy/Jenks Consultants, Feb 2010)

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Figure 3-10

In-Bed or In-Bank Diffuser

Dry Creek Bypass Pipeline Feasibility Study

SONOMA COUNTY WATER AGENCY

Chapter 4 - Screening and Evaluation Criteria

A multi-step evaluation process, shown in Figure 4-1, was developed to evaluate the bypass pipeline alternatives. In the first step, proposed options for the inlet facility, pipeline route alignment, and outlet facility, as presented in Chapter 3, were considered and screened to develop alternatives from suitable combinations of each project component. Following that, the proposed alternatives were evaluated using a common set of evaluation criteria, resulting in individual scorings for each project component. Then a composite score was developed for each complete alternative and the alternatives were ranked.

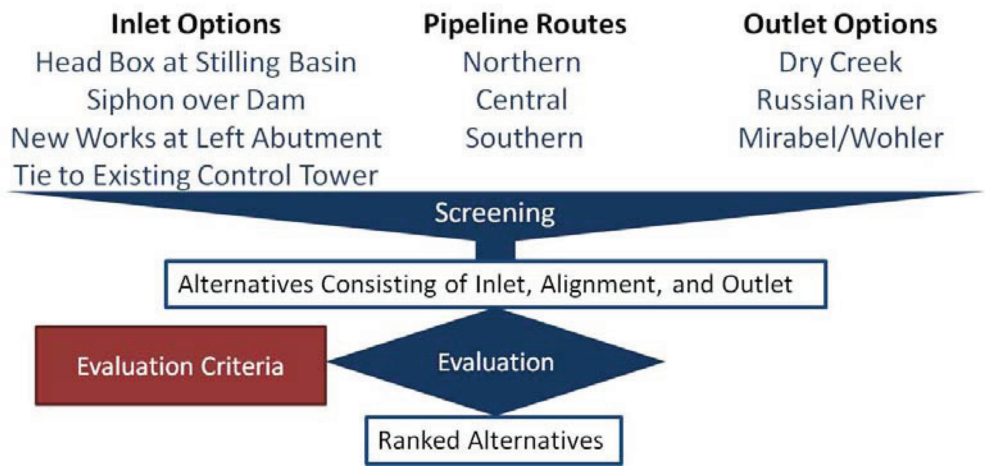

Figure 4-1. Evaluation Process Flow Chart

The screening and evaluation criteria are presented in the following subsections.

Screening Criteria

The screening criteria (see Figure 4-1) for the inlet works, route options, and outlet location are described in the following subsections.

Table 4-1. Screening Criteria

Inlet Facility	Pipeline Alignment	Outlet Facility
Design and Construction	Alignment Length	Proximity to the Confluence (Central Route Discharge to Dry Creek only)
Facility Operability	Topography	Proximity to Pipeline Terminus

Inlet Screening Criteria

Two criteria were developed to screen the inlet facilities, including design and construction and facility operations. Each of these criteria is described below.

Design and Construction

The design and construction criteria include identifying fatal flaw design constraints and unrealistic or extremely difficult construction procedures. Fatal flaw design constraints include a specific design requirement that cannot be achieved through physical law.

The construction procedures for this project would generally be controlled by geotechnical conditions, tunnel and pipe installation procedures, and dam operation. Geotechnical considerations include soil stability during tunneling operations, potential damage to the grout curtain associated with the dam, and damage to the foundation and embankment due to subsidence resulting from tunneling operations. Tunnel and pipe construction are common practice for projects of this nature, however, the four options previously described present various levels of difficulty with regard to constructability and can be weighed accordingly.

The following describes the rating criteria that were developed to screen each option for Design and Construction.

Table 4-2. Inlet Screening Criterion: Design and Construction

Rating	Criteria
Best	All factors are acceptable for design and construction procedures.
Satisfactory	All factors of design, geotechnical, tunnel and pipe installation, and construction during normal dam operation are acceptable, but one or more factors may be difficult.
Unacceptable	Geotechnical, tunnel and pipe installation, and construction conflicts with normal dam operation and causes an unacceptable condition.

Facility Operability

The factors considered to assess facility operability included system capacity, available pressure head, and operational complexity. System capacity is the ability of the system to efficiently provide and maintain the required flow rate to the bypass pipeline. When considering each option, system capacity becomes more complex when integrating the proposed inlet options into the existing structures at the dam.

In addition to system capacity, it is also necessary to provide and maintain the required pressure head needed to convey the bypass water from the inlet to the discharge location. Pressure head is a function of water surface elevation. Each option presents different methods to achieve the required elevation which vary in complexity. Similar to system capacity, maintaining the appropriate pressure head becomes more complex when integrating the proposed inlet works facilities into the existing structures at the dam.

The final consideration for Facility Operability is operational complexity. This considers requirements for seasonal or more frequent mechanical system operation, such as pumps, gate valves, and gate systems needed to increase water surface elevation. In addition, consideration must be given to an integrated system which would provide water to both the existing fish hatchery and the bypass pipeline.

The following describes the rating criteria that were developed to screen each option for Facility Operability.

Table 4-3. Inlet Screening Criterion: Facility Operability

Rating	Description
Best	All factors of system capacity, pressure head, and operational complexity meet project needs.
Satisfactory	All factors of system capacity, pressure head, and operational complexity are acceptable, but one or more factors may be difficult.
Unacceptable	One or more of system capacity, pressure, head and operational complexity cannot be met or is extremely difficult.

Route Screening Criteria

The screening criteria used to identify the preferred alignment option when more than one option was identified for a particular pipeline segment, include alignment length and topography, as described further below.

Alignment Length

Pipeline length and right-of-way (ROW) acquisition directly affect project complexity and construction costs. Thus, in cases where the relative length of similar alignment options differed by greater than 10 percent, the shorter alignment option was selected for inclusion in the alignment alternative.

Table 4-4. Route Screening Criterion: Alignment Length

Rating	Description
Best	Pipeline segment is greater than 10% shorter than other options. .
Satisfactory	Pipeline segment options are within 10% of each other.
Unacceptable	Pipeline segment is greater than 10% longer than other options.

Topography

This criterion was used to assess the constructability of the pipeline along a given alignment. Depending on the inlet option, the available hydraulic grade line (HGL) may be limited to only 220 feet above sea level at WSD. Thus, the presence of hills along an alignment could require deep bury depths (e.g., greater than 25 feet) in order to stay below the HGL. In that case, alternate alignments (e.g., across private property) or construction methodologies (e.g., trenchless installation) were identified, if available.

Table 4-5. Route Screening Criterion: Topography

Rating	Rating
Best	Entire pipeline route is below the HGL.
Satisfactory	Portions of the pipeline route would be above the HGL, although an alternate alignment or construction methodology is feasible.
Unacceptable	Portions of the pipeline route would be above the HGL and no alternate alignments were identified

Outlet Location Screening Criteria

The screening criteria for the outlet facility were developed to identify a short list of feasible discharge locations for each of the potential pipeline route termination nodes. The screening criteria were applied in sequence to develop a preferred option for each of the discharge areas based on the distance from the pipeline termination point and constructability. Application of the screening criteria in this manner resulted in a feasible outlet site near the pipeline termination points.

Proximity to the Confluence with Dry Creek and the Russian River

The proximity to the confluence with Dry Creek and the Russian River, applies only to the outlet locations associated with the Central Routes, and was selected as an initial screening criterion because discharge in Dry Creek close to the confluence of the Russian River would address the fishery issues identified in the Biological Opinion and limit the reach in Dry Creek with increased flows.

Maintaining discharges in Dry Creek near the confluence of Dry Creek and the Russian River would approximate the current flow conditions, where discharges from Lake Sonoma combine with natural flows in Dry Creek to increase flows in the River at that location.

For discharge locations on the Russian River, it would also be preferable for the location of the outlet works to be near the confluence of Dry Creek and the Russian River. The following ratings were assigned to each potential site.

Table 4-6. Outlet Location Screening Criterion: Proximity to Confluence, Russian River

Rating	Description
Best	Less than 1 mile upstream of Confluence with the Russian River
Satisfactory	1 and 3 miles upstream of Confluence with the Russian River
Unacceptable	More than 3 miles upstream of Confluence with the Russian River

Table 4-7. Outlet Location Screening Criterion: Proximity to Confluence, Dry Creek

Rating	Description
Best	Less than 1 mile upstream or downstream from Dry Creek Confluence
Satisfactory	1 and 2 miles upstream or downstream from Dry Creek Confluence
Unacceptable	Greater than 2 miles from Dry Creek Confluence

Proximity to Pipeline Terminus

The proximity to the pipeline terminus was selected as an initial screening criterion since the additional pipeline length required to discharge beyond the end of the pipeline would directly impact the construction cost and could potentially have a greater environmental impact.

It is preferable for the location of the outlet works to be adjacent to or near the pipeline termination point, typically near a bridge or at a section of the road that is close to Dry Creek. However, it is understood that there may be a compelling reason to move the discharge point further upstream or downstream. Therefore, the following ratings were assigned to each potential site.

Table 4-8. Outlet Location Screening Criterion: Proximity to Pipeline Terminus

Rating	Description
Best	Less than 1,000 feet from pipeline terminus node
Satisfactory	Between 1,000 and 2,000 feet from pipeline terminus node
Unacceptable	Greater Than 2000 feet from pipeline terminus node

Evaluation Criteria

The evaluation criteria, summarized in Table 4-9, were developed with the input of the Water Agency and the Dry Creek Advisory group, and include both engineering and environmental criteria. An economic evaluation was conducted separately, as presented in Chapter 8. Some criteria are common to all elements of the Bypass Pipeline, whereas others are specific to only one element (i.e., inlet facility, pipeline alignment, or outlet facility). The criteria are described in the following subsections.

Engineering Criteria

The engineering criteria range between excellent and undesirable. Based on the specific criterion, as few as three rating categories are needed to describe the range of conditions. In some cases, the rating categories have been described separately for the various elements, such that the rating better reflects the inlet facility, alignment, and outlet facility, respectively. The engineering criteria are presented in Table 4-9.

Table 4-9. Evaluation Criteria

Inlet Facility	Pipeline Alignment	Outlet Facility
	Engineering	
Reliability	Reliability	Reliability
Constructability	Constructability	Constructability
Permitting	Permitting	Permitting
Operations	Operations	Operations
	Right of Way Acquisition	Right of Way Acquisition
Liquefaction and Hazard Potential	Liquefaction and Hazard Potential	Liquefaction and Hazard Potential
	Hydropower	River Channel Stability
	Special Crossings	
	Environmental	
Wetlands and Other Waters of the US	Wetlands and Other Waters of the US	Wetlands and Other Waters of the US
Sensitive Habitats and Species	Sensitive Habitats and Species	Sensitive Habitats and Species
Hazardous Materials	Hazardous Materials	Hazardous Materials
Cultural Resources	Cultural Resources	Cultural Resources
	Potential Loss of Trees	Water Quality and Fisheries

Reliability

Because the capacity of Dry Creek to receive flow has not been specifically determined, the flexibility of the inlet, outlet, and pipeline alternatives are important. Some alternatives have greater flexibility when it comes to handling increasing or decreasing flow capacity. A system having the ability to handle a broad range of flows is more reliable and flexible in the long term. Specific issues such as the potential for erosion and bank stability at the outlet works are addressed for each system component.

Table 4-10. Engineering Criterion: Reliability

Rating	Description
Excellent	All elements of the alternative can handle the range of flows and have the ability to enhance specific areas.
Above Average	All elements of the alternative can handle the range of flows, but have a limited ability to enhance specific areas.
Satisfactory	Elements of the alternative can dominantly cover the range of flows with no or very limited ability to enhance specific areas.
Poor	Some elements of the alternate cannot cover the range of flows.
Undesirable	Elements cannot cover the range of flows.

Constructability

Constructability is composed of several sub-criteria, including utility conflicts, tree conflicts, topography, access, excavation and dewatering. Utility conflicts consider overhead utility lines and existing or planned large-diameter utilities. Topography and access impact the construction efficiency and effort required to perform the work. The excavation required to install the facilities can be a significant work effort for all of the project elements.

Inlet Works Constructability Criteria

Interconnection with the existing temperature control structure requires significant tunneling and complex construction methods to tie the bypass pipeline to the existing stand-pipe. The head box requires limited excavation and construction of a concrete box at the ground surface. Constructability was evaluated on the complexity of construction.

Table 4-11. Engineering Criterion: Inlet Constructability

Rating	Description
Excellent	Low technology, open construction.
Satisfactory	Complex technology, underground.
Undesirable	Unusually complex construction.

Pipeline Route Constructability Criteria

Utilities - Along the pipeline route are overhead power lines, trees, plantings, and roadside improvements. Reaches of some route alternatives have water, sewer, natural gas, and fiber optic lines in parallel and crossing the proposed route. This criterion evaluates the degree of difficulty required to accommodate utilities, trees, and roadside improvements.

Table 4-12. Engineering Criterion: Utilities

Rating	Description
Excellent	Minimal existing utility conflicts. Minimal tree conflicts. Excellent topography and easy access. Minimal excavation and/or dewatering requirements.
Above Average	Minimal existing utility conflicts. Minimal tree conflicts. Good topography with some access coordination needed. Increased excavation and/or dewatering requirements.
Satisfactory	Moderate existing utility conflicts. Moderate tree conflicts. Some topography and access coordination. Increased excavation and/or dewatering requirements. Some trenchless boring required for creek crossings and to avoid wetlands or vineyards.
Poor	Significant existing utility conflicts. Significant tree conflicts. Poor topography and tight access requirements. Significant excavation and/or dewatering requirements. Some tunneling required, lengths greater than 1,000 ft.
Undesirable	Significant existing utility conflicts. Significant tree conflicts. Very poor topography requiring special construction with critical access needs. Significant excavation and/or dewatering requirements. Significant tunneling required.

Impacts to Agricultural Operations and Recreation - The Dry Creek valley contains about 9,000 acres of vineyards and 63 wineries. The harvest season is critical and adds an increased amount of traffic flow associated with transportation of crops. Throughout the year, visitors come to the area for the scenery, wine, boating, and recreational activities. Dry Creek road is a critical access route throughout the valley. Major events occur from spring through fall.

The contractor would provide traffic control and safe passage at all times with designs to minimize disruption during harvest and critical area-wide events. The following rating criteria are based on the impact to main roads and ability to provide alternative paths around the construction.

Table 4-13. Engineering Criterion: Impacts to Agricultural Operations and Recreation

Rating	Description
Excellent	Minimum interruption with construction in non-arterial routes and alternative travel options.
Satisfactory	Minimum interruption with construction within arterial traffic routes.
Undesirable	Routes that create access problems for agricultural activities and the public.

Outlet Works Constructability Criteria

Proximity to Outlet Location – The pipeline routes are all located in existing roads, however, suitable outlet locations may not exist at the intersection of the existing road and the river or creek. This criteria was established to evaluate the suitability of an outlet location in proximity to a given route. Outlet locations are effected by stream and bank stabilization and impacts the construction requirements to mitigate problems at the discharge location. Suitable outlet locations in proximity to the pipeline route are advantageous to providing access, limiting potential ROW acquisition, and improving constructability.

Table 4-14. Engineering Criterion: Outlet Constructability, Proximity to Outlet Location

Rating	Description
Excellent	Less than 100 ft from river.
Satisfactory	Between 100 and 150 feet from river.
Undesirable	More than 150 feet from river.

Access - Some outlet locations are near paved roads or roads providing industrial or commercial access. Other areas are along unpaved roads regularly used to access industry or commercial areas. Undesirable locations have access that is only through a vineyard or private residence, typically on a dirt road.

Table 4-15. Engineering Criterion: Outlet Constructability, Access

Rating	Description
Excellent	Near a high volume road in an industrial or commercial area.
Satisfactory	Near low volume road in a industrial or commercial area.
Undesirable	Only access is through a vineyard or private residence.

Floodplain - For this criterion, outlet works are either in or out of the 100-year floodplain.

Table 4-16. Engineering Criterion: Outlet Constructability, Floodplain

Rating	Description
Excellent	All of the site is out of the 100-year floodplain.
Satisfactory	Most of site is outside the 100-year floodplain.
Undesirable	Most of site is inside the 100-year floodplain.

Permitting

The discharge permitting criterion was used to identify sites with the greatest potential or significant obstacles to obtain a permit.

Based on initial discussions with the North Coast RWQCB it is not expected that the project would require an NPDES permit to discharge bypass water back to Dry Creek or the Russian River. During the meeting RWQCB staff specifically said that permits is required for stormwater discharge and Section 401 water quality certification; however, an NPDES permit is not being contemplated at this time. Staff asked for on-going communication and review of a workplan for the Engineering Report.

Construction permitting is also considered in this criterion and addresses whether a potential site is known to contain any unique conditions that would require special permitting relative to other sites. For example, a site near a bridge would have additional permitting coordination requirements with Caltrans or the agency that maintains the bridge, increasing the permitting challenge. Areas identified as having cultural resources may also have additional coordination requirements with the Office of Historic Preservation, which would similarly increase the permitting challenge.

Table 4-17. Engineering Criterion: Permitting

Rating	Description
Excellent	Low relative permitting challenge.
Satisfactory	Average relative permitting challenge.
Undesirable	Permit compliance challenge.

Permit compliance was considered to be limited and included with regular operating requirements because the RWQCB stated that an NPDES permit would not likely be required.

Operations

The pipeline and outlet works would be designed to be free from operator attention. Some maintenance would be required, but there would be no seasonal or regular operation required. The inlet options have varying degrees of operational needs based on the strategy used to create the flow split between the hatchery flows, bypass flows, and additional flow discharged to Dry Creek. Operating criteria also includes the distance from the outlet location to the Water Agency facilities as a measure of response between release and water availability.

Table 4-18. Engineering Criterion: Operations

Rating	Description
Excellent	No operator attention.
Satisfactory	Seasonal operator attention to adjust weirs, valves, or gates.
Undesirable	Frequent attention to adjust weirs, valves, or gates.

Right of Way Acquisition

Right of way (ROW) acquisition can add a significant amount of time, complexity, and cost to the project. Construction in an existing ROW is always preferred over ROW acquisition. It is expected that some ROW acquisition is required for all alternatives. Sites requiring the acquisition of fewer ROW are preferred. For direct discharge, some sites would require an easement on only one parcel to accommodate facilities, whereas other sites might require several property easements. Sonoma County Assessors Parcel maps were used to identify potentially affected parcels.

Table 4-19. Engineering Criterion: Right of Way Acquisition

Rating	Description
Excellent	Public ROW with sufficient area or width (40 feet minimum) available.
Above Average	Mostly public ROW with sufficient width (40 feet minimum) available, temporary/permanent local easements required at limited locations (≤ 20% of the pipeline alignment).
Satisfactory	Mostly public ROW but with limited or restricted width, private easements required along alignment, (≤ 40% of the pipeline alignment).
Poor	Limited access to public ROW. Significant private easements required (>40% and ≤ 50% of the pipeline alignment).
Undesirable	Very limited access to public or utility-owned ROW. Multiple private easements required (>50% of the pipeline alignment).

Liquefaction and Seismic Hazard Potential

This criterion was used to assess the likelihood that a prospective site would experience liquefaction during a seismic event, which could cause significant damage to the facility.

Earthquakes can cause soil movement when soils are saturated with groundwater. As soils become unstable, they cannot support forces in the pipe or support infrastructure built along the slopes next to the river. Liquefaction maps for the Dry Creek and Russian River area are available from U.S. Geological Survey (USGS) OFR 00-444 (Knudsen et al., 2000) and USGS OFR 06-1037 (Witter et al., 2006). USGS classifications of liquefaction are very high, high, moderate, and low. In general, all of the soils on or near the river have a high potential of liquefaction.

Table 4-20. Engineering Criterion: Liquefaction and Seismic Hazard Potential

Rating	Description
Excellent	No or minimal apparent seismic, landslide, or erosion hazards exist along the pipeline route or at the discharge location (low USGS classification).
Satisfactory	A moderate portion of the pipeline route has one or more seismic/landslide/erosion hazards and requires some piling, stabilization, or remediation effort to mitigate (moderate USGS classification).
Undesirable	A more than significant portion of the pipeline route has multiple seismic/landslide/erosion hazards and requires extensive piling, stabilization, or remediation effort to mitigate (high and very high USGS classifications).

Hydropower

Hydropower can be obtained from the existing generator discharging through the outlet structure or through a new turbine generator on the bypass pipeline. Power generation varies with the flow demand and the split between flow through Dry Creek and the bypass pipeline.

Hydropower capacity is based on the remaining hydraulic head available to generate hydropower and the flow through the generator. Flows vary depending on the amount of flow discharged to Dry Creek versus the flow to be bypassed.

Table 4-21. Engineering Criterion: Hydropower

Rating	Description
Excellent	Use of the existing generator up to its maximum capacity.
Satisfactory	Installation of a new generator and use up to its maximum capacity.
Undesirable	Two generators and a flow split that does not maximize the capacity of the generators.

Special Crossings

Crossings of state highways or multi-lane streets, railroads, and waterways and wetlands may require trenchless construction, piling supports, or other engineering solutions. "Difficult" crossings may be considered to be those with deep/long borings, high groundwater conditions, or difficult soil conditions.

Table 4-22. Engineering Criterion: Special Crossings

Rating	Description
Excellent	<4 special crossings along the pipeline route; none are considered difficult. No state highway or railroad crossings.
Above Average	4 - 8 special crossings along the pipeline route; less than 3 may be considered difficult. No state highway or railroad crossings.
Satisfactory	6 -10 special crossings along the pipeline route; 3 – 4 may be considered difficult. No state highway or railroad crossings.
Poor	8 - 12 special crossings along the pipeline route; 4 - 5 may be considered difficult.
Undesirable	More than 12 special crossings along the pipeline route; 5 or more may be considered difficult.

River Channel Stability

River stability includes the evaluation of bank stability, degree of meander and potential for scour. Relevant data were collected during recent field investigations, through historical aerial photography, and by GIS evaluation. Together, these three criteria provide a good indication of the stability of a river and suitability for an outlet facility.

Bank Stability - Bank stability is considered to be the potential for a riverbank to erode or experience undercutting over time. Factors affecting bank stability are vegetation, angle of bank inclination, and location of the primary river on the inside or outside of the bend. Increased vegetation generally increases stability. Angles of inclination for banks should be relatively low unless comprised mostly bedrock. Banks on the outside of a bend are generally less stable because of higher shear velocities.

Table 4-23. Engineering Criterion: River Channel Stability for Bank Stability

Rating	Description
Excellent	High degree of riverbank stability.
Satisfactory	Less stable to slightly eroding bank requiring more engineering stabilization.
Undesirable	Eroding bank.

Meander - The degree of meander, or the meander envelope, is assessed based on the degree to which the low-flow river moves within a wider river over time. These criteria are important because facilities located in reaches of the river with a high potential for scour or erosion, or a high potential for the river to move away from its current location, have a great likelihood of failure. The change in meander of the river has been traced and summarized for the past 65 years for the Russian River and for the past 40 years for Dry Creek, through a series of aerial photographs and topographic maps. Meander was categorized as low, moderate, and high, with high indicating the greatest likelihood of the river to move based on the historic record.

Table 4-24. Engineering Criterion: River Channel Stability for Meander

Rating	Description
Excellent	Low degree of river meander.
Satisfactory	Modest meander that would not impact the discharge works.
Undesirable	High degree of meander that would require stabilization and maintenance.

Scour - Scour is the removal of material from the bed and banks of a river by stream flow. It can be affected by many factors, including changes in hydrologic conditions, engineered structures such as bridges or riprap, the curvature or sinuosity of the stream, river width, the presence of point bars, gradient, and the strength of the geologic materials in which the stream flows.

Table 4-25. Engineering Criterion: River Channel Stability for Scour

Rating	Description
Excellent	Low scour potential.
Satisfactory	Moderate scour potential.
Undesirable	High scour potential.

Environmental Criteria

Environmental criteria have been defined using a scale ranging from excellent to undesirable. It is expected that the evaluation of environmental impacts would be further developed during the CEQA process.

Wetlands and Other Waters of the U.S.

Waters of the U.S. include streams (including intermittent streams) and wetlands. Construction in waters of the U.S. requires permitting and mitigation. Sites or routes having streams and/or wetlands is less desirable if other sites or route alternatives are available.

