Humboldt Bay Municipal Water District

Water Resource Planning Pipeline Routes
Reconnaissance-Level Pipeline Study

GHD Job # 8410954

September 2014

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Executive summary

The Humboldt Bay Municipal Water District (HBMWD or District) operates at the wholesale level by providing drinking water to public agencies in the greater Humboldt Bay region. The District has a water right to 75 million gallons per day (MGD), which has historically included 60 MGD of industrial or untreated surface water from the Mad River.

For almost 50 years, the District supplied 40 to 50 MGD of untreated water to two very large industrial customers (pulp mills) on the Samoa Peninsula. The first mill closed in 1993, and the second mill closed in 2009, with no prospect of resuming operation. The closure of the mills had a large financial impact on the District's operations. The District's right to this water is in jeopardy when it comes up for permit renewal in 2029 if the water is not utilized. With the closure of the mills, loss of associated water sales revenue, and possible loss of its water right, HBMWD initiated a process to find new users of the available water supply.

In 2009, the District's Board of Directors initiated a community-based Water Resource Planning process to address the implications of losing the pulp mills. To lead the process, the Board created an Advisory Committee comprised of three representatives from its Municipal Customer group, nine citizens representing multiple stakeholder perspectives, and two members of the Board. During a 14-month process, they gathered input from the public at 11 meetings, conducted an educational Water Workshop, and formed a Citizen's Study Group comprised of additional stakeholders and citizens randomly selected and invited from voter rolls.

After gathering public and stakeholder input, the Advisory Committee conducted initial research on possible water use options, analyzed these options, and provided recommendations to the Board in a capstone report.

The Board of Directors accepted the Advisory Committee's water use recommendation and established three goals to guide implementation. The three water use goals are to:

- protect the District's water rights
- generate revenues to contribute to the current operation and maintenance, and future capital improvements
- preserve the Mad River environment, and to enhance it if possible

The District segmented the water use options into two tiers and is currently evaluating and attempting to advance the top-tier options. The three options in the top-tier are:

- *Local* sales to new commercial, industrial or agricultural users
- Transfer water to another public agency outside of the District for an authorized beneficial use (e.g. municipal)
- Instream flow dedication in the Mad River for environmental benefit pursuant to Section 1707 of the California Water Code.

The District has 40 to 50 