The U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps were used to estimate the acreage of streams and wetlands for the various alternatives. USGS 7.5 minute quadrangle maps were used to estimate the acreage of streams, including blue-line streams that would be potentially affected.

Table 4-26. Environmental Criterion: Wetlands and Other Waters of the U.S.

Rating	Description
Excellent	No wetlands or streams.
Satisfactory	Minor or temporary impacts to wetlands and streams.
Undesirable	Permanent impacts to wetlands and streams.

Sensitive Habitats and Species

Construction in areas with protected habitat and sensitive plant and animal species requires additional permitting and sometimes significant mitigation. Sites and pipeline routes with sensitive habitat and species were identified using the California Natural Diversity Database (CNDDB) developed by the Department of Fish and Game (CDFG). The primary function of the CNDDB is to gather information on the status of rare and endangered plants, animals, and vegetation types. The database is intended to provide the most current information available to the government agencies, the private sector, and conservation groups in order to promote better-informed land-use decisions.

The CNDDB is an ongoing and continuously updated database; however, it does not constitute an official response from any state agency and will not in itself meet the requirements of the California Endangered Species Act. It should also be noted that absence of data in the CNDDB does not constitute the basis for a negative declaration.

Sensitive habitat and species that are likely to occur in the project area were also identified using the USFWS's Sacramento Fish and Wildlife Office website and CDFG's Special Animals List and Special Plant List.

Table 4-27. Environmental Criterion: Sensitive Habitats and Species

Rating	Description
Excellent	No protected habitat and/or sensitive species present.
Satisfactory	Potential protected habitat and/or sensitive species may be present.
Undesirable	Protected habitat and/or sensitive species present.

Hazardous Materials

Construction through areas where hazardous materials are present requires the removal and disposal of the materials prior to construction and could invoke additional permitting requirements and significant schedule delays. A hazardous waste assessment was conducted to identify Recognized Environmental Conditions (RECs) or Notable Findings with the potential to negatively impact environmental conditions at a given location. As defined by the American Society of Testing and Materials (ASTM) E 1527-05 for the performance of a Phase I ESA, a REC is "the presence or likely presence of any hazardous substance or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substance or petroleum products into the structure, on the property, or into the ground, groundwater, or surface water of the property."

Alternatives were evaluated according the ratings presented below.

Table 4-28. Environmental Criterion: Hazardous Materials

Rating	Description
Excellent	No known hazardous materials. Previous hazardous materials are cleaned up or isolated.
Satisfactory	Past or present hazardous material likely near project location.
Undesirable	Significant hazardous materials/large near project location.

Cultural Resources

The presence of cultural materials and artifacts may slow construction and require the investigation and relocation of artifacts prior to and during construction. Sites with identified cultural resources would require coordination with the State Office of Historical Preservation and possibly county agencies. This could bring into play additional construction requirements and significant schedule delays.

A focused records search was conducted of the North Central Information Center of the California Historical Resources Information System.

Table 4-29. Environmental Criterion: Cultural Resources

Rating	Description
Excellent	No resources within area of potential effect.
Satisfactory	Resources within area of potential effect not likely to be affected.
Undesirable	Resources within area of potential effect likely to be affected.

Potential Loss of Trees

Construction may require tree removal because of route limitations. Construction within the "drip line" (diameter of the canopy) has the potential of damaging the tree. The tree may go into shock because of the loss of root system or become susceptible to tipping over in high winds. Final determination of the pipeline route and impact to trees would be evaluated by a local arborist. For the purpose of evaluation, the linear footage of pipe to be constructed within the canopy was estimated using high resolution aerial photos and field survey.

Table 4-30. Environmental Criterion: Potential Loss of Trees

Rating	Description
Excellent	Limited need for tree removal and/or proximity of pipeline construction within the tree drip line.
Satisfactory	Some need for tree removal and/or proximity of pipeline construction within the tree drip line.
Undesirable	Significant need for tree removal and/or proximity of pipeline construction within the tree drip line.

Water Quality and Fisheries

The most significant issues associated with the bypass pipeline and release of bypassed water back to Dry Creek or the Russian River are those associated with water quality. Key water quality criteria to consider include temperature, dissolved oxygen (DO), turbidity, and river morphology/ velocity.

Temperature and DO – Summer water temperatures at the discharge of the pipeline will be colder than the water that travels through the hatchery and along Dry Creek and colder than the water in the Russian River. DO at the discharge of the pipeline may be less that the DO in Dry Creek or the Russian River discharge. Natural or mechanical aeration may be required to increase the DO to a point equal to or above the DO in the river. Natural increase is DO is preferred over mechanical means for increasing the DO. Temperature and DO impacts to the Russian River will be studied in more detail in the Engineering Report that follows this study. For purposes of this study, the following criteria are used to help rank the options.

Table 4-31. Environmental Criterion: Water Quality and Fisheries, Temperature and DO

Rating	Description
Excellent	Ability to provide DO levels at or near saturation by natural means, no increase in temperature.
Satisfactory	Ability to meet or exceed ambient DO levels by natural means and meet temperature requirements.
Undesirable	Mechanical means necessary to meet DO requirements or increases in temperature > 65^{o}F due to diversion discharge.

Turbidity – During certain times of the year, during turnover of the lake, the turbidity of the water in the bypass pipeline may be greater than the turbidity in the River. In addition, scour at the outlet may create turbid conditions at the point of discharge. Scour and natural lake turbidity impacts at the discharge location will be studied in more detail in the Engineering Report. For purposes of this study, the following criteria are used to help rank the options.

Table 4-32. Environmental Criterion: Water Quality and Fisheries, Turbidity

Rating	Description
Excellent	Low likelihood of discharge containing or increasing turbidity.
Satisfactory	Some risk of increased minor movement of fines but increase is not significant.
Undesirable	Increases in turbidity and gravel movement that potentially impact fisheries.

River morphology – Discharge volumes/velocities that can affect banks and the river bottom could be harmful to fish habitats, especially to habitat attributes such as substrate composition and integrity of critical habitat. Velocities greater than 8 feet per second (ft/s) form impediments to adult migration. The design of the discharge facility would address maximum velocities and available area for fish passage.

Table 4-33. Environmental Criterion: Water Quality and Fisheries, River Morphology

Rating	Description
Excellent	River velocities less than 2 ft/s
Satisfactory	River velocities less than between 2 and 4 ft/s.
Undesirable	River velocities greater than 4 ft/s.

Chapter 5 - Facilities Screening

This chapter presents a summary of the screening analyses for the inlet works, pipeline alignments, and the outlet locations. This chapter also describes the analysis conducted to determine the preferred location of a hydropower facility for each route.

Inlet Screening

As described in Chapter 3 and as shown in Figure 3-1, four inlet facility options were identified, including:

- Option 1, Head Box Adjacent to the Stilling Basin
- Option 2, Siphon Over the Existing Dam
- Option 3, New Outlet Works through Left Abutment
- Option 4, Integrated Facility – New Corps Tunnel to Existing Control Structure

The results of the screening analysis based on the criteria presented in the previous chapter are summarized in Table 5-1, and are described below.

Table 5-1. Inlet Works Screening Results Summary

Option	Design & Construction	Facility Operability
Option 1 Head Box Adjacent to Stilling basin	Satisfactory	Satisfactory
Option 2 Siphon Over Existing Dam	Unacceptable	Unacceptable
Option 3 New Tunnel Through Left Abutment	Unacceptable, with exception	Satisfactory
Option 4 Integrated Facility	Satisfactory	Satisfactory

Note: Screening criteria were evaluated as satisfactory or unacceptable.
Detailed evaluation is contained in the technical memorandum: *Draft Screening Results for Inlet Works, Pipeline Route, and Outlet Works*

Inlet Option 1 (Figure 3-2) is satisfactory for both design and construction and facility operability criteria. Inlet Option 2, siphon over the existing dam, has a design constraint due to the excessive elevation difference between the water surface elevation of Lake Sonoma and the crest of WSD; therefore it was determined to be unacceptable.

Inlet Option 3, new tunnel through left abutment, requires unacceptable construction challenges unless significant geotechnical work is conducted to evaluate conditions to ensure that construction of a new tunnel would not adversely impact the existing WSD structure. The *Final Engineering Report*, dated September 2006, prepared by the Corps, indicates that construction in the left abutment may influence the structural integrity of the dam and the geotechnical implications of completing a new tunnel need to be thoroughly investigated before this option can be considered feasible. At this point, the alternative represents an unacceptable risk unless significant additional geotechnical work is performed to confirm that construction mitigation measures are viable. This option is further challenged because the intake structure would need to be constructed below the water surface elevation of the reservoir, which would require either lowering the water level during construction or construction of a coffer dam and site dewatering. While this is a common construction technique, it is difficult and greatly exceeds the requirements of the other alternatives.

Inlet Option 4, the integrated facility with the Corps, is one of two options being evaluated by the Corps. The Corps may construct a pump system that would have only sufficient capacity to provide an emergency water supply and cannot be integrated with the bypass pipeline. The Corps alternative using a tunnel and a 72" pipeline connection to the control structure provides sufficient capacity for an integrated facility providing water for the hatchery and the bypass pipeline. The integrated facility is satisfactory for both design/construction and facility operability. It would require that the Corps proceed with construction of the emergency water supply pipeline as part of an integrated facility with the bypass pipeline requirements. The BO requires that the Corps provide a reliable emergency water supply for the hatchery and the current Corps plan is to construct a new tunnel with a pipeline into the existing control structure (Figure 3-3).

The Water Agency could pursue a tunnel and connection to the control structure without financial support from the Corps. However, this represents a significant risk to the Water Agency for: 1) construction related problems including damage to the dam and control structure; 2) environmental and permitting requirements that is shared with the Corps as the permitting agency; 3) construction cost risk for the entire project; and 4) Water Agency responsibility for all of the cost. Therefore, it is not advised that the Water Agency pursue the tunnel and connection within the control structure without partnering with the Corps.

Alignment Screening Results

For each combination of alignment and inlet facility, a preliminary hydraulic grade line (HGL) was developed using the Hazen-Williams formula and assuming a flow rate of 180 cfs in a 72-inch diameter pipeline, with a pipe roughness coefficient of 130. The HGLs were compared to the ground profile for each respective alignment to identify unacceptable conditions, such as a final hydraulic head less than the water surface elevation of the receiving water body, and to identify locations where trenchless installation or an alternate alignment would be required. The alignment screening results are summarized for each of the routes below.

Northern Route

The alignment in Dutcher Creek Road would require the integrated inlet in order to have sufficient hydraulic head to minimize tunneling at the Dutcher Creek Road summit. This option was eliminated due to the complexity and technical infeasibility of tunneling and constructability issues when compared with the Canyon Road alignment.

The direct route alignment would require the integrated inlet in order to have sufficient hydraulic head to discharge at the Russian River and 13,000 to 15,000 feet of hard rock tunneling. Geologic mapping indicates that the tunnel would be through Franciscan and Knoxville Formations characterized by consolidated sandstone, shale, and metamorphosed sedimentary and igneous rocks. The alignment was not considered further due to the construction risk and complexity associated with hard rock tunneling, liner installation, and difficult topography at the tunnel entrance.

Table 5-2. Alignment Options Screening Results Summary

Alignment Options	Length	Topography		Hydropower Location
		Head Box Inlet [a]	Integrated Facility Inlet [b]	
Northern Route, WSD to the Russian River near Geyserville and Cloverdale				
Dry Creek Road to Dutcher Creek Road via Theresa	Unacceptable	Unacceptable[c]	Unacceptable[c]	No Hydro
Dry Creek Road to Dutcher Creek Road via Asti	Satisfactory	Unacceptable[c]	Unacceptable[c]	No Hydro
Dry Creek Road to Canyon Road via Black	Satisfactory	Unacceptable[c]	Satisfactory	Near Outlet
Dry Creek Road to Canyon Road via Hwy 128	Satisfactory	Unacceptable[c]	Satisfactory	Near Outlet
Direct Tunnel	Satisfactory	Unacceptable[c]	Unacceptable[c]	No Hydro
Central Route, Warms Springs Dam to the Confluence Area of the Russian River and Dry Creek				
Dry Creek Road to Kinley Road	Satisfactory	Conditionally Satisfactory[d]	Satisfactory	At Dam
East DC Access Road	Satisfactory	Satisfactory	Satisfactory	At Dam
West Dry Creek Road	Satisfactory	Conditionally Satisfactory[d]	Satisfactory	At Dam
West DC Access Road	Satisfactory	Satisfactory	Satisfactory	At Dam
Southern Route, Warms Springs Dam to the Water Agency's Facilities in the Mirabel/Wohler Area				
West Dry Creek Road to Westside Road	Satisfactory	Conditionally Satisfactory[d]	Satisfactory	At Dam
West DC Access Road to Westside Road	Satisfactory	Satisfactory	Satisfactory	At Dam

(a) Initial water surface elevation limited to 220 feet.
(b) Maximum initial water surface elevation is 400 feet for Northern Route and 250 feet for the Central and Southern Routes to accommodate power generation at the dam.
(c) Requires hard rock tunneling.
(d) Requires alternate installation methods or alternate segments in agricultural access roads.

The alignment in Canyon Road is only feasible when combined with the integrated facility inlet option. Other scenarios were eliminated due to the complexity of tunneling or the need to pump the entire bypass flow over the summit.

Central Route

Four alignments, and two alternate alignments, were developed for the Central Route, including:

- **Dry Creek Road.** Two alignments were developed for Dry Creek Road. The first is an alignment completely within the existing road which, due to topography, would require trenchless pipe installation at three locations if combined with the head box inlet. The second alignment (i.e., alternate alignment), considered only for the head box inlet, would be constructed mostly in the road, except for three locations, at which the alignment would follow access roads in adjacent agricultural property to avoid high elevation locations.

- **East DC Access Road.** This alignment, which follows the agricultural access road on the east side of Dry Creek, is feasible based on the screening criteria considered.
- **West DC Access Road.** This optimized alignment generally follows the agricultural access road on the west side of Dry Creek, and is feasible based on the screening criteria considered.
- **West Dry Creek Road.** Two alignments were developed for West Dry Creek Road. The first is an alignment completely within the existing road, which would require trenchless installation at one location if combined with the head box inlet. The second alignment (i.e., alternate alignment), considered only for the head box inlet, would leave West Dry Creek Road at one location where the required bury depth exceeds 15 feet for more than 1,000 feet.

Southern Route

This route is essentially an extension of the alignments on the west side of Dry Creek, which follows Westside Road down to the Water Agency's facility at Mirabel. This route would require tunneling at an additional seven locations if combined with the head box inlet. Despite the satisfactory ratings, as described in Chapter 3, the Southern Route was eliminated due to the inability to discharge the required bypass flow range into the ponds at Mirabel (as described in the next section).

Outlet Screening

Both outlet location and outlet facility type were screened to identify feasible options. These analyses are described in the following subsections.

Outlet Location

The screening process identified multiple suitable outlet sites at each general outlet location.

- **Upper Russian River** sites within 2,000 feet from the pipeline termination node were evaluated; however since there is no available access roads along the river, sites beyond 1,000 feet from the pipeline termination node were considered undesirable. The screening process identified two reaches on the upper Russian River for further evaluation:
  - near the extension of Canyon Road, and
  - near the Geyserville Bridge (Hwy 128).
- **Lower Russian River** short list reaches represent locations within 2,000 feet of a pipeline termination node and within 3 miles of the confluence with Dry

Creek. The screening process identified two reaches on the lower Russian River for further evaluation:

- near the Hwy 101 Bridge, and
- near the confluence with Dry Creek. There are no sites identified below this reach.

- **Lower Dry Creek** short list reaches represent locations within 2,000 feet of a pipeline termination node and within 3 miles of the confluence with the Russian River. The screening process identified four short list reaches on Dry Creek, from just above Westside Road Bridge to the confluence with the Russian River, and two short list reaches on Norton Slough, a tributary to Dry Creek, for further evaluation:
  - near Westside Road Bridge,
  - near Magnolia Drive,
  - near Mill Creek, and
  - near the confluence with the Russian River,
  - near Kinley Drive, and
  - near the confluence with Dry Creek.
- **Southern Route (Water Agency Facilities).** It was agreed that a discharge near the confluence of Dry Creek and the Russian River was preferred to downstream locations at, or in close proximity to the Water Agency's facilities because recharge of significant quantity of water discharged from the bypass pipeline, within a localized area and through the riverbed aquifer is not feasible because of spatial and time constraints. The water must be allowed to recharge the aquifer over a large area to provide sufficient natural filtration and allow for efficient extraction at the Water Agency's facilities downstream of the area which recharge occurs along the riverbed. Therefore, the Southern Route was not carried forward for this analysis.

Table 5-3 lists the potential discharge reaches identified for each pipeline alignment and associated with each pipeline termination node. In addition, the suitable discharge sites are illustrated in Figures 3-5 and 3-6.

Outlet Facility Screening

Hydraulic and water quality modeling will be performed in a subsequent study (Project Engineering Report) for the preferred alternative(s) and associated discharge locations. Therefore, while a preliminary evaluation of the outlet facility is presented here, the results will be revisited and updated in the subsequent study, at which time the preferred outlet facility type will be identified. The purpose of presenting the information contained in the following subsections is to provide a basis for evaluating alternatives and developing project costs.

Table 5-3. Summary of Outlet Location Screening Results

Discharge Reach	Pipeline Alignment	Outlet Location	
		Short List Reach Description	Pipeline Termination Node
Upper Russian River	Canyon Road	Near Canyon Road	RR_1
		Near Geyserville Bridge	RR_2
Lower Russian River	Dry Creek Road or East DC Access Road	Hwy 101 Bridge	RR_3
		Confluence of Dry Creek and Russian River	RR_4
	Westside Road or West DC Access Road	Confluence of Dry Creek and Russian River	RR_5
Dry Creek	Westside Road	Westside Rd Bridge	DC_W1
		Mill Creek Confluence	DC_W2
		Confluence of Dry Creek and Russian River	RR_5
	West DC Access Road	Westside Rd Bridge	DC_W1
		Mill Creek Confluence	DC_W2
		Confluence of Dry Creek and Russian River	RR_5
	East DC Access Road	Westside Rd Bridge	DC_E1
		Upper Norton Slough	NS_1
		Magnolia Drive	DC_E2
		Mill Creek Confluence	DC_E3
		Lower Norton Slough	DC_E3
		Hwy 101 Bridge	RR_3
		Confluence of Dry Creek and Russian River	RR_4
	Dry Creek Road	Westside Rd Bridge	DC_E1
		Norton Slough	NS_1
		Magnolia Drive	DC_E2
		Mill Creek Confluence	DC_E3
		Lower Norton Slough	DC_E3
		Hwy 101 Bridge	RR_3
		Confluence of Dry Creek and Russian River	RR_4

Discharge Design Capacity and Velocity

As described in Chapter 2, the facilities must be capable of bypassing a range of flowrates: 80 cfs, 100 cfs and 180 cfs. Most of the outlet facility configurations presented may be modified to discharge this range of flows. Typically, there are not significant cost savings between the 80 cfs and 180 cfs facilities as the site work and primary facilities are comparable.

The velocity of the discharge is correlated with the discharge flow and the type of outlet facility. Higher flows typically result in higher velocities; however, some discharge facilities provide more energy dissipation, which would result in lower velocities. The affect of an outlet facility on in-stream velocity would depend significantly on location, particularly on whether a site is on the Russian River or Dry Creek.

Fisheries Considerations

A preliminary assessment of the potential impact of each type of outlet facility type on fisheries and habitat was performed. Fishery considerations include an assessment of the potential impact of the outlet facility based on the following criteria:

- Dissolved Oxygen (DO) – ability to naturally raise the DO to match the DO in the receiving water,
- Temperature – creation of concentrated coldwater zone,
- Erosion – erosion of the bank or river bottom and subsequent increase turbidity and suspended solids,
- Predator Habitat – increase or decrease in predator habitat
- Bank Habitat – improve or deteriorate river and bank associated habitat,
- River Dynamics – changes to local river hydraulics that positively or adversely affect habitat
- Construction – temporary and permanent footprint and intensity of construction within the river.

This assessment is generic in nature, as fishery considerations vary significantly between sites, particularly on whether a site is on the Russian River or Dry Creek. Hydraulic and water quality modeling will be performed as part of the Project Engineering Report to address these issues in more detail for the preferred alternative(s) and associated discharge.

A summary of the preliminary assessment of each outlet facility type with respect to fisheries considerations is provided in Table 5-4.

Outlet Screening Results

Table 5-5 summarizes the advantages and disadvantages of the evaluated outlet facility options for the bypass pipeline based on engineering considerations such as cost, operations, mixing, water quality, aesthetics, and scour potential.

Table 5-6 provides a qualitative rating of each outlet facility based on the engineering and fishery assessments of each type of outlet facilities, described in Table 5-4 and Table 5-5, respectively, and as shown in Figures 3-7, 3-8 and 3-9.

Table 5-4. Summary of Outlet Facilities Assessment Regarding Fisheries Criteria

The potential impact of the outlet facility:	**Dissolved Oxygen** *To improve dissolved oxygen concentrations in receiving water*	**Temperature** *To create concentrated coldwater zone*	**Erosion** *To erode bank or river bottom*	**Predator Habitat** *To provide predator habitat*	**Bank Habitat** *To adversely affect structural river/bank habitat*	**River Dynamics** *To modify river local hydraulics that adversely affect habitat*	**Construction** *On temporary and permanent footprint and intensity of construction within river*
Riverbank Outfalls							
Riprap River Riverbank Outfall	Maximum aeration opportunity	Provides moderate mixing	Minimal risk of bank failure, erosion	No in stream structure to attract predators, however concentrated/confined discharge has moderate risk of providing predator habitat	Restoration/mitigation required for area constructed over bank/riparian area. River has potential to create new habitat.	Modest changes potential in discharge zone	Minimal area within river is disturbed during construction. Riparian and bank is affected during construction.
Concrete Chute Riverbank Outfall	Maximum aeration opportunity	Provides moderate mixing	Minimal risk of bank failure, dissipated discharge	No in stream structure to attract predators, however concentrated/confined discharge has moderate risk of providing predator habitat	Restoration/mitigation required for area constructed over bank/riparian area.	Modest changes potential in discharge zone	Minimal area within river is disturbed during construction. Riparian and bank is affected during construction.
Screened Riverbank Outfall	Maximum aeration opportunity	Provides moderate mixing	Minimal risk to bank failure, erosion	Small in stream structure to attract predators, however concentrated/confined discharge has moderate risk of providing predator habitat	Restoration/mitigation required for area constructed over bank/riparian area.	Modest changes potential in discharge zone	Minor, but some area within river is disturbed during construction. Riparian and bank is affected during construction.
In-River Diffusers							
Typical In-River Diffuser Installation	The temperature and oxygen characteristics of flow entering a diffuser remain unchanged at discharge	Near optimal mixing	Risk of fluidizing the alluvium dependent upon design	Some potential attraction to areas of cooler temperature	Minimal risk of adverse effect	Minimal risk potentially restricted to design flaws	Some in stream and bank impact during construction during several critical life stage periods
Microtunnel In-River Diffuser Installation	The temperature and oxygen characteristics of flow entering a diffuser remain unchanged at discharge	Near optimal mixing	Risk of fluidizing the alluvium dependent upon design	Some potential attraction to areas of cooler temperature	Minimal risk of adverse effect	Minimal risk potentially restricted to design flaws	Risk of impacts minimized by subsurface excavation

Table 5-4. (con't) Summary of Outlet Facilities Assessment Regarding Fisheries Criteria

The potential impact of the outlet facility:	**Dissolved Oxygen** *To improve dissolved oxygen concentrations in receiving water*	**Temperature** *To create concentrated coldwater zone*	**Erosion** *To erode bank or river bottom*	**Predator Habitat** *To provide predator habitat*	**Bank Habitat** *To adversely affect structural river/bank habitat*	**River Dynamics** *To modify river local hydraulics that adversely affect habitat*	**Construction** *On temporary and permanent footprint and intensity of construction within river*
Bridge Pier In-River Diffuser Installation	The temperature and oxygen characteristics of flow entering a diffuser remain unchanged at discharge	Near optimal mixing	Risk of fluidizing the alluvium dependent upon design	Some potential attraction to areas of cooler temperature and any substrate-surface associated alterations	Minimal risk of adverse effect	Minimal risk potentially restricted to design flaws	Risk of impacts to bank and riparian areas is minimized by integrating structure with a bridge; however instream impact during construction
In-Bed Diffusers							
In-Bed Diffusers	Opportunity for increased aeration (relative to in-river diffuser).	Maximum mixing opportunity	Risk of fluidizing the alluvium dependent upon design	No perceived risk of enhancing predation	Risk of fluidizing the alluvium dependent upon design	No perceived change in hydraulics that would influence habitat - well dissipated discharge.	Primary effect to bank, or non-riverine areas.
Radial Injection Well	Opportunity for increased aeration (relative to in-river diffuser).	Maximum mixing opportunity	Risk of fluidizing the alluvium dependent upon design	No perceived risk of enhancing predation	Minor perceived risk of fluidizing the alluvium dependent upon design and no structures extending into riverine environment	No perceived changes in local hydrology that would affect habitat conditions	High level of disturbance of bank and riverine areas during construction.
In-Bank Diffusers							
In-Bank Diffusers	Opportunity for increased aeration (relative to in-river diffuser).	.	No perceived effect on erosion on bank or in river.	No perceived concentration of conditions to enhance predator habitat.	Project footprint can cover/remove riparian/bank habitats.	No perceived changes in local hydrology that would affect habitat conditions	Primary effect to bank, or non-riverine areas.

Table 5-5. Summary of Advantages and Disadvantages of Direct Discharge Facilities

Type of Facility	Advantages	Disadvantages
Riverbank Outfalls		
Riprap River Riverbank Outfall	Lowest construction costs, variable oxygenation of discharge, low potential to impact turbidity.	High visibility, limited mixing and dilution as the discharge "attaches" to the bank, potential for slope undercutting, subsidence, and collapse on the downstream side, public safety issues and potential for vandalism.
Concrete Chute Riverbank Outfall	Low capital costs, variable oxygenation at discharge, low potential to impact turbidity, increased dilution and mixing, increased bank stability, few public safety issues.	High visibility, limited mixing and dilution as the discharge "attaches" to the bank.
Screened Riverbank Outfall	Low capital costs, variable oxygenation at discharge, increased dilution and mixing, increased bank stability, few public safety issues, less visible.	Limited mixing and dilution as the discharge "attaches" to the bank, some potential to increase turbidity during startup.
In-River Diffusers		
Typical In-River Diffuser Installation	Enhanced mixing and dilution, low visibility.	High capital costs, requires significant dewatering and in-river construction, potential for scour for below-riverbed diffusers or potential for damage for above-riverbed diffusers, potential to increase turbidity during startup, permitting challenges.
Microtunnel In-River Diffuser Installation	Enhanced mixing and dilution, low visibility, reduced in-water work, minimized environmental disruption.	High capital costs, potential for scour for below-riverbed diffusers, or potential for damage for above-riverbed diffusers, potential to increase turbidity during startup, permitting challenges.
Bridge Pier In-River Diffuser Installation	Enhanced mixing and dilution, added stability, low visibility, reduced in-water work, minimized environmental disruption.	High capital costs, potential for scour for below-riverbed diffusers, or potential for damage for above-riverbed diffusers, potential to increase turbidity during startup, requires Caltrans or County permission.
In-Bed Diffusers		
Without Engineered Backfill	Diffusers are not exposed, less potential for scour or damage from river traffic, low visibility, lateral fluid spread through bed, no affect on bank stability	High capital costs, mixing over longer river distance, potential for bed fluidization, potential to increase turbidity during startup, longer diffuser length required without engineered backfill, difficult to measure long-term performance, permitting challenges.
With Engineered Backfill	Diffusers are not exposed, less potential for scour or damage from river traffic, low visibility, greater lateral fluid spread and shorter length with engineered backfill, no affect on bank stability	High capital costs, mixing over longer river distance, potential for bed fluidization, potential to increase turbidity during startup, difficult to measure long-term performance, permitting challenges.
Radial Injection Well (Reverse Ranney Well)	Diffusers are not exposed, less potential for scour or damage from river traffic, low visibility, lateral fluid spread through bed, no affect on bank stability	High capital costs, mixing over longer river distance, potential for bed fluidization, potential to increase turbidity during startup, longer diffuser length required without engineered backfill, difficult to measure long-term performance, permitting challenges. Maximum flow capacity is 30 cfs.
In-Bank Diffusers		
Typical In-Bank Diffusers Installation	Bed fluidization issues avoided, higher flow per unit length, shorter diffuser distance, enhanced bank stability, more confidence estimating long-term performance, less potential for river-traffic damage, low visibility.	High capital costs, requires bank section with riprap or needing riprap protection, potential to increase turbidity during startup, mixing over longer river distance, early season discharge may be visible and induce erosion on bank, permitting challenges.

Table 5-6. Outlet Facilities Screening Results

Outlet Facility	Engineering Criteria	Fisheries Criteria
Riverbank Outfalls		
Riprap River Riverbank Outfall	Excellent	Satisfactory
Concrete Chute Riverbank Outfall	Excellent	Poor
Screened	Excellent	Excellent
In-River Diffusers		
Typical In-River Diffuser Installation	Satisfactory	Satisfactory
Microtunnel In-River Diffuser Installation	Satisfactory	Satisfactory
Bridge Pier In-River Diffuser Installation	Satisfactory	Satisfactory
In-Bed Diffusers		
Without Engineered Backfill	Poor	Excellent
With Engineered Backfill	Poor	Excellent
In-Bank Diffusers		
Typical In-Bank Diffusers Installation	Poor	Excellent

Riverbank outfalls are ranked excellent for engineering criteria (design and construction), but the concrete chute is ranked poor under the fisheries criteria and ranked satisfactory for the riprap type outfalls. Only the screened riverbank outfall received excellent rankings for both engineering and fisheries criteria. Riverbank outfalls are suitable for most sites, though some may require restoration and/or mitigation depending on bank stability.

In-river diffusers are ranked satisfactory for engineering criteria and satisfactory for fisheries criteria. The in-river diffusers offer better mixing and less visual impact at a higher cost with more complex operational requirements. In-river diffusers may not be suitable at sites where there is significant meander in the river or where water levels are low at certain times of the year.

Radial injection wells were evaluated during the screening process and were determined not to have sufficient capacity to meet the proposed range of flows (80 to 180 cfs).

In-bank diffusers have similar advantages and disadvantages to the in-river diffusers but, have a greater cost with more complex operational requirements. In-bed and in-bank diffusers are highly dependent on site conditions, require a significant length of river bank, and have a higher potential for increasing turbidity due to fluidization of bed and bank sediments.

For the purposes of developing and evaluating the feasibility of the various alternatives, the screened riverbank outfall was used. The riverbank outfall was the only outlet facility ranked excellent for both engineering and fisheries criteria. It is also the most site-adaptable given the geology and topographic conditions. Once a specific site is identified as the most feasible, a subsequent study, the Engineering Report, will continue the evaluation of outfall types during the evaluation of discharge impacts to the river.

Hydropower Location

Hydropower generation would be a secondary facility of the Dry Creek Bypass Pipeline project. However, the Water Agency is committed to become Carbon Neutral, and new hydropower presents an opportunity to produce clean carbon-free power. The Dry Creek Bypass Pipeline Project could also benefit financially from revenues from power sales to offset facility costs.

Hydropower is currently generated at WSD using the existing generator and discharging through the outlet structure. Construction of a new hydropower generation facility that requires decommissioning the existing generator in WSD would only be beneficial for the Water Agency if the new facility produced substantially more power.

Opportunities for power generation vary based on the combination of inlet facility, pipeline alignment, and outlet location because power generation is the result of residual hydraulic head available after head losses. A preliminary analysis of hydropower generation was performed to determine the preferred location, whether upstream at the inlet or downstream near the outlet, for a new hydropower facility. The analysis was based on two cases for the inlet facility:

- Head Box Inlet. Alternatives with the head box inlet could either continue to use the existing hydropower facility at WSD or could include a new hydropower facility near the outlet. Initial hydraulic head is 220 feet.
- Integrated Facility Inlet. Alternatives with the integrated facility inlet would require a new hydropower facility either at the dam or near the outlet. Initial hydraulic head of 439 feet (average Lake Sonoma surface elevation).

For hydropower generation at the dam, a continuous flow of 240 cfs, which includes both the bypass flow and flow to the DCFH, was used to estimate potential hydropower capacity. For hydropower generation near the outlet, a flow of 180 cfs was used. These flows represent the best case scenario, in terms of power generation, because flow releases will vary throughout the year during actual operations. These conditions were used for comparison purposes only, to determine the preferred location of hydropower for each case. The results are shown in Table 5-7.

For the Northern Route, which is only feasible with the integrated facility inlet, it is necessary to locate the hydropower facility near the outlet to preserve the hydraulic head necessary to provide gravity flow over the summit.

Table 5-7. Hydropower Location Screening

Route	Hydropower Location	Initial Elevation[a] (feet)	Pipe Length (feet)	Pipe Headloss[b] (feet)	Elevation of Suitable Site[c] (feet)	Residual Hydraulic Head (feet)	Hydropower Potential[d] (MW)
Integrated Facility Inlet							
Northern[e]	Outlet	440	36,840	53	220	209	2.7
Central	WSD Inlet	440	n/a	n/a	250[f]	189	3.4
Central[g]	Outlet	440	62,120	88	100	251	2.5
Head Box Inlet							
Central	Existing	440	n/a	1	235.4	204	2.6

(a) Elevation data is based on 2009 LIDAR data set provided by Water Agency, supplemented with 2007 LIDAR data provided by Water Agency.
(b) Based on 180 cfs in 72-inch pipe with Hazen Williams coefficient of 130.
(c) Based on suitable topography and land use near the outlet location and FEMA Digital Flood Insurance Rate Map (DFIRM) flood elevation.
(d) Based on a combined turbine and generator efficiency of 82 percent.
(e) Based on Canyon Road alignment to outlet near Highway 128 Bridge.
(f) 250 feet is desired at WSD to minimize bury depth for the alignments in Dry Creek and West Dry Creek Roads.
(g) Based on Dry Creek Road alignment to outlet near Westside Road Bridge.

Regarding the Central Route combined with the integrated facility inlet, the potential hydropower capacity is similar whether the facility is located at the dam or near the outlet. The hydraulic head conditions for the Central Route WSD inlet are very close to the same as head loss through the pipe to a hydropower facility at the outlet (Westside Road Bridge or the Confluence). During summer conditions, Dry Creek and the Russian River give the appearance that additional fall (hydraulic head available for hydropower) would be available; however, the generator must discharge above the 1:100 year flood elevation and construction at ground level negates the minor additional elevation. A second factor is that the hydropower generation at the dam would operate on the bypass flow plus the hatchery flow, while generation at the outlet operates only on the bypass flow and an additional in-line turbine generator would be required on the hatchery flow to generate an equivalent amount of electricity.

Since the combination of head and flow results in potential power generation capacities that are about the same, additional factors were considered. While the dam has existing power transmission facilities that could be used, a hydropower facility near the outlet would require new infrastructure to transmit power from the generator, as well as property acquisition and potentially (because of location) increased environmental mitigation. Therefore, locating the hydropower facility at the dam is preferred.

For the Central Route combined with the head box inlet scenario, the residual hydraulic head is insufficient to justify the construction of a new hydroelectric facility near the outlet location, particularly considering the values presented in Table 5-7 are based on a best case scenario with continuous peak flow and is much lower in practice. Therefore, continuing to use the existing hydropower facility at the dam is preferred.

Based on the results described above, the preferred location for a hydropower facility, for each case respectively, is:

- Head Box Inlet - Existing generator at the dam.
- Integrated Facility Inlet.
  - Northern Route – New generator near the outlet
  - Central Route – New generator at the dam.

Chapter 6 - Project Alternatives

The screening process resulted in two feasible inlet options, five general alignments and their respective outlet facilities on the Russian River and Dry Creek. The alignments are predominantly located in Canyon Road, Dry Creek Road, the access roads paralleling Dry Creek, and West Dry Creek Road. Feasible outlet sites were identified on the upper Russian River at the extension of Canyon Road and near the Geyserville Bridge, on the Russian River near the confluence with Dry Creek and at the Highway 101 Bridge, and finally on Dry Creek near the Westside Road Bridge. Figure 6-1 illustrates these facilities, including the general location of the inlet facility at WSD, the pipeline alignments that were determined feasible, and the suitable outlet sites associated with each alignment.

Based on the facilities described above, there are 21 possible combinations of screened facilities. These combinations, which are shown in Table 6-1, make up the alternatives which were further evaluated.

Table 6-1. Definition of Alternatives for Evaluation

Pipeline Alignment	Inlet Facility	Alignment Description	Outlet Location	Pipeline Node	Alternative ID
Canyon Road	Integrated Facility	Dry Creek Road to Canyon Road	Extension of Canyon Road	RR_1	1a
			Near Geyserville Bridge	RR_2	1b
Dry Creek Road	Integrated Facility	Dry Creek Road to Kinley Road and Westside Road	Westside Road Bridge	DC_E1	2a
		Dry Creek Road to Kinley and Magnolia	Confluence	RR_4	2b
		Dry Creek Road to Kinley Road	HWY 101 Bridge	RR_3	2c
	Head Box (with microtunnels)	Dry Creek Road to Kinley Road and Westside Road	Westside Road Bridge	DC_E1	3a
		Dry Creek Road to Kinley and Magnolia	Confluence	RR_4	3b
		Dry Creek Road to Kinley Road	HWY 101 Bridge	RR_3	3c
	Head Box (without microtunnels)	Dry Creek Road/Ag Land to Kinley Road and Westside Road	Westside Road Bridge	DC_E1	4a
		Dry Creek Road / Ag Land to Kinley and Magnolia	Confluence	RR_4	4b
		Dry Creek Road / Ag Land to Kinley Road	HWY 101 Bridge	RR_3	4c
East DC Access Road	Integrated Facility or Head Box	East DC Access Road To Westside Road Bridge	Westside Road Bridge	DC_E1	5a
		East DC Access Road to Confluence	Confluence	RR_4	5b
West DC Access Road	Integrated Facility or Head Box	West DC Access Road to Westside Road Bridge	Westside Road Bridge	DC_W1	6a
		West DC Access Road to Confluence	Confluence	RR_5	6b
West Dry Creek Road	Integrated Facility	West Dry Creek Road to Westside Road	Westside Road Bridge	DC_W1	7a
		West Dry Creek Road to Westside Road and private roads	Confluence	RR_5	7b
	Head Box (with microtunnels)	West Dry Creek Road to Westside Road	Westside Road Bridge	DC_W1	8a
		West Dry Creek Road to Westside Road and private roads	Confluence	RR_5	8b
	Head Box (without microtunnels)	West Dry Creek Road/Ag Land to Westside Road	Westside Road Bridge	DC_W1	9a
		West Dry Creek Road/Ag Land to Westside Road and private roads	Confluence	RR_5	9b

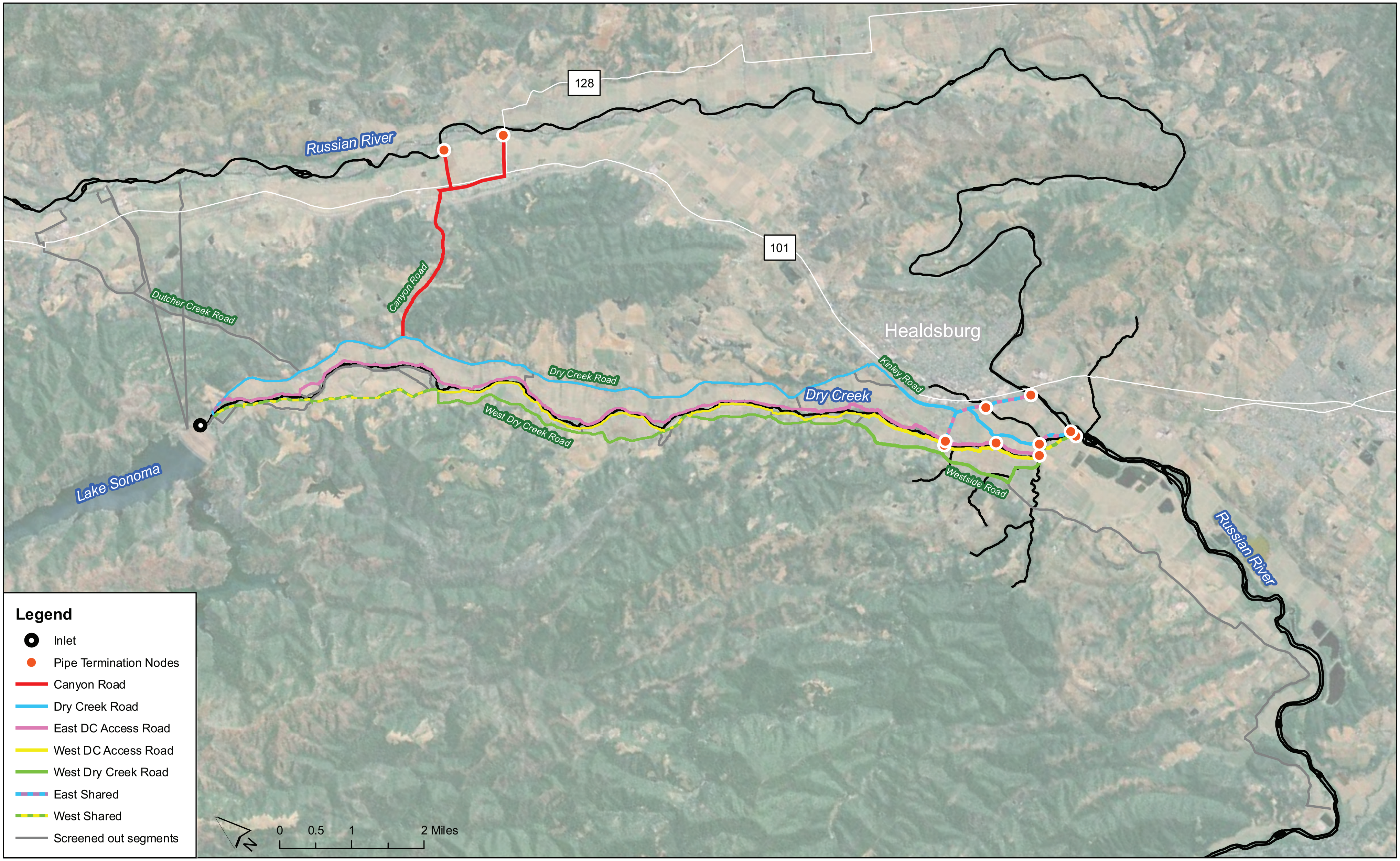

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Figure 6-1
Results of Facilities Screening
Dry Creek Bypass Pipeline Feasibility Study

Since there are 21 alternatives, they have been grouped by route, see Figures 6-2 and 6-3. Facilities screening resulted in two Northern Route alternatives with alignments along Canyon Road. In contrast, there are 19 alternatives for the Central Route with alignments along Dry Creek Road, the East and West DC Access Roads, and West Dry Creek Road.

There are 3 alternatives each for both Dry Creek Road (Alternatives 2, 3, and 4) and West Dry Creek Road (Alternatives 7, 8 and 9) to reflect the slight variations associated with the inlet facilities. Specifically, Alternatives 2 and 7, which include the integrated facility, can be constructed completely in the road using open trench construction, while the remaining Alternatives (3, 4, 8 and 9), which include the head box inlet, either require some microtunneling to accommodate excessive bury depths or must depart from the road alignment to avoid excessive bury depths.

The Southern Route was eliminated during the outlet screening analysis.

Once the alternatives were defined, hydroelectric facilities were further developed and evaluated, as described in the following section.

Hydropower Facilities

As described in Chapter 5, hydropower could be obtained from use of the existing generator in WSD or through a new hydroelectric generation facility. Alternatives with the head box inlet would use the existing generator at the dam, Northern Route alternatives would have a new hydropower facility near the outlet, and Central Route alternatives (with the integrated inlet) would have a new hydropower facility at the dam. The following hydropower options were considered:

- **Existing Generator** – Installed in 1988 in a confined space, 33 stories underground. The facility includes a Francis vertical turbine with 2.6 megawatt (MW) nameplate capacity with a range of flow operations between 70 cfs and 165 cfs.
- **New Hydropower Facility** – Would have a higher efficiency and operate over a wider flow range using two turbines that would be sized to "follow the water", optimizing the efficiency and the size of the system.
- **Mini In-line Turbine** – Located inside the 36-inch diameter pipeline to the hatchery. Applicable for scenarios where the emergency bypass pipeline becomes the primary hatchery feed and the existing turbine is bypassed or abandoned.
- **Adding a Second Hydropower Generator to WSD** – Located in the chamber next to the existing hydropower station may be feasible, but would result in a loss of generation from the existing system for an extended period of time; and would only be able to generate power for flows above the existing flow of 165 cfs. Thus it would be used infrequently, and this option was not considered feasible.
- **Increasing Capacity of Existing Generator** - Is not feasible due to the existing configuration and space constraints inside the control structure.

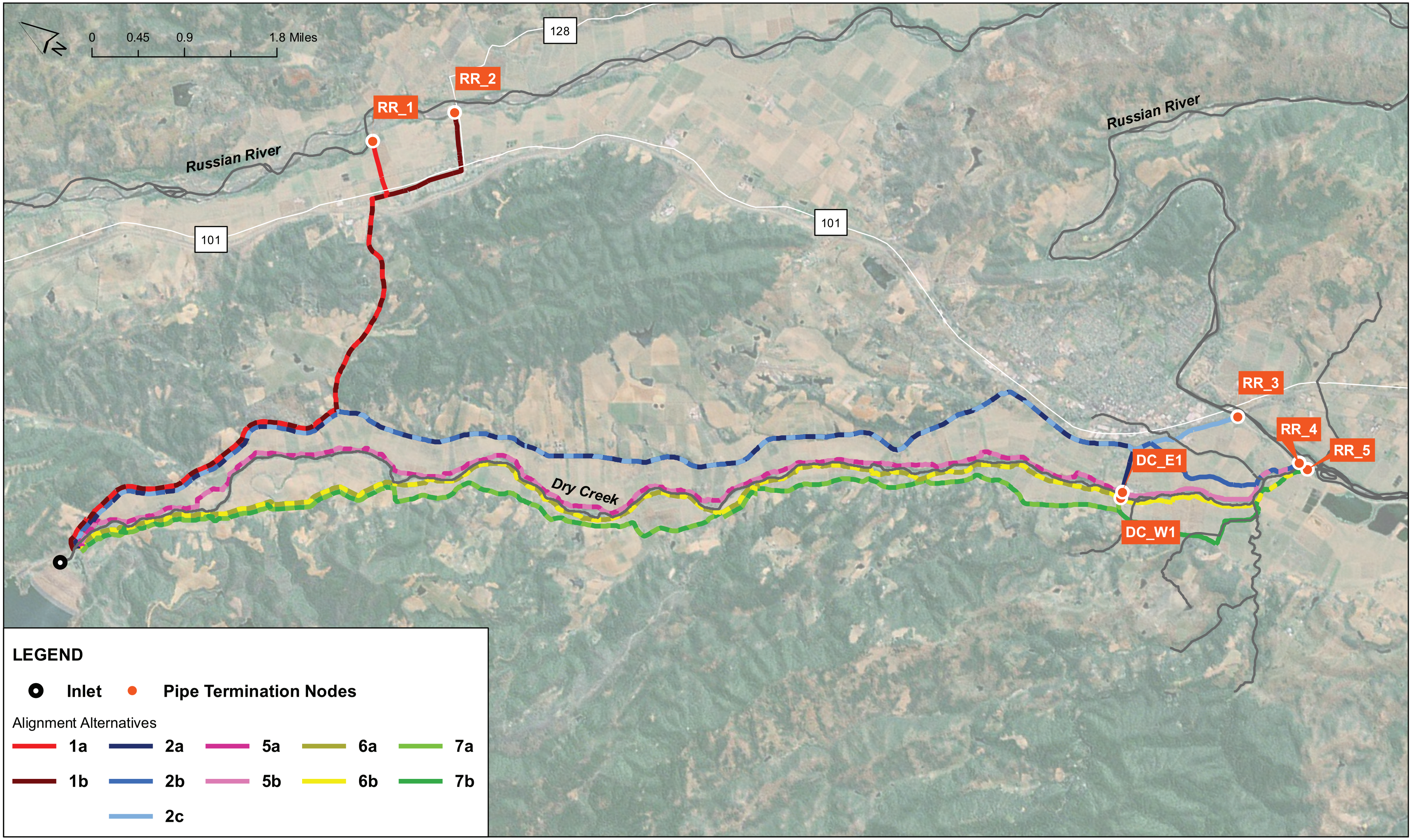

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Figure 6-2
Alignment Alternatives with Integrated Facility Inlet
Dry Creek Bypass Pipeline Feasibility Study

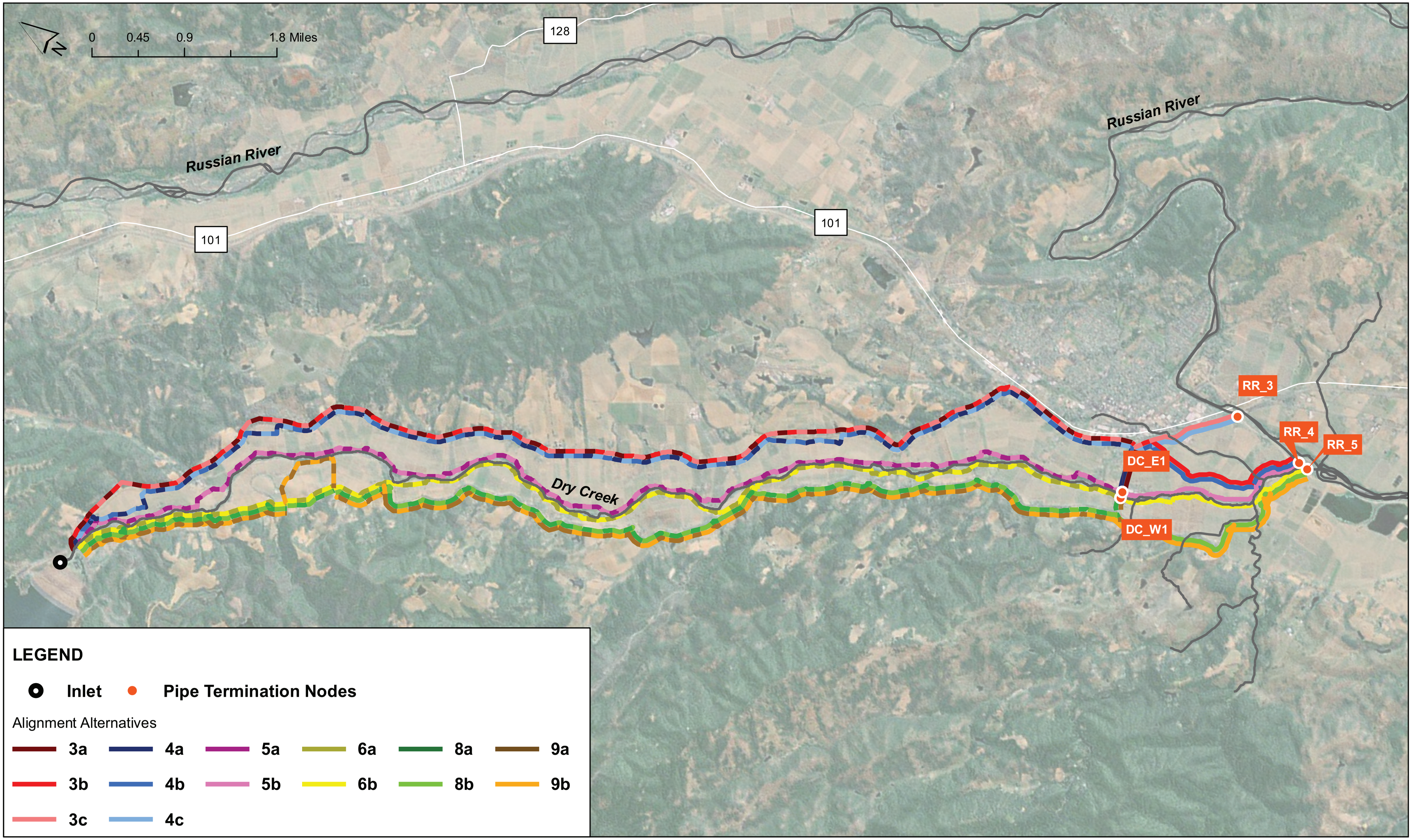


Figure 6-3
Alignment Alternatives with Head Box Inlet
Dry Creek Bypass Pipeline Feasibility Study

Based on the configurations of the 21 alternatives described above, three hydroelectric facility alternatives were defined and evaluated:

- **Alternative A: Head Box.** This alternative includes the continued use of the existing hydroelectric generator and control structure at the dam. Under this alternative, the water surface elevation (WSE) in the head box is increased by 10 feet to 220 feet; however, hydropower generation is the same as existing conditions because the turbine elevation (235.4 ft) would not change.
- **Alternative B: Integrated Facility at the Stilling Basin.** This alternative would apply only to the Central Route alternatives. It would discontinue the use of the existing generator and include the construction of a new hydroelectric generator at the stilling basin. The turbine would be located at an elevation to allow for free discharge at the outlet (approximately 250 feet elevation depending on the pipeline alignment). Hydropower is generated from the combined flow of the bypassed flow and flows discharged to Dry Creek via the hatchery.
- **Alternative C: Canyon Road Facility near the Russian River.** This alternative would apply to the Northern Route alternatives. It would discontinue use of the existing generator and include construction of a new hydroelectric generator at the end of the Canyon Road alignment near the Russian River. The turbine would be located at an elevation to allow for discharge at the outlet of the Canyon Road pipeline (200 feet elevation). The hydroelectric facility at the end of Canyon Road would generate power from the bypassed flows only. A mini, in-line turbine could be constructed on the Corps' 36-inch diameter pipeline to the hatchery as part of this alternative to capture energy from hatchery flows.

The following subsections present the potential hydropower generation and conceptual sites for these alternatives.

Hydropower Generation

For each of the alternatives listed above, the potential hydropower generation was calculated based on average monthly flow through the generator. The results are shown in Table 5-8.

As a point of reference, the current hydropower generator would generate between 13 and 14 megawatts/year based on Water Agency model flow model for 75k. Alternative A – Head Box is based on projected use of the existing generator.

Table 6-2. Potential Hydropower Generation

Hydropower Alternative	Estimated Available Head[(a)] (ft)	Estimated Average Flow[(b)] (cfs)	Estimated Facility Capacity[(c)] (MW)	Estimated Annual Energy Production[(d)] (kWh/year)
A - Head Box	204	137	2.6	12,900,000
B - Integrated Facility	187	137	3.4	15,000,000
C - Canyon Road	209	77	2.7	9,400,000
Mini In-line Turbine	187	60	0.8	7,100,000

(a) Based on average inlet elevation at dam of 440 ft, and estimated headlosses and turbine elevation.
(b) Based on Water Agency model of daily flows for annual average normal rainfall conditions for last 50 years.
(c) Estimated facility capacity (MW) = Max power generated (kW) x 1.05/1000; new facility based on 80% efficiency and in-line turbine based on 85% efficiency.
(d) Based on new facility operation of 360 days per year and in-line turbine operation of 365 days per year. Existing facility operates at 350 days per year.

Hydropower Siting

General considerations for siting a new hydropower facility include:

- Location
- Load rejection
- Proximity to transmission lines
- Site Characteristics
- Environmental issues

For Alternative B, there are a number of sites available in the area of the existing stilling basin where a hydroelectric facility could be placed, as shown in Figure 5-1. Final determination would require coordination with the Corps. The exact location would also depend on the required turbine elevation based on the selection of a Central Route alignment and the configuration of integrated facility inlet.

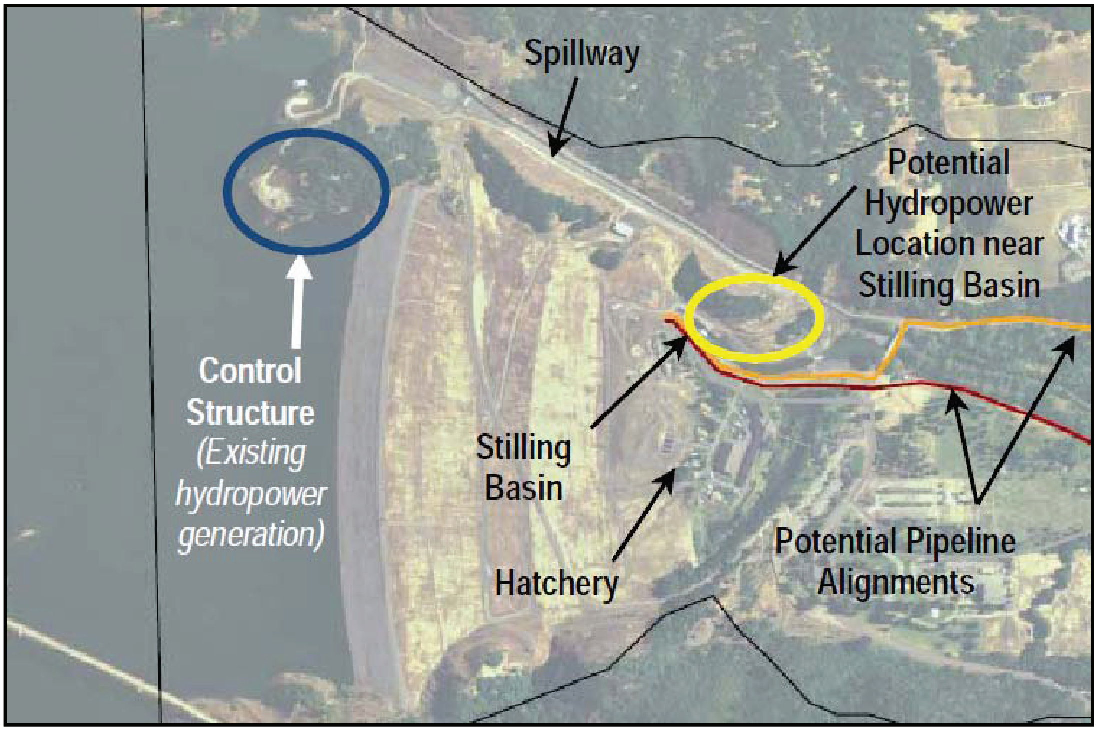


Figure 6-4. Potential Sites for Hydropower Alternative B

As illustrated in Figure 5-2, the new facility for Alternative C could be located in proximity to Highway 101, in a vacant lot or near the on-ramp or off-ramp to the highway. Sites near the highway would require coordination with Caltrans. Any exposed site easily accessible by the public would require additional security. All of these sites would require additional load rejection facilities such as construction of a basin or a means to bypass water around the turbine to allow for release directly to the river.

Locating a new facility in an open area near the Russian River would have the benefit of minimizing additional facilities required for load rejection. However, constructing a new facility in the 100-year floodplain has other significant issues, such as potential damage to the facility during flooding, additional permitting requirements, and environmental impacts. Further analysis is required to evaluate the advantages and disadvantages of locating the facility away from the River versus in the 100-year floodplain.

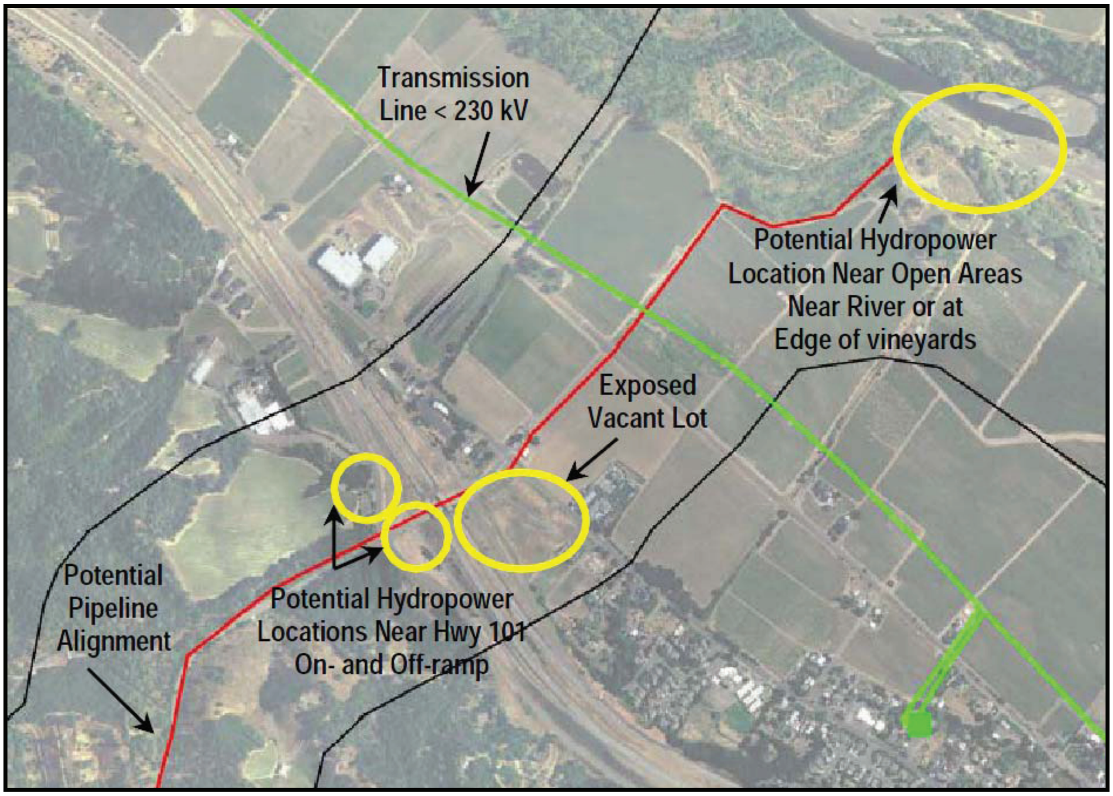


Figure 6-5. Potential Sites for Hydropower Alternative C

Chapter 7 - Alternatives Evaluation

The evaluation results for the inlet, alignment, and outlet alternatives are described in the following sections. The alternatives were evaluated based on the criteria presented in Chapter 4, each of which included a rating scale from Excellent to Undesirable. To facilitate a numerical analysis of the evaluation results, the results were converted from the Excellent to Undesirable scale, to a numerical scale, with 5 being excellent and 1 being undesirable. The results are described in the following sections.

Inlet Evaluation

The evaluation results for the inlet alternatives are shown in Table 7-1. The evaluation results are very similar, and the average score is the same. The biggest differences are in constructability, where the integrated facility is more difficult to construct, and in the operations, where the head box would require more effort to operate and would have less operational flexibility.

Table 7-1. Inlet Evaluation Results

Evaluation Criteria	Head Box	Integrated Facility
Reliability	3	3
Constructability	5	3
Permitting	5	5
Operations	3	5
Right of Way Acquisition	5	5
Liquefaction and Hazard Potential	5	5
Wetlands	5	5
Habitats and Sensitive Species	4	4
Hazardous materials	5	5
Cultural Resources	5	5
Average	**4.5**	**4.5**

Rating scale: 5 is excellent; 4 is above satisfactory; 3 is satisfactory; 2 is poor; and 1 is undesirable.

While nearly all of the criteria were rated above satisfactory or excellent, reliability was rated as satisfactory for both alternatives because the peak operational flows for the bypass pipeline and hatchery are not fully defined at this point in time. With the head box inlet, flows would use the existing hydropower turbine which has a capacity limitation of 178 cfs, although the Water Agency restricts flows to the turbine to 165 cfs for safety. Therefore, to facilitate the total peak operational flow of 240 cfs (180 cfs for the bypass flow and 60 cfs for the hatchery), the future design would need to alter the existing facilities and operations or lower the peak bypass flow by reducing peak water demand or increasing the acceptable flow in Dry Creek. With the integrated inlet, the diameter of the existing standpipe in the control structure is 60 inches; considering a peak operational flow of 240 cfs, the velocity in the 60 inch tunnel and pipeline would exceed 10 fps. Therefore, because of potential capacity constraints, both facilities were rated simply satisfactory for reliability.

Pipeline Alignment Evaluation

The results of the alignment evaluation are described for the Northern and Central Routes in the following subsections. Alignment alternatives are referred to with the same numbering scheme presented in Table 6-1.

Northern Route

A comparison of the alternatives for the Northern Route is presented in Table 7-2. Both alternatives follow an alignment along Dry Creek and Canyon Road to Hwy 101 near Geyserville. Alignment 1b, through Geyserville to the Geyserville Bridge, is slightly longer, but has less impact to private property. Alignment 1a maintains a more direct route to the River using private access roads.

Table 7-2. Northern Route Alignment Evaluation Results

Evaluation Criteria	Canyon Road Alignment 1a	Canyon Road Alignment 1b
Reliability	5	5
Constructability	4.4	4.3
Permitting	4	4
Operations	3	3
Right of Way Acquisition	4	5
Liquefaction and Hazard Potential	3	3
Hydropower	1	1
Special Crossings	3	3
Wetlands and Other Waters of the US	3	3
Sensitive Habitats and Species	3	3
Hazardous materials	5	3
Potential Loss of Trees	5	5
Cultural Resources	1	1
Average	**3.4**	**3.3**

Rating scale: 5 is excellent; 4 is above satisfactory; 3 is satisfactory; 2 is poor; and 1 is undesirable.

As shown in Table 7-2, the alignments were generally rated the same with the exception of constructability, right of way acquisition and hazardous materials. The low score for cultural resources was based a study identifying the potential presence of cultural resources. As described in Chapter 4, the constructability criterion is a composite criterion based on several factors including utility conflicts and impacts to agricultural operations and recreation. Alignment 1b ranked slightly lower than Alignment 1a due to the number of utility conflicts associated with construction in the arterial roads in Geyserville. Similarly, Alignment 1b was rated lower for the hazardous materials criterion due to the presence of RECs in proximity to the alignment within Geyserville. However, right of way acquisition would be easier for Alignment 1b since the alignment would remain in public roads, whereas Alignment 1a would require right of way acquisition in private property. Based on the results presented in Table 7-2, Alignment 1a is slightly preferred over Alignment 1b.

Central Route

A number of central route alternatives were created to delineate various key differences among the alignments. These alignment alternatives are associated with hydraulic differences between the head box and integrated facility. The former requires microtunneling or adjustments to the alignments to avoid excessive bury depths to maintain gravity flow conditions in the Dry Creek Road and West Dry Creek Road alignments.

Refer to Table 6-1 for a list of route characteristics and alignment number. The evaluation results of the alignment alternatives in Dry Creek Road, the private access roads adjacent to Dry Creek, and West Dry Creek Road are presented in the following subsections, respectively.

Dry Creek Road

The alignment alternatives in Dry Creek Road are compared in Alignments 2a through 4c as presented in Table 7-3.

As shown in Table 7-3, the accumulative total average ranking is about the same ranging from 3.1 to 3.3. The majority of the rankings are the same because variations in alignments were small. The greatest differences were constructability for Alignments 3a, 3b, and 3c and permitting for alignments 4a, 4b, and 4c. Alignments 3a, 3b, and 3c were rated lower for constructability because these alignments require some microtunneling for pipe installation. Alignments 4a, 4b, and 4c were rated lower for permitting due to the length of pipe located in private roads which require right of way acquisition. Results for hydropower potential are higher for Alignments 3 and 4 because they are combined with the head box and would use the existing hydropower facility, as opposed to Alignment 2 which, combined with the integrated facility, would require a new hydropower facility located at the dam. Finally, Alignments 2a, 3a and 4a, which terminate at the Westside Road Bridge, were ranked slightly higher for the Special Crossings criterion because they would cross one less, but significant tributary (Norton Slough). The results for the remaining criteria are similar for each alignment alternative.

Table 7-3. Dry Creek Road Alignment Evaluation Results

Evaluation Criteria	Alignment								
	2a	2b	2c	3a	3b	3c	4a	4b	4c
Reliability	5	5	5	5	5	5	5	5	5
Constructability	3.9	3.8	3.8	3.4	3.4	3.4	3.9	3.8	3.8
Permitting	4.3	4.3	4.3	4.3	4.3	4.3	3.7	3.7	3.7
Operations	3	3	3	3	3	3	3	3	3
Right of Way Acquisition	5	4	5	5	4	5	4	4	4
Liquefaction and Hazard Potential	3	3	3	3	3	3	3	3	3
Hydropower Potential	2	2	2	3	3	3	3	3	3
Special Crossings	3	2	2	3	2	2	3	2	2
Wetlands and Other Waters of the US	3	3	3	3	3	3	3	3	3
Sensitive Habitats and Species	3	3	3	3	3	3	3	3	3
Hazardous materials	1	1	1	1	1	1	1	1	1
Potential Loss of Trees	5	5	5	5	5	5	5	5	5
Cultural Resources	1	1	1	1	1	1	1	1	1
Average	**3.2**	**3.1**	**3.2**	**3.2**	**3.1**	**3.2**	**3.2**	**3.1**	**3.1**

Rating scale: 5 is excellent; 4 is above satisfactory; 3 is satisfactory; 2 is poor; and 1 is undesirable.

East and West DC Access Roads

The results of the evaluation of the East and West DC Access Roads are listed in Table 7-4. The low score for cultural resources was based a study identifying the potential presence of cultural resources. There are no significant differences among the alignment alternatives for the East or West DC Access roads. Each of the alignment alternatives would require right of way acquisition for nearly the entire pipeline length. Due to the proximity to Dry Creek, each of the alignment alternatives received low scores for liquefaction, wetlands, habitat and sensitive species, and impacts to trees. The alignment alternatives also have low scores for constructability because of poor soil conditions, tight working conditions, and presence of groundwater.

West Dry Creek Road

The evaluation results for the alignments in West Dry Creek Road are presented in Table 7-5. The average scores for the alignment alternatives in West Dry Creek Road are similar. Although some of the alignments have more pipe length in private property, those distances, as with a percentage of the total distances, are not enough to change the results.

Table 7-4. East and West Dry Creek Access Road Alignment Evaluation Results

	Alignment 5a	Alignment 5b	Alignment 6a	Alignment 6b
Reliability	5	5	5	5
Constructability	2.1	2.1	1.9	1.9
Permitting	2.3	2.3	2.7	2.7
Operations	3	3	3	3
Right of Way Acquisition	1	1	1	1
Liquefaction and Hazard Potential	1	1	1	1
Hydropower Potential	3	3	3	3
Special Crossings	2	2	2	2
Wetlands and Other Waters of the US	1	1	1	1
Sensitive Habitats and Species	1	1	1	1
Hazardous materials	3	3	3	3
Potential Loss of Trees	1	1	1	1
Cultural Resources	3	3	3	3
Average	**2.2**	**2.2**	**2.2**	**2.2**

Table 7-5. West Dry Creek Road Alignment Evaluation Results

	Alignment 7a	Alignment 7b	Alignment 8a	Alignment 8b	Alignment 9a	Alignment 9b
Reliability	5	5	5	5	5	5
Constructability	2.3	2.3	2.2	2.2	2.3	2.3
Permitting	3.0	3.0	3.0	3.0	2.7	2.7
Operations	3	3	3	3	3	3
Right of Way Acquisition	3	3	3	3	3	3
Liquefaction and Hazard Potential	3	3	3	3	3	3
Hydropower Potential	2	2	3	3	3	3
Special Crossings	2	2	2	2	2	2
Wetlands and Other Waters of the US	3	3	3	3	3	3
Sensitive Habitats and Species	3	3	3	3	3	3
Hazardous materials	3	3	3	3	3	3
Potential Loss of Trees	2	2	2	2	2	2
Cultural Resources	1	1	1	1	1	1
Average	**2.7**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**

Constructability was rated relatively low when compared to the Dry Creek Road alignments due to the narrow right of way conditions, the amount of trees overhanging and adjacent to the roadway, and the potential impact to recreation and agricultural operations due to road closures during construction. The need to close the road and reroute traffic during construction also resulted in a lower permitting score for the West Dry Creek Road alignments, and the significant number of trees adjacent to the roadway when compared to Dry Creek Road, resulted in a relatively lower rating for the potential loss of trees criterion. Conversely, the West Dry Creek Road alignments were ranked higher for the hazardous materials criterion because fewer RECs and Notable Findings were identified on the west side of Dry Creek.

Central Route Comparisons

Comparing the Central Route alignments with one another, average scores for each alignment variation are similar. The highest scores and their associated alignments are listed in Table 7-6. The comparison of evaluation criteria shows that Dry Creek Road is the highest rated alignment for the Central Route.

Table 7-6. Central Route Evaluation Results Comparison

Road	Highest Score	Alignments
Dry Creek Road	3.1 – 3.3	2a, 2c, 3a, 3c, and 4a
East and West Access Roads	2.2	5a, 5b, 6a, 6b
West Dry Creek Road	2.7 – 2.8	8a, 8b, 9a, 9b

Outlet Evaluation

The results of the outlet evaluation are presented in Table 7-7. Outlet locations are not directly comparable because it is not a choice of one outlet over another, rather outlets must be associated with the alignment termination node. Many of the results are similar, however outlets associated with the northern alignments were ranked lower for liquefaction, operations and maintenance, right-of-way acquisition, and river channel stability.

One of the greatest concerns regarding the feasibility of the outlet location is the impact on water quality and fisheries. To better understand this potential impact and how one outlet location compares to another; an HDR fisheries biologist met with a representative of the National Marine Fisheries Service (NMFS) in August, 2010. Based on that discussion, the following preferences were identified:

- The discharge location should be far enough upstream to minimize potential for fish straying. The Westside Road Bridge location was the furthest upstream point considered because of the need for habitat restoration necessary for discharge to Dry Creek. Discharge at Westside Road Bridge must be evaluated in detail in conjunction with the improvements to Dry Creek from Westside Road Bridge to the confluence to accommodate higher flows.

Table 7-7. Outlet Evaluation Results

Outlet Facility	Northern Route		Central Route		
	Extension of Canyon Rd RR_1	Near Geyserville RR_2	Westside Rd Bridge DC_1	HWY 101 Bridge RR_3	Confluence RR_4
Reliability	3	4	5	4	4
Constructability	2	3	4	3	3
Permitting	3	3	3	3	3
Operations	2	2	3	5	5
Right of Way Acquisition	1	1	4	2	2
Liquefaction and Hazard Potential	1	1	1	2	2
River Channel Stability	1	1	4	5	3
Wetlands	3	3	3	5	3
Habitats and Sensitive Species	3	3	3	2	3
Hazardous materials	5	3	1	3	3
Cultural Resources	3	3	3	3	3
Water Quality/Fisheries	1	1	5	3	4
Average	**2.3**	**2.3**	**3.2**	**3.3**	**3.2**

- Flow diversions should be managed to provide cold water habitat in the Russian River reach from the discharge location to at least Dry Creek. Thus, the Highway 101 Bridge location is preferred over the Northern Route discharge locations.

The ratings shown for the Water Quality / Fisheries criterion in Table 7-7 reflect these preferences.

Another concern regarding the outfall was permitting requirements, and specifically permit requirements that may be imposed by the RWQCB regarding water quality (e.g., turbidity, temperature, etc.). To better understand the potential concerns of the RWQCB, HDR and Water Agency staff met with representatives of the RWQCB in July, 2010. Based on the discussions during that meeting, the RWQCB would require a stormwater construction permit and a Section 401 water quality certification. An NPDES permit is not being contemplated at this time. The RWQCB requested a work plan showing the specific analysis, modeling, and evaluation to be performed during the Engineering Report in support of the EIR.

Based on the results presented in Table 7-7, the discharge location near the Highway 101 Bridge is the highest ranked for the Central Route alternatives. There is no difference between the discharge locations for the Northern Routes.

Alternatives Evaluation Summary

The individual results for the inlet, alignment, and outlet facility, were combined into a single score for each alternative. The resulting combined scores are presented in Table 7-8, in addition to the relative ranking of the alternatives. Table 7-8 was sorted by rank to better identify the most advantageous alternatives.

As shown in Table 7-8, the alternatives in Dry Creek Road (refer to Table 6-1 for a complete list of alternatives and inlet, route, and outlet locations) are generally preferred over other alternatives, with alternative 3, 2, and 4 ranking highest, respectively. The alternatives associated with the Northern Route, ranked 16th and 17th.

Table 7-8. Alternative Ranking Results

Alternative	Inlet Facility	Pipeline Alignment	Outlet Facility	Total	Rank
Alternative 3a	45	42.9	39	126.9	1
Alternative 3c	45	41.8	40	126.8	2
Alternative 2a	45	42.2	39	126.2	3
Alternative 2c	45	41.1	40	126.1	4
Alternative 4a	45	41.6	39	125.6	5
Alternative 4c	45	40.4	40	125.4	6
Alternative 3b	45	40.8	38	123.8	7
Alternative 4b	45	40.4	38	123.4	8
Alternative 2b	45	40.1	38	123.1	9
Alternative 8a	45	36.2	39	120.2	10
Alternative 9a	45	36.0	39	120.0	11
Alternative 7a	45	35.3	39	119.3	12
Alternative 8b	45	36.2	38	119.2	13
Alternative 9b	45	36.0	38	119.0	14
Alternative 7b	45	35.3	38	118.3	15
Alternative 1a	45	44.4	28	117.4	16
Alternative 1b	45	43.3	28	116.3	17
Alternative 6a	45	28.6	39	112.6	18
Alternative 5a	45	28.4	39	112.4	19
Alternative 6b	45	28.6	38	111.6	20
Alternative 5b	45	28.4	38	111.4	21

As listed in Table 7-8, Alternatives 2, 3, and 4 ranked the highest overall and all have pipeline alignments in Dry Creek Road. These alternatives ranked higher due to their alignment, while the scores they received for the inlet and outlet were similar in comparison to other alternatives.

The difference among the top six ranked alternatives is negligible, at about one percent or 1.5 points out of and average of 126. Alternatives 3a and 3c include the headbox inlet and microtunnel construction to maintain the alignment in Dry Creek Road. Alternatives 2a and 2c use the integrated inlet and also maintain all of the alignment in Dry Creek Road. Alternative 4a and 4c use the headbox inlet and use private roads to avoid microtunnel construction. The small point differential is due the slight increase in construction on private property. The next three alternatives (3b, 2b, and 4b) use the headbox or integrated inlet and Dry Creek Road alignment, but discharge to the confluence of Dry Creek and the Russian River. The lower point total is due to the increased length of pipe installed in private roads and environmentally sensitive areas along the route to the confluence.

The alternatives with alignments in Dry Creek Road ranked higher than the other Central Routes due to several factors. First, the Constructability and Potential Loss of Trees criteria were ranked higher because Dry Creek Road is wider, more accessible, and construction could be done in a way that would minimize impacts to agriculture operations and recreation in the valley, in comparison to the other alignments. Right of Way Acquisition was also ranked higher because most of the alignment is in an existing public right of way, compared to the other alignments which would require significant right of way acquisition. Furthermore, the alternatives with alignments in Dry Creek Road ranked significantly higher than those with alignments in the DC Access Roads due to the latter's expected disruption in the riparian area during construction and proximity to Dry Creek, which resulted in these alternatives receiving low scores for Wetlands and Other Waters of the US, and Sensitive Habitats and Species, as well as Liquefaction.

Chapter 8 - Economic Evaluation of Alternatives

The following sections present the basis for the cost estimates, and the capital, operations and maintenance (O&M), and present value cost estimates for each of the 21 alternatives.

Basis of Cost Estimates

Published unit cost values from RS Means were used where possible and cost estimates maintained by HDR were used for the remainder of the items. These costs were adjusted to be appropriate for the Bypass Pipeline Project, which would be located in Sonoma County, CA. The industry standard for adjusting unit costs is the Construction Cost Index (CCI). Index values tracking the aggregate increase in heavy construction costs are maintained and published by Engineering News Record. The CCI was used to adjust some of the unit cost values to reflect the current date and evaluated the historic trends in CCI to look at what costs may do in the future. The CCI value used in this report is 8950.

To facilitate the evaluation of the alternatives, a cost model was constructed in MS Excel. For each alternative, the model used the input values shown in Table 8-1.

Table 8-1. Input Values for Construction Cost Model

Item	Unit	Source
Length of Pipeline in Dry Creek Road	Ft	GIS - Vertical shoring
Length of Pipeline in West Dry Creek Road	Ft	GIS - Vertical shoring
Length of Pipeline in Other Paved Roads	Ft	GIS - Vertical shoring
Length of Pipeline in Private Access Road	Ft	GIS - Vertical shoring
Length of Pipeline in Agricultural Property	Ft	GIS - Open cut, no shoring
Length of Pipeline in Unimproved Property	Ft	GIS - Open cut, no shoring
Number of Stream Crossings for Bore and Jack	Ea	Hand counted
Average Length of Crossing	Ft	Estimate from GIS
Number of Microtunnels	Ea	Screening TM
Length of Microtunnel in Pavement	Ft	GIS
Pipe Diameter	Inch	72 RCP
Average Depth of Pipe	Ft	Hydraulic Profile
Length of Permanent Easements		
In existing right of way	Ft	GIS
In agricultural land	Ft	GIS
In a private road	Ft	GIS
In unimproved land	Ft	GIS
Length of Temporary Construction Easements		
In existing right of way	Ft	GIS
In unimproved land	Ft	GIS

Given the pipe diameter, location, and length of the pipeline, the model is set up to calculate the excavation, shoring, backfill, spoils, and pavement restoration quantities to allow a detailed application of unit costs. Additional miscellaneous costs are accounted for on a unit or prorated lump sum basis including dewatering, safety, traffic control, clearing, and restoration.

Tunneling detail includes excavation, shoring, dewatering, and backfill of the access and receiving pits, quantities to drill and shoot the tunnel, use of the tunneling machine, crane, support crew, pipe, demobilization, and cleaning. Some cost strategies for tunneling show the purchase of the tunneling machine with no accounting for resale or salvage value after the project. The cost estimate uses a depreciation or rental cost method to account for the fact that most machines are resold or salvaged after construction. It should also be noted that many tunneling cost estimates separate the cost of the tunnel from the cost of the pipe and complete installation. Typically about half the cost of a utility pipeline is the cost of the tunnel and the other half is the cost of the pipe material, installation, and miscellaneous costs. The cost separation reflects the fact that tunneling work is a specialty item and subcontracted out by the general contractor.

The cost results presented in this technical memorandum are based on a 72-inch diameter reinforced concrete pipe (RCP) for the Central Route alternatives and a 72-inch diameter reinforced concrete cylinder pipe (RCCP) for the Northern Route alternatives (due to the higher pressure associated with the Northern Route). For alternatives including the integrated facility inlet, the pipe from the control structure to the generator, constructed in partnership with the Corps, was priced as a 72-inch steel pipe. This estimate includes an estimate of the entire cost and cost sharing between the Water Agency and the Corps that will be refined as the Corps Emergency Hatchery Water Supply project develops.

Right-of-Way Acquisition

Right of way (ROW) costs were divided between permanent and temporary easement costs and identified as existing right of way, within agricultural property, along private road (paved and unpaved), or through unimproved property. The unit costs for the acquisition of ROW, shown in Table 8-2, were developed specifically for the project study area by a ROW specialist. The table shows the standard widths used with the length provided from GIS output, an area was determined for each easement type. A typical construction width of 33 ft is required to install a 72-inch pipeline.

ROW property costs were listed separately from acquisition and legal costs. ROW acquisition and legal costs were estimated to be 25% of the ROW cost.

Table 8-2. Right-of-Way Unit Costs

Location	Cost Per Acre	Basis	Width
Permanent Easements			
Existing ROW	$1,000	Nominal fee to cover any compensation that may be associated with support costs	18 ft
Agricultural land	$100,000	Value determined from recent vineyard property sales. These sales would be the same information an appraiser would reference.	33 ft
Private farm road	$100,000	The private road is considered to be encumbered, but are within the vineyard and valued as though the permanent easement is through vineyard property.	33 ft
West Dry Creek paved road	$25,000	Road is paved and a dedicated road, but privately owned	33 ft
Unimproved land	$100,000	May be developed as vineyard in the future. The impact is not more than the permanent easement value through the vineyard.	33 ft
Construction Temp Easement			
Existing ROW	$1,000	Nominal fee to cover any contingencies.	15 ft
Unimproved land	$100,000	Based on rental of property during the construction.	15 ft

Construction Cost Markups

Construction markups include the contractor's field overhead, mobilization, and demobilization; sales tax (which although applies only to materials and construction equipment, was adjusted downward to apply to the total construction value); general contractors overhead and profit; and costs for the contractors bonds and insurance which are applied to the construction subtotal. The values used, as shown in Table 8-3, are typical of the industry, but the application of sales tax is unique to each project.

Table 8-3. Construction Cost Markups

Item	Percent
Contractor's field overhead, mobilization, and demobilization	9%
Sales tax (adjusted for total construction cost)	2%
General contractors overhead and profit	15%
Contractor's bonds and insurance	1%
Contingency for Undefined Scope of Work	25%

Construction contingency is typically added to account for undefined scope of work items. The percentage applied is based on the class and detailed level of design. For preliminary design, the undefined contingency is typically 25%. Thus, a 25% undefined scope of work contingency was used in this cost estimate based on the relative level of design development and design risk. This value is not a reflection on the accuracy of the cost estimate which ranges between -15% and +30%, but on the uncertainty associated with planning level design development.

Potential Environmental Mitigation, Permitting, EIR, and Legal

Environmental costs included potential environmental mitigation, permitting, EIR, and associated legal costs. The pipe cost included bore and jack under waters of the US and environmentally sensitive areas. Costs include restoration and revegetation along the pipeline route (when not in roads) and at the outlet locations.

For the alternatives that discharge into Dry Creek, the environmental mitigation costs include restoration of Dry Creek from the point of discharge to the confluence so that higher flows in Dry Creek are acceptable.

The costs were divided into environmental mitigation and permitting as distinct from the EIR and legal costs associated with the EIR. Because the environmental and EIR costs are dominated by the outlet facilities, the same costs were used for each alternative.

Project Cost Markups

Project related work includes engineering design of all facilities, legal, construction administration, and Water Agency costs for managing the project. These items are estimated as a percentage of construction costs, as shown in Table 8-4.

Table 8-4. Project Cost Markups

Project Markup	Percent
Engineering	10%
Legal	5%
Construction Administration	8%
Owner Administration	5%

Capital Costs

Inlet

To meet the requirements set out in the BO for a new emergency water supply line for the Don Clausen Fish Hatchery, the Corps completed a 35% design of their Alternative 3A – Pump Station and Alternative X, Option C – Carrier Tunnel with 72" pipeline. The 35% design included a cost estimate for each alternative, dated November 1, 2010. The cost estimates included a 25% contingency, taxes, and contractor markups to provide a total construction cost. The estimate for Alternative 3A – Pump Station was $15,632,000 and the estimate for Alternative X – Carrier Tunnel was $37,638,000. It is HDR's understanding that if the Water Agency chooses to pursue a partnership with the Corps in implementing Alternative X, Option C, then the Water Agency's share for the project is the cost difference between Alternative 3A and Alternative X, Option C. For purposes of alternative comparison, HDR used the value of $22 million, which is the difference between the Corps Alternative 3A ($15.6 M) and Alternative X ($37.6 M). The value may vary slightly with continued design development. Because construction markups are already applied, the Inlet cost was included below the subtotal of Route and Outlet costs. As the Corps continues to develop the projects, the cost of the Carrier Tunnel and Water Agency's share of the costs should be monitored.

The head box construction cost was estimated by HDR to be $1,700,000 (raw construction cost) and $2,584,000 after markups. The cost includes the concrete box, connection to the bypass pipeline, and gate installed in the stilling basin. The value for the head box inlet presented in Table 8-6 includes all of the contractor's and undefined scope markups for the full cost of construction and contingency. For ease of comparison, the marked up head box inlet costs were presented in the same row of Table 8-6 as the Corps' estimate for the integrated inlet.

Alignment

Detailed estimates of the pipeline routes are listed in the attachments. The estimates account for piping, bore and jack, tunneling, easement, and environmental mitigation. An additional 10% was added to the construction in the Private Access roads and unimproved areas to account for the added cost of construction due to limited access and mobility. The pipeline cost element was divided between key topographic areas:

- Length of Pipeline in Dry Creek Road, West Dry Creek Road, and Other Paved Roads
- Length of Pipeline in Private Access Road
- Length of Pipeline in Agricultural Property
- Length of Pipeline in non-Agricultural Property
- Length of Pipeline in Unimproved Property

The three methods of trenchless construction were included based on the number of locations and distances for bore and jack, microtunnels, and hard rock tunneling. Hard rock tunneling was used to confirm the Corps cost estimate for the inlet tunnel.

Outlet

The outlet costs were estimated to be about $3.5 million (construction cost without markup) and an additional $520,000 was added to account for the added difficulty and risk of constructing in the river. The added cost was based on potential stream diversion, turbidity control measures, and limited access. The costs for the Canyon Road option were estimated to be $1 million more than the central route because of soil conditions, potential flooding, constructability, and access conditions for the outlet and coordination with the hydropower facility.

Hydropower

Hydropower costs were estimated for both capital construction and estimated income from energy sales. The results of the analysis are shown in Table 8-5.

Table 8-5. Economic Analysis of Hydropower Location for Central Route Alternatives

	Unit	Existing Hydropower Facility	New Hydropower Facility at Dam
Capital Cost of Hydropower Facility	$	-	$ 13,200,000
Capital Cost of Microturbine to Hatchery	$		$1,900,000
Revenue for Northern Route	$ / year	-	($720,000)
Revenue for Central Route	$ / year	($660,000)	($730,000)

Energy sales were estimated to be $0.08/kWh based on current revenue and market value for power generation. For cost comparison purposes, $0.05/kWh was used as income with $0.03 used for operation and maintenance.

There are no capital costs associated with the existing generator and revenue, estimated at $0.05/kWh, is approximately $0.66 mil/year. For a new hydropower facility at the dam, in conjunction with the Central Route alternatives, the capital cost is about $13.2 million with a revenue of approximately $0.73 mil/year. For a new hydropower facility in conjunction with the Northern Route alternatives, two facilities were developed and evaluated. The main hydropower facility would be located near the discharge to the Russian River and the second facility would be a microturbine in the pipeline leading to the DCFH. The total capital cost of the two facilities is $15.1 million with revenue of about $0.72 mil/year.

Capital Cost Summary

The capital cost summary for each alternative is presented in Table 8-6. The estimates for the inlet, pipeline alignment, and outlet are listed separately, then take into account the construction costs, contractor markups, allowances for undefined work and change orders, potential environmental mitigation, right-of-way acquisition, project administration, and hydropower costs. All cost estimates were based on 180 cfs of bypass flow in a 72-inch diameter pipeline.

Alternative 1a, which includes the integrated inlet, a pipeline alignment along Dry Creek and Canyon Roads to the Russian River, and a new hydropower facility near the outlet, is the least costly alternative at an estimated $136.6 million. Alternative 7a, which includes the integrated inlet, a pipeline alignment along West Dry Creek Road to Dry Creek, restoration of Dry Creek to allow discharge, and a new hydropower generation facility at the dam, is the most costly alternative at $184.3 million.

Operations and Maintenance Costs

Due to the differences in power generation and other factors, separate operation and maintenance (O&M) estimates were prepared for the Integrated Inlet and Central Route in Table 8-7, for the Integrated Inlet and Northern Route in Table 8-8, and for the Head Box Inlet and Central Route in Table 8-9.

The O&M estimate accounts for annual pipe inspection and seasonal flow adjustment. Five year maintenance was applied to the outlet works and mechanical equipment (gates and valves) and a twenty five year replacement on the outlet screen and mechanical equipment.

Present value estimates are based on a discount rate of two percent for a period of fifty years.

Table 8-6. Capital Cost Estimates

Summary of Alternatives and Costs		Alternative 1a	Alternative 1b	Alternative 2a	Alternative 2b	Alternative 2c	Alternative 3a	Alternative 3b	Alternative 3c	Alternative 4a	Alternative 4b
Inlet Option		Integrated	Integrated	Integrated	Integrated	Integrated	Headbox	Headbox	Headbox	Headbox	Headbox
Hydropower location		Russian R	Russian R	Dam	Dam	Dam	Existing	Existing	Existing	Existing	Existing
Route		Canyon Rd	Canyon Rd	DC+Westside	DC	DC + Kinley	DC+Westside	DC	DC + Kinley	DC+Westside	DC
Outlet location		Russian R	Geyserville Br	Dry Cr	Confluence	Hwy 101 Br	Dry Cr	Confluence	Hwy 101 Br	Dry Cr	Confluence
Route		$ 38,780,000	$ 43,100,000	$ 52,520,000	$ 58,040,000	$ 55,690,000	$ 66,370,000	$ 72,120,000	$ 69,660,000	$ 58,290,000	$ 63,800,000
Outlet		$ 5,110,000	$ 5,110,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000
Construction Subtotal		$ 43,890,000	$ 48,210,000	$ 56,610,000	$ 62,130,000	$ 59,780,000	$ 70,460,000	$ 76,210,000	$ 73,750,000	$ 62,380,000	$ 67,890,000
Contractor's Field Overhead and Mob/Demob	9%	$ 3,950,000	$ 4,340,000	$ 5,090,000	$ 5,590,000	$ 5,380,000	$ 6,340,000	$ 6,860,000	$ 6,640,000	$ 5,610,000	$ 6,110,000
Sales Tax on Materials and Rentals	2%	$ 880,000	$ 960,000	$ 1,130,000	$ 1,240,000	$ 1,200,000	$ 1,410,000	$ 1,520,000	$ 1,480,000	$ 1,250,000	$ 1,360,000
Contractor's Fee (Office Ovhd and Profit)	15%	$ 6,580,000	$ 7,230,000	$ 8,490,000	$ 9,320,000	$ 8,970,000	$ 10,570,000	$ 11,430,000	$ 11,060,000	$ 9,360,000	$ 10,180,000
Contractor's Bonds and Insurance	1%	$ 550,000	$ 610,000	$ 710,000	$ 780,000	$ 750,000	$ 890,000	$ 960,000	$ 930,000	$ 790,000	$ 860,000
Undefined Scope of Work Estimated Cost	25%	$ 13,960,000	$ 15,340,000	$ 18,010,000	$ 19,770,000	$ 19,020,000	$ 22,420,000	$ 24,250,000	$ 23,470,000	$ 19,850,000	$ 21,600,000
Route+Outlet Subtotal		$ 69,810,000	$ 76,690,000	$ 90,040,000	$ 98,830,000	$ 95,100,000	$ 112,090,000	$ 121,230,000	$ 117,330,000	$ 99,240,000	$ 108,000,000
Inlet		**$ 22,000,000**	**$ 22,000,000**	**$ 22,000,000**	**$ 22,000,000**	**$ 22,000,000**	**$ 2,584,000**	**$ 2,584,000**	**$ 2,584,000**	**$ 2,584,000**	**$ 2,584,000**
Construction Value Total		**$ 91,810,000**	**$ 98,690,000**	**$ 112,040,000**	**$ 120,830,000**	**$ 117,100,000**	**$ 114,674,000**	**$ 123,814,000**	**$ 119,914,000**	**$ 101,824,000**	**$ 110,584,000**
Environmental Mitigation and Permitting		$ 1,050,000	$ 1,050,000	$ 12,250,000	$ 1,050,000	$ 1,050,000	$ 12,250,000	$ 1,050,000	$ 1,050,000	$ 12,250,000	$ 1,050,000
EIR and Legal		$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000
Subtotal		**$ 95,360,000**	**$ 102,240,000**	**$ 126,790,000**	**$ 124,380,000**	**$ 120,650,000**	**$ 129,424,000**	**$ 127,364,000**	**$ 123,464,000**	**$ 116,574,000**	**$ 114,134,000**
Right-of-Way and Easements		$ 308,000	$ 41,000	$ 68,000	$ 343,000	$ 81,000	$ 12,250,000	$ 1,050,000	$ 1,050,000	$ 964,000	$ 1,299,000
Right-of-Way Acqusition and Legal		$ 77,000	$ 10,000	$ 17,000	$ 86,000	$ 20,000	$ 3,063,000	$ 263,000	$ 263,000	$ 241,000	$ 325,000
Subtotal		**$ 95,750,000**	**$ 102,290,000**	**$ 126,880,000**	**$ 124,810,000**	**$ 120,750,000**	**$ 144,740,000**	**$ 128,680,000**	**$ 124,780,000**	**$ 117,780,000**	**$ 115,760,000**
Engineering	10%	$ 9,180,000	$ 9,870,000	$ 11,200,000	$ 12,080,000	$ 11,710,000	$ 11,470,000	$ 12,380,000	$ 11,990,000	$ 10,180,000	$ 11,060,000
Construction Legal	5%	$ 4,590,000	$ 4,930,000	$ 5,600,000	$ 6,040,000	$ 5,860,000	$ 5,730,000	$ 6,190,000	$ 6,000,000	$ 5,090,000	$ 5,530,000
Construction Administration	8%	$ 7,340,000	$ 7,900,000	$ 8,960,000	$ 9,670,000	$ 9,370,000	$ 9,170,000	$ 9,910,000	$ 9,590,000	$ 8,150,000	$ 8,850,000
Owner Administration	5%	$ 4,590,000	$ 4,930,000	$ 5,600,000	$ 6,040,000	$ 5,860,000	$ 5,730,000	$ 6,190,000	$ 6,000,000	$ 5,090,000	$ 5,530,000
Subtotal Project Costs		**$ 121,450,000**	**$ 129,920,000**	**$ 158,240,000**	**$ 158,640,000**	**$ 153,550,000**	**$ 176,840,000**	**$ 163,350,000**	**$ 158,360,000**	**$ 146,290,000**	**$ 146,730,000**
Hydropower Cost		$ 15,100,000	$ 15,100,000	$ 13,200,000	$ 13,200,000	$ 13,200,000	$ -	$ -	$ -	$ -	$ -
Grand Total		**$ 136,600,000**	**$ 145,000,000**	**$ 171,400,000**	**$ 171,800,000**	**$ 166,800,000**	**$ 176,800,000**	**$ 163,400,000**	**$ 158,400,000**	**$ 146,300,000**	**$ 146,700,000**

Summary of Alternatives and Costs		Alternative 4c	Alternative 5a	Alternative 5b	Alternative 6a	Alternative 6b	Alternative 7a	Alternative 7b	Alternative 8a	Alternative 9a	Alternative 9b
Inlet Option		Headbox	Headbox	Headbox	Headbox	Headbox	Integrated	Integrated	Headbox	Headbox	Headbox
Hydropower location		Existing	Existing	Existing	Existing	Existing	Dam	Dam	Existing	Existing	Existing
Route		DC + Kinley	E Access	E Access	W Access	W Access	WDC	WDC	WDC	WDC	WDC
Outlet location		Hwy 101 Br	Dry Cr	Confluence	DryCr	Confluence	DryCr	Confluence	DryCr	DryCr	Confluence
Route		$ 61,450,000	$ 54,960,000	$ 63,010,000	$ 57,060,000	$ 65,840,000	$ 51,340,000	$ 60,870,000	$ 56,000,000	$ 55,350,000	$ 69,820,000
Outlet		$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000	$ 4,090,000
Construction Subtotal		$ 65,540,000	$ 59,050,000	$ 67,100,000	$ 61,150,000	$ 69,930,000	$ 55,430,000	$ 64,960,000	$ 60,090,000	$ 59,440,000	$ 73,910,000
Contractor's Field Overhead and Mob/Demob	9%	$ 5,900,000	$ 5,310,000	$ 6,040,000	$ 5,500,000	$ 6,290,000	$ 4,990,000	$ 5,850,000	$ 5,410,000	$ 5,350,000	$ 6,650,000
Sales Tax on Materials and Rentals	2%	$ 1,310,000	$ 1,180,000	$ 1,340,000	$ 1,220,000	$ 1,400,000	$ 1,110,000	$ 1,300,000	$ 1,200,000	$ 1,190,000	$ 1,480,000
Contractor's Fee (Office Ovhd and Profit)	15%	$ 9,830,000	$ 8,860,000	$ 10,070,000	$ 9,170,000	$ 10,490,000	$ 8,310,000	$ 9,740,000	$ 9,010,000	$ 8,920,000	$ 11,090,000
Contractor's Bonds and Insurance	1%	$ 830,000	$ 740,000	$ 850,000	$ 770,000	$ 880,000	$ 700,000	$ 820,000	$ 760,000	$ 750,000	$ 930,000
Undefined Scope of Work Estimated Cost	25%	$ 20,850,000	$ 18,790,000	$ 21,350,000	$ 19,450,000	$ 22,250,000	$ 17,640,000	$ 20,670,000	$ 19,120,000	$ 18,910,000	$ 23,520,000
Route+Outlet Subtotal		$ 104,260,000	$ 93,930,000	$ 106,750,000	$ 97,260,000	$ 111,240,000	$ 88,180,000	$ 103,340,000	$ 95,590,000	$ 94,560,000	$ 117,580,000
Inlet		**$ 2,584,000**	**$ 2,584,000**	**$ 2,584,000**	**$ 2,584,000**	**$ 2,584,000**	**$ 22,000,000**	**$ 22,000,000**	**$ 2,584,000**	**$ 2,584,000**	**$ 2,584,000**
Construction Value Total		**$ 106,844,000**	**$ 96,514,000**	**$ 109,334,000**	**$ 99,844,000**	**$ 113,824,000**	**$ 110,180,000**	**$ 125,340,000**	**$ 98,174,000**	**$ 97,144,000**	**$ 120,164,000**
Environmental Mitigation and Permitting		$ 1,050,000	$ 12,250,000	$ 1,050,000	$ 12,250,000	$ 1,050,000	$ 12,250,000	$ 1,050,000	$ 12,250,000	$ 12,250,000	$ 1,050,000
EIR and Legal		$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000
Subtotal		**$ 110,394,000**	**$ 111,264,000**	**$ 112,884,000**	**$ 114,594,000**	**$ 117,374,000**	**$ 124,930,000**	**$ 128,890,000**	**$ 112,924,000**	**$ 111,894,000**	**$ 123,714,000**
Right-of-Way and Easements		$ 976,000	$ 5,391,000	$ 6,212,000	$ 12,250,000	$ 1,050,000	$ 12,250,000	$ 1,050,000	$ 12,250,000	$ 12,250,000	$ 1,050,000
Right-of-Way Acqusition and Legal		$ 244,000	$ 1,348,000	$ 1,553,000	$ 3,063,000	$ 263,000	$ 3,063,000	$ 263,000	$ 3,063,000	$ 3,063,000	$ 263,000
Subtotal		**$ 111,610,000**	**$ 118,000,000**	**$ 120,650,000**	**$ 129,910,000**	**$ 118,690,000**	**$ 140,240,000**	**$ 130,200,000**	**$ 128,240,000**	**$ 127,210,000**	**$ 125,030,000**
Engineering	10%	$ 10,680,000	$ 9,650,000	$ 10,930,000	$ 9,980,000	$ 11,380,000	$ 11,020,000	$ 12,530,000	$ 9,820,000	$ 9,710,000	$ 12,020,000
Construction Legal	5%	$ 5,340,000	$ 4,830,000	$ 5,470,000	$ 4,990,000	$ 5,690,000	$ 5,510,000	$ 6,270,000	$ 4,910,000	$ 4,860,000	$ 6,010,000
Construction Administration	8%	$ 8,550,000	$ 7,720,000	$ 8,750,000	$ 7,990,000	$ 9,110,000	$ 8,810,000	$ 10,030,000	$ 7,850,000	$ 7,770,000	$ 9,610,000
Owner Administration	5%	$ 5,340,000	$ 4,830,000	$ 5,470,000	$ 4,990,000	$ 5,690,000	$ 5,510,000	$ 6,270,000	$ 4,910,000	$ 4,860,000	$ 6,010,000
Subtotal Project Costs		**$ 141,520,000**	**$ 145,030,000**	**$ 151,270,000**	**$ 157,860,000**	**$ 150,560,000**	**$ 171,090,000**	**$ 165,300,000**	**$ 155,730,000**	**$ 154,410,000**	**$ 158,680,000**
Hydropower Cost		$ -	$ -	$ -	$ -	$ -	$ 13,200,000	$ 13,200,000	$ -	$ -	$ -
Grand Total		**$ 141,500,000**	**$ 145,000,000**	**$ 151,300,000**	**$ 157,900,000**	**$ 150,600,000**	**$ 184,300,000**	**$ 178,500,000**	**$ 155,700,000**	**$ 154,400,000**	**$ 158,700,000**

Table 8-7. O&M Costs for Integrated Inlet and Central Route Alternatives

Item	Basis	Cost	Present Value (2%, 50 yrs)
Annual O&M			
Inlet Works	Corps eval.	$26,000	$817,014
Annual Pipe Inspection	24 hr/yr	$8,000	$251,389
Flow Adjustment	8 hr/mo	$32,000	$1,005,555
Flow Monitoring during Storm Release	6 day/yr	$2,000	$62,847
Annual Cleaning Outlet Works	40 hr/yr	$13,000	$408,507
Materials		$2,000	$62,847
Total Annual O&M		*$83,000*	*$2,608,159*
Five Year Maintenance			
Outlet Works and Valves	10% of capital $	$42,000	*$259,647*
Total Five Year O&M		*$43,000*	*$259,647*
Twenty-five Year Replacement			
Excavate and replace material at screen	80% of capital $	$1,027,500	$626,293
Replace Valves	80% of capital $	$64,000	$39,010
Total 25 Year Replacement		*$1,091,500*	*$665,303*
Total O&M Cost			**$3,533,000**
Net hydropower Revenue		*($730,000)*	*($22,939,232)*
Total Present Value (2%, 50 years)			**($19,406,000)**

Table 8-8. O&M Costs for Integrated Inlet and Northern Route Alternatives

Item	Basis	Cost	Present Value (2%, 50 yrs)
Annual O&M			
Inlet Works	Corps eval.	$31,000	$817,014
Annual Pipe Inspection	24 hr/yr	$8,000	$251,389
Flow Adjustment	8 hr/mo	$32,000	$1,005,555
Flow Monitoring during Storm Release	6 day/yr	$2,000	$62,847
Annual Cleaning Outlet Works	40 hr/yr	$13,000	$408,507
Materials		$2,000	$62,847
Total Annual O&M		*$83,000*	*$2,608,159*
Five Year Maintenance			
Outlet Works and Valves	10% of capital $	*$43,000*	*$259,647*
Total Five Year O&M		*$43,000*	*$259,647*
Twenty-five Year Replacement			
Excavate and replace material at screen	80% of capital $	$1,027,500	$626,293
Replace Valves	80% of capital $	$64,000	$39,010
Total 25 Year Replacement		*$1,091,500*	*$665,303*
Total O&M Cost			**$3,533,000**
Net hydropower		*($720,000)*	*($22,624,996)*
Total Present Value (2%, 50 years)			**($19,092,000)**

Table 8-9. O&M Costs with Head Box and Central Routes

Item	Basis	Cost	Present Value (2%, 50 yrs)
Annual O&M			
Annual Pipe Inspection	24 hr/yr	$8,000	$251,389
Flow Adjustment	8 hr/mo	$32,000	$1,005,555
Gate Operation	3 day/yr x2	$16,000	$502,778
Flow Monitoring during Storm Release	6 day/yr	$2,000	$62,847
Annual Cleaning Outlet Works	40 hr/yr	$13,000	$408,507
Materials		$2,000	$62,847
Total Annual O&M		*$73,000*	*$2,293,923*
Five Year Maintenance			
Outlet Works and Gates	10% of capital $	*$50,000*	*$301,915*
Total Five Year O&M		*$50,000*	*$301,915*
Twenty-five Year Replacement			
Excavate and replace material at screen	80% of capital $	$1,027,500	$626,293
Replace Gate	80% of capital $	$96,000	$58,515
Total 25 Year Replacement		*$1,123,500*	*$684,808*
Total O&M Cost			**$3,281,000**
Net hydropower		*($660,000)*	*($20,739,580)*
Total Present Value (2%, 50 years)			**($17,459,000)**

Present Value Costs

Project capital costs (Table 8-6) were combined with the present value of the O&M cost estimates (Tables 8-7 through 8-9) to determine the Project Net Present Values listed in Table 8-10.

The least costly project, on a present value basis, is Alternative 1a, which includes the integrated inlet and an alignment along Canyon Road to the Russian River near Geyserville.

Table 8-10. Summary of Capital, O&M, and Present Value Cost Estimates

Alternative	Inlet/Route/Outlet	Capital Cost	Present Value O&M	Net Present Value
Northern Route Alternatives				
1a	Integrated/Canyon Rd	$136.6	-$19.1	$118
1b	Integrated/Canyon Rd	$145.0	-$19.1	$126
Central Route Alternatives				
2a	Integrated/DC+Westside	$171.4	-$19.4	$152
2b	Integrated/DC	$171.8	-$19.4	$152
2c	Integrated/DC + Kinley	$166.8	-$19.4	$147
3a	Headbox/DC+Westside	$176.8	-$17.5	$159
3b	Headbox/DC	$163.4	-$17.5	$146
3c	Headbox/DC + Kinley	$158.4	-$17.5	$141
4a	Headbox/DC+Westside	$146.3	-$17.5	$129
4b	Headbox/DC	$146.7	-$17.5	$129
4c	Headbox/DC + Kinley	$141.5	-$17.5	$124
5a	Headbox/E Access	$145.0	-$17.5	$128
5b	Headbox/E Access	$151.3	-$17.5	$134
6a	Headbox/W Access	$157.9	-$17.5	$140
6b	Headbox/W Access	$150.6	-$17.5	$133
7a	Integrated/WDC	$184.3	-$19.4	$165
7b	Integrated/WDC	$178.5	-$19.4	$159
8a	Headbox/WDC	$155.7	-$17.5	$138
9a	Headbox/WDC	$154.4	-$17.5	$137
9b	Headbox/WDC	$158.7	-$17.5	$141

Chapter 9 - Preferred Alternative

Based on the alternative evaluation results presented in Chapter 7 and the alternative cost estimates presented in Chapter 8, preferred alternative was identified. The sections below describe the preferred alternative, the permitting requirements and present a project implementation schedule.

Preferred Alternative Identification

The top 9 highest ranked alternatives from Table 7-8 are listed in Table 9-1 along with their capital and present value cost. The evaluation scores for the top 6 ranked alternatives are essentially equal, and among those, the least cost alternative is Alternative 4c. Alternative 4c uses a head box inlet, with a route along Dry Creek Road and Kinley Road to an outlet near the Highway 101 Bridge. To reduce pipeline construction cost, the route alignment uses private roads within agricultural property to avoid microtunnel construction in Dry Creek Road, while maintaining gravity flow conditions. The next two alternatives, Alternatives 4b and 4a, consist of the same head box inlet and alignment, but have a different outlet location. Alternatives 3a through 3c all use microtunnel pipe installation to keep the pipeline in Dry Creek Road at the high points; therefore these alternatives have a higher cost. Alternative 2a through 2c use the integrated inlet, and if the Corps share of the construction cost were to increase, these would be higher ranked and cost competitive with Alternative 4c and the other least cost alternatives.

Table 9-1. Top 9 Ranked Alternatives and Present Value Cost

Alternative	Evaluation Score	Evaluation Rank	Capital Cost	Present Value Cost	Key Difference from Alternative 4c
Alternative 4c (Preferred)	125.4	6	$141.5	$124.0	Head Box Inlet, Dry Creek Road and Private Road (Ag Land) to avoid microtunnel, HWY 101 Bridge Outlet
Alternative 4b	123.4	8	$146.7	$129.2	Confluence Outlet
Alternative 4a	125.6	5	$146.3	$128.8	Westside Bridge Outlet
Alternative 3c	126.8	2	$158.4	$140.9	Microtunnel to keep pipe in Dry Creek Road ROW
Alternative 3b	123.8	7	$163.4	$145.9	Microtunnel, Confluence Outlet
Alternative 3a	126.9	1	$176.8	$159.3	Microtunnel, Westside Bridge Outlet
Alternative 2c	126.1	4	$166.8	$147.4	Integrated Inlet
Alternative 2b	123.1	9	$171.8	$152.4	Integrated Inlet to Confluence Outlet
Alternative 2a	126.2	3	$171.4	$152.0	Integrated Inlet to Westside Road

The evaluation scores for the top nine alternatives range between 126.9 and 123.1 or about 3%. This is within the accuracy of the scoring evaluation and therefore, all alternatives are essentially equal and are equally viable as route alternatives. Within the top 9 route alternatives, the least cost alternative is Alternative 4c and is preferred because of its favorable evaluation score and cost. Alternative 4c uses a head box inlet, with a route along Dry Creek Road and Kinley Road to an outlet near the Highway 101 Bridge. However the Water Agency should monitor the Corps progress and cost. If the Corps moves ahead with the emergency water supply line to the fish hatchery and if the economics of partnering with the Corps is favorable to the Water Agency, the additional hydraulic head provided by the integrated inlet facility would facilitate a gravity pipeline constructed entirely within Dry Creek Road using open cut trench technology. Under these conditions, Alternative 2c should be considered, which is ranked slightly higher because the entire route remains in Dry Creek Road. The Water Agency could also consider Alternative 3c as an alternate to Alternative 4c. Alternative 3c uses microtunnel technology to keep the pipeline in the Dry Creek Road ROW, and therefore ranked higher, but it is more costly than Alternative 4c.

Inlet Structure

While the inlet facilities were equally rated, the lowest cost inlet facility for the preferred project is the head box, which saves the cost of a new hydropower facility by using the existing facility at the dam. As shown in Figure 9-1, the head box consists of a concrete box inlet to the bypass pipeline and a gate installed in the existing stilling basin which would increase the water elevation in the stilling basin such that it can be diverted into the bypass pipeline.

The most promising gate options within the stilling basin include an Obermeyer gate, Figure 9-2 and an inflatable dam, see Figure 9-3. Both gates install within the basin and allow adjustment as well as deflation to accommodate high flows during storm releases.

The head box may not ultimately be necessary, but has been included to allow installation of a weir to provide fine control of flow to the hatchery, as well as flow to the bypass pipeline and if needed, flow directly discharged to Dry Creek. If fine control is not required, the pipe could simply penetrate the stilling basin wall and enter the bypass pipeline without a box.

The maximum water surface elevation of the head box is estimated to be approximately 220 ft. This elevation should be revisited during design to determine the extent of backwater effects and to determine if a higher elevation would be feasible, since it could reduce or eliminate hydraulic constraints for the pipeline alignment.

Alignment

The alignment in Dry Creek Road, illustrated in Figure 9-4, is approximately 67,500 linear feet. As introduced above, the alignment follows Dry Creek Road except where the hydraulic head would require a bury depth greater than 25 ft (refer to the hydraulic profile in Figure 9-5). To avoid deep bury depths, the alignment was rerouted into adjacent private roads within agricultural property. As indicated in Figures 9-4 and 9-5, there are three locations where the alignment leaves Dry Creek Road, totaling approximately 10,000 linear feet. Figure 9-4 also illustrates the locations at which trenchless construction would be required if it is later

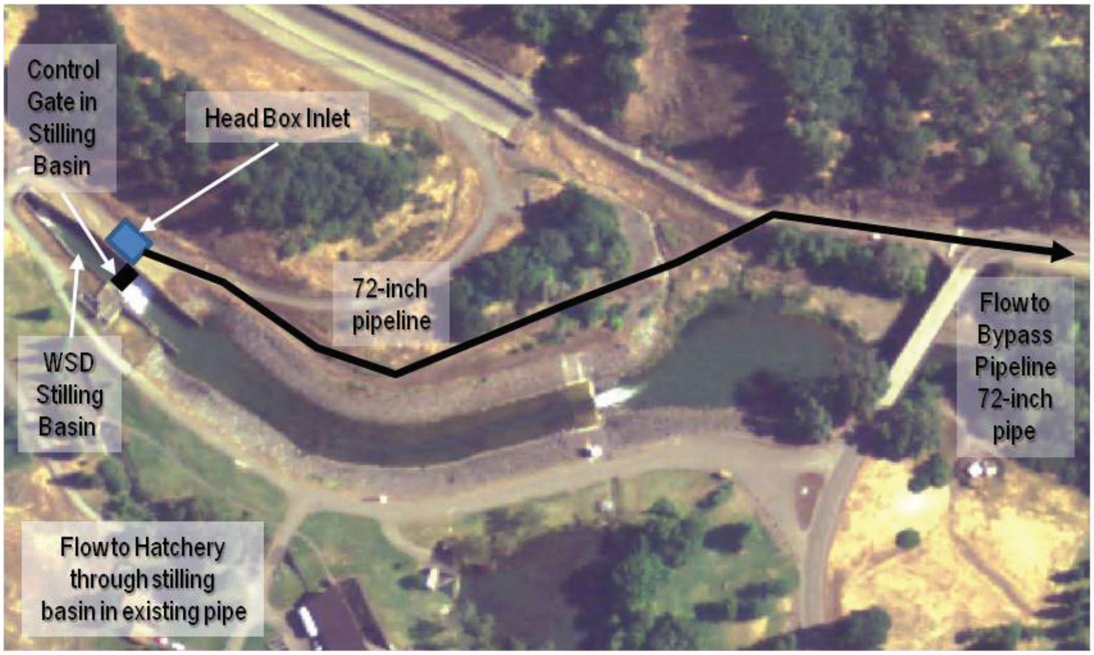


Figure 9-1. Central Route Inlet Facility – Head Box Inlet

Figure 9-2. Potential Gates Installed in the Stilling Basin – Obermeyer Spillway Gate Installation (left) In Service (right)

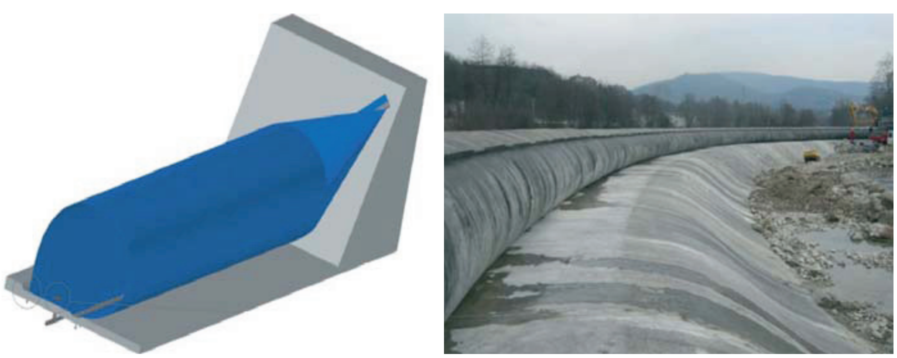


Figure 9-3. Potential Gates Installed in the Stilling Basin – Inflatable Rubber Dam Cut Away (left) In Service (right)

HDR

Figure 9-4
Central Route Pipeline Alignment
Dry Creek Bypass Pipeline Feasibility Study

SONOMA COUNTY WATER AGENCY

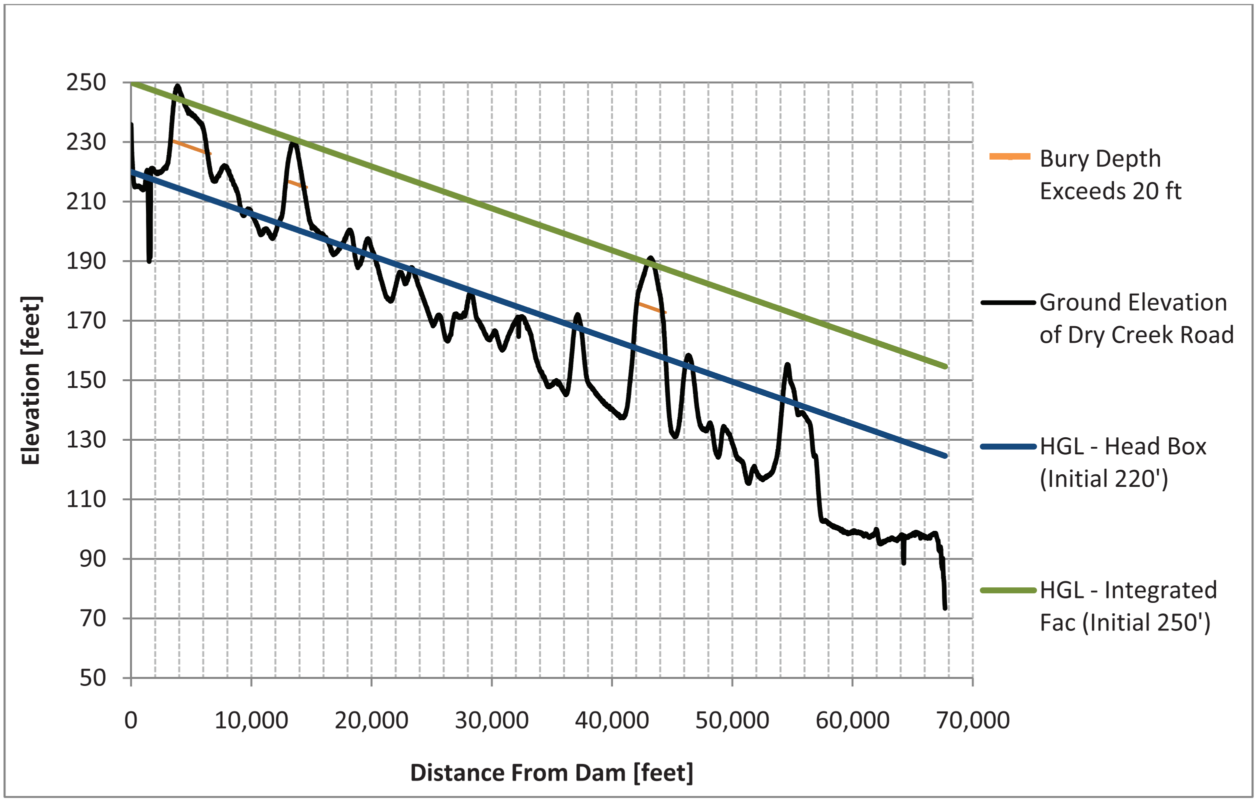


Figure 9-5. Central Route Hydraulic Profile

determined that Alternative 3c is preferred over Alternative 4c to avoid constructing the pipeline in private property.

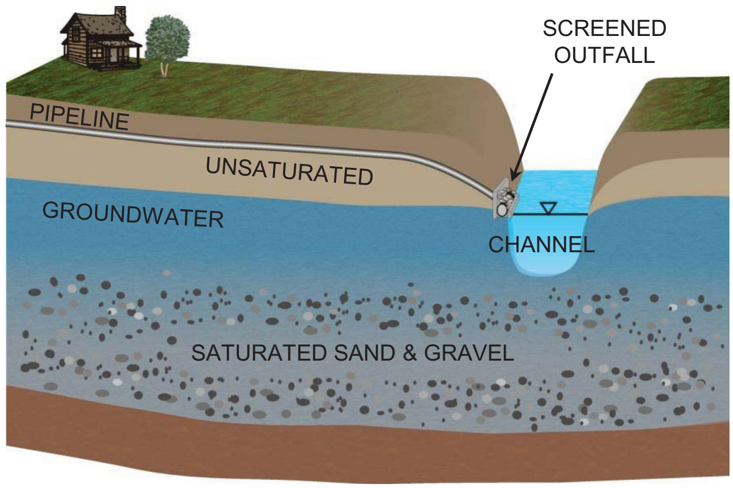
In addition to the hydraulic constraints, the alignment in Kinley Road must be carefully selected due to the presence of the City of Santa Rosa's 42-inch diameter reclaimed water pipeline, as well as a high pressure natural gas line and sewer pipelines. It is expected that some utilities would need to be relocated to accommodate the 72-inch diameter bypass pipeline.

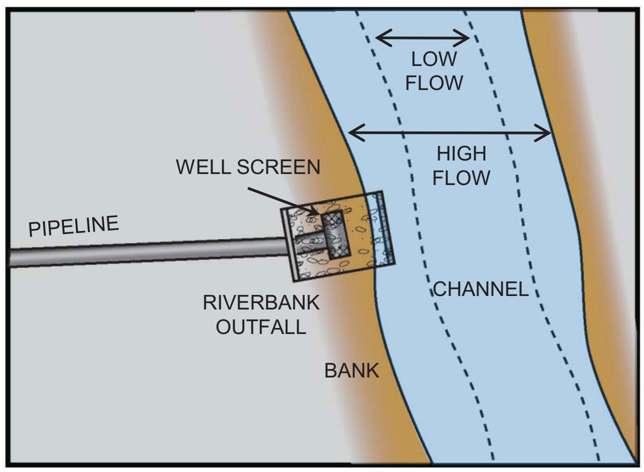
Outlet Facility

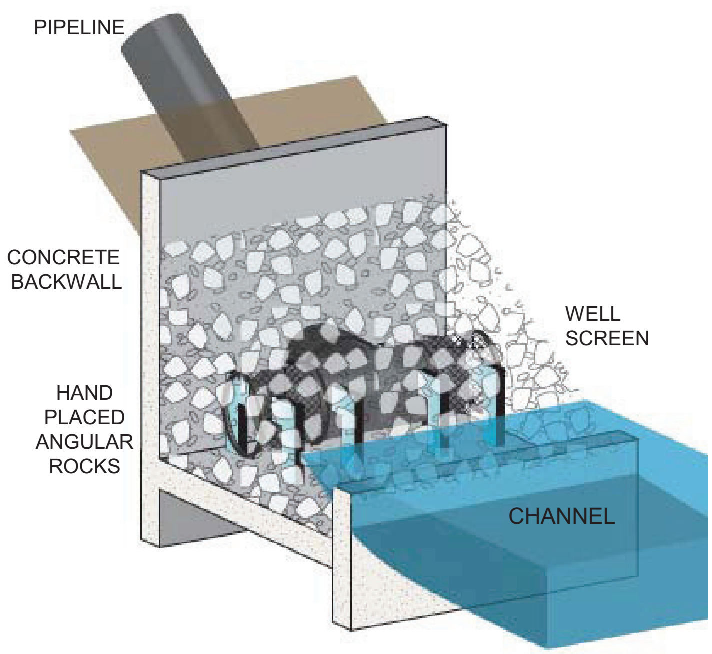
The outlet would be located at or adjacent to the Highway 101 Bridge, at or near river mile 33.2 on the Russian River (refer to Figure 3-7). The outlet facility is shown in Figure 9-6. Although the figure shows a riverbank outfall facility, the facility type will be confirmed in a subsequent study (Engineering Report).

Hydroelectric Facilities

With the head box inlet, the preferred project would continue to use the existing hydropower facility at WSD. The existing facility has a capacity of 2.6 MW and is projected to have an annual energy production of 12.9 million kWh/year.







Adapted from Conceptual Outlet Facility Evaluation TM
(Kennedy/Jenks Consultants, Feb 2010)

HDR

Figure 9-6
Outlet Facility
Dry Creek Bypass Pipeline Feasibility Study

SONOMA COUNTY WATER AGENCY

Since the existing turbine has a capacity of 185 cfs, the feasibility of adding another hydropower generator at WSD or increasing the capacity of the existing generator was considered. While the addition of another generator in the chamber next to the existing hydropower station may be feasible, it would result in a temporary loss of generation from the existing system for an extended period of time, and would only be able to generate power for flows above the existing flow of 185 cfs. Thus it is used infrequently. It was also determined that increasing the capacity of the existing generator is not feasible due to the existing configuration and space constraints.

Cost Summary for Preferred Alternative

The estimated capital cost of the preferred alternative is $141.5 million as itemized in table 9-2, below.

Table 9-2. Estimated Cost of Preferred Alternative, 72-inch Diameter Pipe

Item	Basis	Cost, 72-inch Pipe
Route		$ 61,450,000
Outlet		$ 4,090,000
Construction Subtotal		$ 65,540,000
Contractor's Field Overhead and Mob/Demob	9%	$ 5,900,000
Sales Tax on Materials and Rentals	2%	$ 1,310,000
Contractor's Fee (Office Overhead and Profit)	15%	$ 9,830,000
Contractor's Bonds and Insurance	1%	$ 830,000
Undefined Scope of Work Estimated Cost	25%	$ 20,850,000
Route+Outlet Subtotal		**$ 104,260,000**
Inlet		$ 2,584,000
Construction Value Total		**$ 106,844,000**
Environmental Mitigation and Permitting		$ 1,050,000
EIR and Legal		$ 2,500,000
Subtotal		**$ 110,394,000**
Right-of-Way and Easements		$ 976,000
Right-of-Way Acquisition and Legal		$ 244,000
Subtotal		**$ 111,610,000**
Engineering	10%	$ 10,680,000
Construction Legal	5%	$ 5,340,000
Construction Administration	8%	$ 8,550,000
Owner Administration	5%	$ 5,340,000
Total Project Costs		**$ 141,520,000**

Reduced Pipe Diameter Cost Estimate

A bypass flow of 180 cfs is based on a maximum flow in Dry Creek which is equivalent to the hatchery flows (60 cfs). If flow above 60 cfs are allowed in Dry Creek, the bypass pipeline could be reduced in diameter. The gate in the stilling basin may not provide fine control of flow; therefore a weir installed in the head box could be used to control the bypass flow. Flow discharged to the stilling basin would be split three ways: (1) to the hatchery, (2) directly to Dry Creek up to the maximum flow, and (3) flow to the bypass pipeline. Costs for the weir and head box were included in the cost estimate.

Pipeline costs are reduced because of a smaller pipe diameter and associated installation costs. Table 9-3 presents a project cost estimate for a project with a 48-inch bypass pipeline. As shown, outlet costs are also less, but not proportionally so. Many of the other costs are the same or reduce in proportion to project cost. Modifying the pipe diameter did not change the ranking order or the order of the project costs.

Table 9-3. Estimated Cost of Preferred Alternative, 48-inch diameter pipe

Item	Basis	Cost, 48-inch Pipe
Route		$ 44,691,000
Outlet		$ 4,090,000
Construction Subtotal		$ 48,781,000
Contractor's Field Overhead and Mob/Demob	9%	$ 4,390,000
Sales Tax on Materials and Rentals	2%	$ 980,000
Contractor's Fee (Office Overhead and Profit)	15%	$ 7,320,000
Contractor's Bonds and Insurance	1%	$ 610,000
Undefined Scope of Work Estimated Cost	25%	$ 15,520,000
Route+Outlet Subtotal		**$ 77,601,000**
Inlet		$ 1,824,000
Construction Value Total		**$ 79,425,000**
Environmental Mitigation and Permitting		$ 1,050,000
EIR and Legal		$ 2,500,000
Subtotal		**$ 82,975,000**
Right-of-Way and Easements		$ 976,000
Right-of-Way Acquisition and Legal		$ 244,000
Subtotal		**$ 84,195,000**
Engineering	10%	$ 7,940,000
Construction Legal	5%	$ 3,970,000
Construction Administration	8%	$ 6,350,000
Owner Administration	5%	$ 3,970,000
Total Project Costs		**$ 106,425,000**

Permitting Requirements

Table 9-4 identifies the potential permits required for construction and operation of the various project facilities, as well as the agencies responsible for those permits.

Project Schedule

The Dry Creek Bypass Pipeline project would be implemented if the on-going in-stream habitat improvement projects are not successful. As defined in the BO, studies, habitat restoration in Dry Creek and monitoring will be conducted between 2008 and 2018. In 2018, the success of the restoration projects will be evaluated and a decision made to continue the restoration projects or construct the pipeline bypass, if the restoration projects are unsuccessful.

Figure 9-7 shows a typical schedule for pre-design, NEPA/CEQA, permitting, design, and construction. There are several factors that may have an impact on the schedule including:

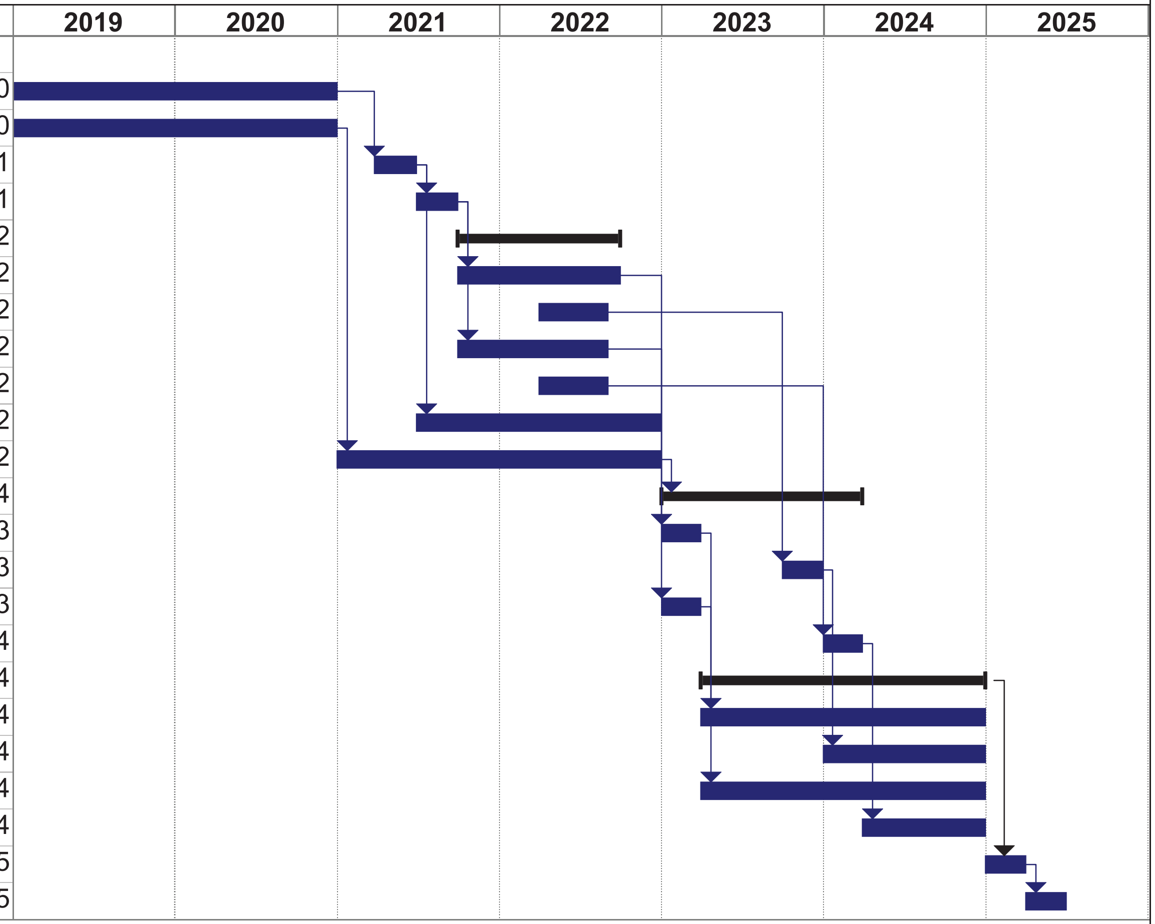
- Coordination with the Corps project to provide an emergency water supply to the Don Clausen Fish Hatchery.
- Schedule of the implementation and monitoring of the in-stream habitat enhancement projects.
- Phasing of construction
- Funding

Table 9-4. Potentially Applicable Permits and Approvals

Water Agency	Type of Permit or Approval	Regulated Activity	Review Period
Federal Agency Permits and Approvals			
Army Corps of Engineers	DA Permit (Section 404)	Discharge of dredged or fill material into waters of the U.S. (including wetlands).	6 to 8 months after application submittal. Application based on 50% design. 10 to 12 months if an individual permit is required.
Advisory Council on Historic Preservation	Section 106 Review and Compliance	Consideration of a Section 404 permit by the Corps.	Up to 6 months after DA permit application and any 106 study result submittal
USFWS/NMFS	Section 7 Consultation	Consideration of a Section 404 permit by the Corps.	4 to 6 months after DA permit application and BA submittal
State Agency Permits and Approvals			
Caltrans	Encroachment Permits	Use of California rights-of-way for installation of pipelines along state freeways and roads.	2 months after certification of EIR
Caltrans	Transportation Permit	Transport of heavy or oversized loads on state roads during construction.	1 day
CalOSHA	Permits for construction, trench excavations, and demolition	Construction of trenches or excavations 5 feet or deeper and into which a person is required to descend. Construction or demolition of any building, structure, scaffolding, or falsework more than three stories high. The underground use of diesel engines in working mines and tunnels.	1 week
DFG	Streambed Alteration Agreement	Crossing of streams, rivers, or lakes.	1 month
DFG	Section 2081 Management Agreement	Potential adverse effects to state endangered or threatened species or species proposed for state listing. Incidental "take" of state-protected species by a non-state entity.	7 months
State Lands Commission	Lease	Construction within State Lands Commission Jurisdiction.	
Water Resources Control Board	Petition for Change	Change in location or amount of current water discharge	6 to 12 months
Regional Agency Permits and Approvals			
RWQCB	General Construction Stormwater NPDES Permit	All stormwater discharges when clearing, grading, and excavation result in a land disturbance of 5 or more acres.	Prior to construction.
RWQCB	Section 401 Water Quality Certification	Discharge of fill materials to waters of the U.S.	6 months
Northern Sonoma AQMD	Authority to Construct and Permit to Operate	Any project that emits criteria pollutants. Project also subject to reporting under Toxic Hot Spots legislation (AB 2588).	1 year or longer
County and City Agency Permits and Approvals			
County	3836R Permit	Construction in flowing waters.	6 weeks
County	Road Encroachment Permit	New transmission, water, or gas line crossings, or construction on or across county roads.	1 to 2 months
County	Grading Permit	Certain grading activities if conducted prior to obtaining a building permit.	2 months
County	Transportation Permit	Transport of heavy or oversized loads on county roads.	1 day

Preliminary Project Schedule

Task Name	Start	Finish
Environmental Impact Report (EIR)	1/1/19	12/31/20
Design Confirmation and Predesign	1/1/19	12/31/20
Survey	3/26/21	6/28/21
Geotechnical Investigation	6/29/21	9/29/21
Design	9/30/21	9/30/22
Inlet	9/30/21	9/30/22
Hydropower	4/1/22	9/2/22
Pipeline	9/30/21	9/2/22
Outlet	4/1/22	9/2/22
Right-of-Way	6/29/21	12/31/22
Permitting	1/1/21	12/31/22
Bidding	1/2/23	3/28/24
Inlet	1/2/23	3/30/23
Hydropower	10/1/23	12/29/23
Pipeline	1/2/23	3/30/23
Outlet	1/1/24	3/28/24
Construction	3/31/23	12/30/24
Inlet	3/31/23	12/30/24
Hydropower	1/1/24	12/30/24
Pipeline	3/31/23	12/30/24
Outlet	3/29/24	12/30/24
Final Connections	12/31/24	3/31/25
Startup	4/1/25	6/30/25



Task | Milestone | Summary

Sonoma County Water Agency
Dry Creek Bypass Pipeline

Figure 9-7. Implementation Schedule

Appendix A

AGENDA | Wednesday, May 12, 2010, 2:00-4:00
Dry Creek Advisory Group
Russian River Instream Flow & Restoration Program

Location
Healdsburg Community Center, Library
1557 Healdsburg Ave.

Contact Information
Anne Crealock, Sonoma County Water Agency, 707-547-1948, annec@scwa.ca.gov

Time	Agenda Item
2:00	**Welcome, Introductions & Updates**
2:10	**Discussion with HDR: Draft Pipeline Feasibility Study** Discussion, Questions & Feedback
3:00	**Discussion with Inter-Fluve: Draft Dry Creek Current Conditions Report** Discussion, Questions & Feedback
3:55	**Wrap Up**

Welcome, Introductions & Updates

After introductions, Anne and others gave several updates. They included:

- Anne will be on maternity leave for several months starting in late July. During her absence, Ann DuBay will manage the Dry Creek Advisory Group.
- Anne stated that some DCAG members had expressed interest in bringing more landowners into the group and said that everyone should invite any landowners they would like to the meetings. The group can also add members if the group expresses support and those landowners are willing to commit to attending meetings and reviewing documents.
- Other items related to the Biological Opinion that aren't generally discussed at the DCAG meetings, include changes to estuary management and flow on the mainstem Russian River. A Notice of Preparation of Environmental Impact Report has been prepared for estuary management. Public meetings are currently scheduled at the Jenner Community Center on May 19 and at Sonoma County Permit and Resource Management Department Meeting Room on May 20. More information and the NOP are available at www.sonomacountywater.org. Additionally, as mandated in the BO, the Agency has petitioned the State Water Resources Control Board to reduce flows in the Russian River for summer 2010. Public meetings are scheduled for May 27,

June 2, and June 3. More information is available at http://www.scwa.ca.gov/public-notices/.

Discussion with HDR: Draft Pipeline Feasibility Study

Mark Hammer and Holly Kennedy from HDR were joined by Dawn Taffler and Timothy Monahan from Kennedy Jenks to give a PowerPoint presentation. (Please see PowerPoint Presentation at www.sonomacountywater.org/rrifr.) HDR last met with the DCAG on October 22, 2009 to seek input on screening criteria. They have now incorporated those ideas into their draft feasibility study. When it becomes available, the draft study will be distributed to DCAG members for review. Anne then referred the group to a handout for more information on the timeline for pipeline-related work.

The screening and evaluation process has 2 steps. First, the individual inlet, pipeline route, and outlet options go through an initial screening process to evaluate feasibility from a technical perspective. Next, the resulting set of individual options are combined into complete alternatives and evaluated more thoroughly according to engineering and environmental criteria. The result is a list of ranked alternatives, each including an inlet, route, and outlet. At this time, only the initial screening process has been completed.

INLETS

Four inlet options were included in the initial screening process:

- a new inlet and tunnel through the left abutment (left side of dam)
- a new head box at the existing outfall structure
- a new integrated facility that would include partnering with the Corps on a new tunnel/pipeline tapping into the existing wet well (right side of dam)
- a siphon over the top of the dam

After the screening criteria were applied, two inlet options remained feasible: the headbox at the outlet/stilling basin and the tunnel/pipeline with the Corps.

The inlet option is important because it determines, to a large extent, which routes are feasible. An inlet at the existing outfall structure does not produce as much water pressure as the Corps tunnel/pipeline through the right side of the dam. That pressure is needed, in some cases, to push water over hills on its way to the Russian River.

PIPELINE ROUTES

Northern route options include tunneling through the hills east of Lake Sonoma and Dry Creek, a pipeline down Dutcher Creek Road, and a pipeline down Canyon Road. Tunneling through the hills was quickly eliminated because tunneling through those types of rocks is very risky (shale, conglomerate, etc.). A northern route along Dutcher Creek Road was eliminated because it would require significant pumping to get the water over those higher elevations. The Canyon Road route is feasible in combination with the Corps tunnel through the dam because that inlet option provides enough pressure to push the water over the hills to Geyserville.

The four Central routes include Dry Creek Road, West Dry Creek Road, access roads adjacent to the creek on the west side, and access roads adjacent to the creek on the east side of Dry Creek. All four routes passed the initial screening if the Corps tunnel inlet option is used. If the headbox inlet option is used then the Dry Creek Road and West Dry Creek Road routes become more problematic due to a lack of pressure to push the water over the topography. It was noted that the access road routes, however, would involve working with many property owners, creating a set of other challenges. All four routes are approximately the same length.

A southern route to Mirabel/Wohler was eliminated due to the capacity limits at the existing ponds.

OUTLETS
Outlet design options fall into two categories: riverbank outfalls and diffusers. Various options in each category were including in the initial screening with varying results. One option, the screened riverbank outfall did very well under both categories. In many cases, options that did well under engineering criteria did not do well under fisheries criteria and vice versa. However, the consultant emphasized that the feasibility and potential impacts of each option varies considerably from site to site so more evaluation would be needed once potential locations are chosen.

HDR screened various outlet locations, including a few on Dry Creek at Westside Bridge and near the confluence with the Russian River, and several on the Russian River at Geyserville, the Highway 101 overpass at Healdsburg, and near the confluence with Dry Creek.

The inlet, route, and outfall options will be evaluated further according to both engineering and environmental criteria, including those created by the DCAG in October of 2009.

Q&A
Comment: West Dry Creek Road doesn't go all the way to the dam. There are 3 properties that you'd need to get through.

Response: HDR was aware of that and stated that access issues will be included in the evaluation of all the options.

Question: Did you look at any options from the northern areas of Lake Sonoma to Cloverdale?

Response: No. The project would run into the same or even greater problems getting over or through those hills.

Question: What water elevations did you look at?

Response: HDR looked at several, including a 1 in 100 year low lake level, and were conservative in the feasibility analysis. The average water level is about 440 feet but the worst case scenario considered was 280 feet.

Question: Are you looking at impacts to the Russian River if the outlet is at Geyserville? What kind of fish impacts are we talking about?

Response: Yes. HDR will look at it. There would be an impact at whichever location is chosen. On one hand, fish like cold water. On the other hand, the water will likely have lower dissolved oxygen levels. Fisheries biologists do this part of the analysis.

Question: What kind of costs are we talking about?

Response: There are too many factors and not enough design done to know but that information will be available later in the process. Tunnels are more expensive. Length of the pipeline is one factor but there are many other factors that would affect cost.

Question: What about impacts at the outfalls?

Response: Some designs are lower impact than others. The screened outfall is buried and has less of a visual impact. The radial injection well has arms that reach out and diffuse water slowly. You don't know which option has the least impact until you look at the geology, hydrology, etc. of a specific site. More will be done to evaluate impacts of these options during the next stage of evaluation.

Question: Why look at outlets in Dry Creek? Wouldn't that defeat the purpose of the habitat enhancement?

Response: The outlet locations on Dry Creek would be located in the bottom two miles. HDR would have to work closely with Inter-Fluve to make sure that habitat enhancement of those bottom two miles is done to handle extra flow.

Question: What kind of flow are we talking about?

Response: From a 72-inch pipeline, there would be a maximum of 180 cfs but generally it would be less than that.

Question: Would multiple outlet locations reduce the impacts? Or would that be cost prohibitive?

Response: In most cases, multiple outlets just end up creating multiple impact areas. It's generally better to mitigate the impact in one area rather than multiple areas.

Question: What water quality issues are going to be considered?

Response: Water temperature, velocity, turbidity, dissolved oxygen, and others. Attraction flow shouldn't be an issue for fish since all the hatchery flow will be going down Dry Creek.

Question: Could cold water spots attract salmonids and therefore predators? That is a problem in some other river systems.

Response: Right. That issue will be considered.

Question: Could length of pipe affect dissolved oxygen?

Response: HDR will be considering water quality before and after a run through a pipeline.

Question: What happens to Dry Creek in the summer if the pipe is running 180 cfs? Does it go dry?

Response: There are still minimum flow requirements in Dry Creek. The summer flow would be around 40-60 cfs down Dry Creek.

Discussion with Inter-Fluve: Draft Current Conditions Report

Last summer, Inter-Fluve collected data throughout much of Dry Creek to get a "snapshot" of Dry Creek's current conditions. On January 27, they reported many of their findings to the Dry Creek Advisory Group and at a public meeting afterwards. Since then, they have compiled their data into a draft report. This report was distributed to all official members of the DCAG for review. Comments are due on May 14 at 5pm. Individuals were encouraged to talk to Anne for an extension if needed. Anne referred group to timeline handout.

Inter-Fluve's studies are being conducted in two phases. First, Inter-Fluve has just completed an inventory of Dry Creek's current conditions. They have conducted field work and have collected other resources (past studies, aerial photos, discussions with landowners, etc.) to produce a current conditions report to describe watershed characteristics and history, hydrology, stream geomorphology and existing fish habitat as they stand today, and a preview of enhancement opportunities. Second, Inter-Fluve will complete a feasibility and conceptual design. This phase will explore locations along Dry Creek and conceptual designs that may be feasible in those locations to provide coho and steelhead habitat. Inter-Fluve will consider how hydrological, hydraulic, vegetative, geomorphic and other factors interact in order to design feasible projects that are sustainable and viable over time, given the challenges of high winter flows. Both system-scale and project-scale feasibility will be considered.

Inter-Fluve will work on the feasibility analysis during the spring and summer of 2010. During the fall of 2010, Inter-Fluve will work on concept designs and ranking of opportunities. During the summer of 2011, the Agency should be ready to break ground on a demonstration project along one mile of Dry Creek with a group of landowners who have volunteered to take part. The Agency hopes that this first mile will satisfy NMFS and DFG requirements so that it qualifies as the first of 6 miles of habitat restoration.

Q&A

Question about Table 8 on page 26: It looks like the units converting feet to meters in the table are wrong. Also, are these really the most recent thalweg measurements? They're from 1984 and there should be some more recent data.

Response: The units in the table are meters with standard deviations in parentheses, not feet to meter conversions. Inter-Fluve will try to make the table caption more clear; it's taken straight from the 1984 report we referenced. It includes the most recent data available regarding thalwegs on Dry Creek that resulted from a USACE effort to measure the same cross sections over time. The effort began in 1967 and the last known measurement was in 1984. Inter-Fluve will take new measurements as part of the feasibility report at many of the same locations and compare them to the historic data to look at factors such as downcutting. Inter-Fluve has also consulted USGS cross sections at Yoakim Bridge and other locations. The rating curves at Yoakim Bridge suggest significant changes at the location over the history of the gage (since 1960).

Question: What's an area of interest?

Response: A few different approaches may be utilized to enhance rearing habitat: enhancing existing pools, seed riffles to break up especially long pools and glides, and off-channel alcoves and backwater habitats (where there is space to do this). The areas of interest are primarily wider areas in the creek corridor where there may be space to create channel alcoves and backwater habitats, which are especially beneficial for coho. Off-channel habitat would need to be hydrologically connected to the creek all year long. Comparing what they saw last year and this year (after the winter flows) will help them decide what configurations are sustainable through winter flows. Inter-Fluve will be investigating areas of interest in addition to other locations over the next year. They'll collect more data and do modeling to help prescribe specific projects for different sites.

Question: Why are there such large gaps of time in your aerial imagery? Do you think it's all you need to predict what you'll see?

Response: Inter-Fluve included the aerial photos to show where the creek has moved over time and only included 3 overlapping images to make the figure less confusing. However, they've consulted aerial photos that were taken about every ten years starting in the 1940's through just a few years ago. This has given them a pretty complete record of how the creek has moved. Additionally, aerial imagery has shown the changes in vegetation before and after Warm Springs Dam. After construction of the dam, the gravel bars became vegetated. This makes them hydrologically rough which focuses flow in the primary channel, which may locally cause incision. Slower flow over the rough gravel bars causes sediment to drop, thus building them higher. So the active channel deepens while the gravel bars get taller.

Question: What about sediment supply?

Response: Above Peña Creek, the flows are removing smaller particles from the gravel (armoring process). However, down near Westside Bridge/Mill Creek/confluence with the Russian River, sediment drops out when the River levels are high and flow backs up. This reach may be aggradational. Between Pena Creek and Westside Bridge, conditions are more variable due to successive tributary sediment inputs and other factors.

Question: How do you measure success?

Response: The Water Agency has contracted with ESSA out of British Columbia to come up with an adaptive management framework to help the Agency define success as the work proceeds and lessons are learned along the way. This group is very experienced doing similar work in California and other areas in the west.

Question: How many fish are we expecting to see as a result of these improvements?

Response: According to page 282 of the BO, NFMS and DFG see the potential for approximately 50,000 to 150,000 juvenile stealhead and 30,000 juvenile coho.

Comment: NMFS commented that staff has really liked Inter-Fluve's work thus far and has ground-truthed some of their data with very good results.

Comment: I feel there should be a technical advisory committee beyond the advisory group overseeing Inter-Fluve's work. There should be a hydraulic engineer reviewing Inter-Fluve's report.

Response: The technical advisory committee currently includes SCWA, NMFS, and DFG staff and includes expertise in geomorphology, fisheries, hydrology, etc. Once we get to the design stage, we'll include engineers in the process. There will be an internal discussion with NMFS and DFG to decide whether or not to add technical advisors.

Question: If a 72-inch pipeline would carry a max if 180 cfs in the summer, what about winter flows? Landowners are concerned about winter flows.

Response: The BO only requires the Agency to look at conveying summer flows. The decision about if and how to use the pipeline during the winter would be separate. That said, habitat enhancements will be planned to be viable considering higher winter flows.

Wrap Up

Anne reminded the group that, aside from verbal comments made today on Inter-Fluve's draft report, DCAG members can submit comments by mail, email, or fax. Also, when HDR's draft report is ready, it will be distributed to DCAG members for their review.

AGENDA | Thursday, October 22, 2009, 10-11:30
Dry Creek Pipeline Workshop
Russian River Instream Flow & Restoration Program

Location
Healdsburg Community Center, Room 4 (moved to Library)
1557 Healdsburg Avenue

Contact Information
Anne Crealock, Sonoma County Water Agency, 707-547-1948

Time	Agenda Item
10:00	**Welcome & Introductions**
10:10	**Discussion with HDR** Feasibility Study Process & Current Status Feedback on Map Criteria Other Questions & Concerns
11:25	**Wrap Up**

Attendees:

Anne Crealock, SCWA
Bill Hearn, NMFS
Bob Anderson, United Winegrowers
Don McEnhill, Russian Riverkeeper
Edson Howard, DCVA
Erik Brown, SCWA
Fred Corson, DCVA, Clean Water Coalition-WSC
Glen Wright, City of Santa Rosa, WAC
Holly Kennedy, HDR
Jessica Martini-Lamb, SCWA
Jim Grossi, CSW / Stuber-Stroeh
John Nagle, EJ Gallo
Judith Olney, DCVA
Mark Hammer, HDR
Merle Griffin, ACOE
Pete Downs, Kendall-Jackson
Richard Rued, Landowner
Rick Rogers, NMFS
Rue Furch
Tom Roth, Rep. Lynn Woolsey's office
Tom Yarish, Spawn, Friends of the Esteros

Welcome & Introductions
The Biological Opinion requires SCWA to study a potential pipeline from Lake Sonoma to the Russian River for current water supply. This pipeline would only be built if the habitat enhancement work in Dry Creek doesn't meet success criteria. The decision to pursue the pipeline would take place in 2018 (see handout with Dry Creek habitat enhancement flowchart). The purpose of today's meeting is to discuss this pipeline, get input from the group in some key areas, and address questions and concerns.

SCWA is designing the pipeline to handle a range of flows for current water supply, including 70cfs, 100cfs, and 180cfs. The worst case scenario (critically dry) would require a 72-inch diameter pipeline.

SCWA hired HDR to conduct a feasibility study for a pipeline. This study is looking at inlet options, pipeline routes, and outlet options from a technical / engineering perspective. There are a few key ways that this group can provide input to influence this process. Mark and Holly from HDR will talk more about that.

Discussion with HDR
HDR is looking at inlet options, outlet options, and pipeline routes.

Inlet Options
Inlet options include:

- headbox at stilling basin,
- siphon over dam,
- new works at the left (west) abutment, and
- tie to existing wet well in partnership with a pipeline project by the US Corps of Engineers.

Siphoning over the dam wouldn't work at low lake levels.

If we tie into the existing wet well, there would be enough head at the dam to push water through the valley or over Canyon Road. We would place new power generator at the base of the dam then run the pipeline down the valley to the Russian River or to Dry Creek between West Side Road bridge and the Russian River. Alternatively, we could use the water level behind the dam to push water over Canyon Road to a discharge to the Russian River near Geyserville. We would place a power generator on the downhill side before the outlet at the Russian River. Because there would not be enough water to operate the existing generator in the inlet tower, the existing power generator at WSD would not be used.

Having enough head at the dam affects which routes are feasible.

If we tie into the headbox at the stilling basin, there is enough head (water level) to flow water down the valley. A pump station would be needed (not enough head at the dam) to pump the water over Canyon Road. A generator station on the downhill side before the outlet at the Russian River would be required to recover the energy to pump over Canyon Road.

A generator requires 85 cfs to work. The flow in the pipeline would depend on what the final flow recommendations are to comply with the Biological Opinion.

Outlet Options
The outlet options begin at West Side Road bridge and continue along the 2.2 miles to the Russian River on the west and east sides of Dry Creek. There are at least 9 potential outlet locations in this area. The outlet option for the Canyon Road route is located at the Russian River near Geyserville. There are two possible discharge points from Canyon Road, one is a shorter distance but the other may have better stream stability.

There are many designs for outlet works including diffusers and others, the suitability of which will vary depending on conditions at each site.

Question: What about tunneling?

Answer: Tunneling under Canyon Road to Geyserville would be a very expensive option because it's only possible to drill .5 miles at a time. Then another vertical shaft is needed to access then next .5 mile of horizontal tunnel.

HDR will take the inlet options, route options, and outlet options and link them up to create alternatives.

Concern: Some of the water put into the Russian at Canyon Road could disappear before it reaches Wohler.

Response: Bill Hearn thought that the introduction of cold water to the Russian River at Geyserville could benefit salmonids in the mainstem.

Discharge into Dry Creek would require significant improvements to Dry Creek in that stretch, necessitating two channels, one for fish and another for water transmission.

Concern: If the habitat enhancement projects didn't work elsewhere in Dry Creek, why would they work in the bottom 2.2 miles?

Response: This would be different type of work. Not focusing on habitat enhacement but on passage and conveyance of water.

Concern: Earthquake faults, erosion.

Response: There are engineering solutions for these issues.

Concern: Dam instability, siltation. How long will dam be in use?

Response: Data is available in FERC documents. Mike Dillabough from USACE has info and has estimated approximately a 100-year timeline before the lake has lost 50% capacity. USACE is waiting for funding to study this.

Route Options
Routes along Dry Creek Road would tie up one lane to construction along fairly short segments at a time. There are some high points in the road that would present a challenge depending on the inlet works. A tie to the existing wet well would work but the headbox at the stilling basin would not because the pipe would need to be constructed 30-40 feet deep in places.

West Dry Creek Road is narrow and construction would take up the whole width of the road one segments at a time, however there are fewer hills to complicate construction.

Comment: There will be more resistance from landowners if construction takes place along West Dry Creek Road than along Dry Creek Road.

Another option is to construct along the access roads that parallel Dry Creek itself. The slope would be helpful and trenches would be less deep.

Comment: There will be even more resistance from landowners if construction takes place along the creek.

Another option is Dry Creek Road to Canyon Road emptying into the mainstem near Geyserville.

Comment: Bill Hearn expressed his initial support for this option.

The use of a headbox at the stilling basin would make some route alternatives infeasible. For example, the lower water level requires a pumping station to pump over Canyon Road to the Russian River at Geyserville.

Criteria/Concerns Discussion

HDR discussed the process for coming up with criteria for evaluating the alternative routes, inlets, and outlets. The group was asked to contribute their ideas for criteria.

Concerns/Criteria as listed by group:

- Stability of Dry Creek relies on riparian trees. Construction near the riparian corridor could damage tree roots, reducing bank stability.
- Landowner rights / right-of-way issues if construction were to take place along riparian corridor
- Channel enhancement in bottom 2.2 miles of Dry Creek
  - General concern as to what this entails and its potential for success/failure (HDR clarified that it refers to habitat enhancement and the use of side channels for fish habitat)
- Concerns about stability of structures/banks with high flows
- Impacts to Russian River (Would there be positive impacts resulting from the Canyon Road route? Water Quality/temp, etc?)

- Impact at Dry Creek/Russian River confluence if Canyon Road option is pursued (loss of cold water/habitat at this location)
- Impacts of diversions to pipeline on groundwater, especially after a series of dry years
- Construction seasonality
    - Especially impacts to agricultural operations during harvest, crush
    - Impacts to recreation, especially cycling, during the summer
- Control of water (loss of water in mainstem to diverters under Canyon Road option)

Mark from HDR explained that the group's input will be used to draft criteria and prepare a technical memo with technical criteria and screening analysis criteria. Alternatives would then be developed. The group will be consulted again to help weight the criteria. Once that is done, HDR will use the ranking criteria and weighting factors to develop a prioritized list of alternatives.

Comment: Request to see a timeline for the feasibility study.

Response: Erik and Mark to work on this.

Wrap Up

- Anne will get criteria/concerns to HDR and minutes to group.
- Erik and Mark to create a timeline for the feasibility study for distribution.
- HDR will then distribute the draft criteria and instructions for providing input on weighting criteria via email.
- HDR will then distribute the results to the group.

Appendix B

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Meeting Notes

Subject:	Initial Meeting with the North Coast Regional Water Quality Control Board		
Client:	Sonoma County Water Agency		
Project:	Dry Creek Bypass Pipeline Feasibility Study	Project No:	
Meeting Date:	July 14, 2010	Meeting Location:	DCJ Room
Attendees:	Michele Stern, HDR; Mark Hammer, HDR; Connie Barton, SCWA; David Manning, SCWA; Mark Neely, RWQCB; David Leland RWQCB; John Short, RWQCB; Craig Lichty, Kennedy/Jenks; Erik Brown, SCWA; Bob Klamt, RWQCB; Pam Jeane, SCWA; Cat Kuhlman, RWQCB; Jay Jasperse, SCWA		
Notes by:	Mark Hammer, HDR		

Topics Discussed

I. Project needed to comply with the Biological Opinion (BO)

- Three salmon species are federally listed as threatened or endangered (Coho salmon, steelhead, and Chinook salmon). To avoid the likelihood of jeopardy to the species, Sonoma County Water Agency (SCWA) is working with National Marine Fisheries Service (NMFS), California Fish and Game (DFG), and the U.S. Army Corps of Engineers (Corps) to promote enhancements to the habitat. One of the BO requirements is to investigate the feasibility of constructing a pipeline to deliver water from Lake Sonoma to the mainstream of the Russian River. This bypass pipeline would divert flow prior to the hatchery, parallel to Dry Creek, and back to the Russian River.
- The Feasibility Study to evaluate the inlet, pipeline route, and outlet options has been completed and project alternatives consisting of 1 inlet, 1 route, and 1 outlet location are currently being evaluated. The Feasibility Study needs to be completed by early December according to the BO. The Engineering Report containing the modeling results in support of the Environmental Impact Report (EIR) will be completed by the spring of 2011.

II. Range of bypass and Dry Creek flows

- The hatchery flow would always flow through Dry Creek and the estimated hatchery flow is 60 cubic feet per second (cfs). The viability of higher flows has not been determined. Bypass flows could range from 80 to 180 cfs.
  - Q: How does this compare with current agency flow rates?
  - A: Flow rates are currently being limited, but previously, high flows were in the 175 cfs range with peak flows of 210 cfs. SCWA is limited by existing water rights.

III. Public Involvement

- SCWA and their consultants are currently working with a Dry Creek Advisory Group consisting of land owners, fisheries representatives, and interested parties. The handout provided at this meeting was part of a presentation to that group.

IV. Project Alternatives

A. Inlet Options

1. A new control structure on the left Dam abutment.

2. SWCA would partner with the Corps to provide a new pipe from the existing control structure. Per the BO, the Corps is planning a 48-inch-diameter pipe in a tunnel to provide a backup supply to the hatchery. SCWA and the Corps are looking to upsize the 72-inch pipe, which will provide enough capacity for both the hatchery and the bypass pipeline.
3. A headbox at the existing spillway could be constructed to divert excess flow into a bypass pipeline.

B. Pipeline Route Options

1. Northern routes to the Russian River at Asti or Geyserville.
2. Central routes to the Russian River at the confluence with Dry Creek or Dry Creek at the Westside Road Bridge.
3. Southern route, which would extend a portion of the flow from the Central Route to SWCA's facilities.
    - Q: Would the pipelines be in the road?
    - A: Two of the routes that would use Dry Creek Road and West Dry Creek Road are in paved roads. The routes parallel to Dry Creek would be in farm access roads that are not paved.

C. Outlet

Outlet locations were developed for each of the routes. Several outlet locations are viable from a construction perspective. The outlet facility types include river bank outfalls and in-river or in-bed diffusers. Each facility type varies in its ability to mix and distribute the water, increase DO concentration, and potentially increase turbidity, particularly during the initial use of the facility seasonally. Some options could be co-located with existing bridge structures or proposed in-stream fish habitat improvements for operations access and stability. More than one outlet may provide operational advantages with respect to managing receiving water impacts. It is anticipated that water quality monitoring, active management of outlet works, and best management/operating practices will be required to operate facilities. In-river diffusers are proposed for a project with Santa Rosa.

The NCRWQCB is preparing a draft plan to be released in the fall of 2010 regarding DO BP Objectives. BP Objectives for Temperature will not be changed. NCRWQCB staff are interested in seeing water quality data and approaches that are targeted at demonstrating and confirming objectives can be met and measured/managed. Existing lake, Dry Creek and Russian River data are of specific interest for T, DO and turbidity (along with historical flow/stage data). Some NCRWQCB staff and meeting attendees consider the possibility that the bypass pipeline could offer environmental benefits in conveying water, as bypass flows would not experiences agricultural-related water

V. Technical information needed to show compliance with Basin Plan

- Water quality constituents of interest include: DO, temperature, and turbidity. All of these will be evaluated as part of the Engineering Report.
- DO. Water taken from Lake Sonoma through the control structure may have a DO concentration less than the Russian River. Some of the outfall alternatives can be configured to enhance aeration and increase DO prior to release to the Russian River, others may require mechanical aeration. The head box option offers some aeration as the water leaves the structure, but the other alternatives do not have good opportunities to increase DO prior to the bypass. TMDL limits for DO have been established for the Klamath River and will be developed for the rest of the region.
- Temperature. Water from Lake Sonoma will be split with flows of about 60 cfs going to the hatchery and then to Dry Creek; flows up to 180 cfs in the bypass pipeline. The water temperature is the same at the Dam and will change little once in the pipeline, while the flow down Dry Creek will vary depending on the ambient temperature. In general, bypass water will be colder than water flowing down Dry Creek.
- Turbidity. The outfall facility type varies in the degree to which discharge may transport sediment and increase turbidity. In addition, it has been noticed that during certain spring months, the turbidity in Lake Sonoma is greater than the turbidity at the confluence of Dry Creek and the Russian River. This may be due to turnover in the lake.

- Bypass water will be the same water withdrawn using the control structure at an elevation that does not draw sediment, and therefore, does not contain mercury or other contaminants.

VI. Process for future communication

- A stormwater construction permit and a Section 401 water quality certification will be required for construction.
- No NPDES permit is being contemplated.
- SCWA will provide an Engineering Report Work Plan Presentation to NCRWQCB showing the specific analyses, modeling, evaluations that will be performed to respond to their issues and to support the preparation of the Project EIR, should one be initiated in the future.
- Other project updates will be provided as work progresses.

Appendix C

A number of key assumptions were made to support the execution of the Dry Creek Bypass Pipeline Feasibility Study. These assumptions and the respective impacts to the project if the assumptions are changed are summarized in the table below.

Key Assumptions and Impact to the Project

Assumption	Impact to Project
Inlet Related Assumptions	
The Corps would allow installation of a gate in the stilling basin to raise the water level for diversion	Without the gate, the head box option would not be feasible
Maximum water level in the stilling basin is 220 feet and an impoundment for diversion would require a head box	Pipeline and inlet capital costs could be reduced if the water level were higher and if the head box could be eliminated
The integrated facility would use the Emergency Water Supply Line as the primary water supply and the control structure as the emergency supply	Control strategy would need to be revisited during design
The Corps would allow construction of a hydropower facility on the emergency water supply line and would operate it as the primary supply for both the bypass and hatchery flows	Income from hydropower generation may be reduced if a new hydropower facility uses only the bypass flow to generate hydropower
For options where hydropower is only generated on the bypass flow, an in-line turbine could be used on the hatchery flow	Hydropower income would be reduced if power is not generated on the hatchery flow
Corps will fund their proportional share and lead the integrated inlet	If the Water Agency selects the integrated inlet and the Corps does not receive funding, the Water Agency may incur increased costs
Route Related Assumptions	
72 inch pipe is the largest pipe size considered and evaluated	Based on Water Agency input, a maximum of 180 cfs (72 inch pipe) is required to bypass all but the hatchery flows; smaller pipeline diameters would reduce capital cost
Trenchless construction would be used for stream crossings and environmentally sensitive areas	If open cut construction of the streams and sensitive areas were allowed, the cost savings could be used to cover environmental mitigation costs
Trenchless microtunnel construction would be through soil and not through rock	Construction along the Central Routes are in sedimentary material and should not contain rock, the Northern Route may contain rock and could slightly increase the cost
Outlet Related Assumptions	
NPDES permit would not be required to discharge bypass water into the Russian River	Permitting cost, operating costs to maintain the permit, sampling, and laboratory testing
The screened riverbank outfall is viable (will be further evaluated during the Engineering Analysis)	Outlet costs may increase or decrease
An outlet is feasible and not limited by turbidity or other water quality issues	The feasibility of the outlet is based on previously approved similar projects and the Engineering Report will provide additional evaluation of outlet conditions
Other Assumptions	
The bypass pipeline will be pursued only if improvements to Dry Creek fail	
Costs were not extrapolated to the date of construction	Costs were estimated to November 2010, using CCI 8950
Hydropower income based on $0.08 and year-round flow	Changes to the income on the sale of power and flow affect the income from hydropower

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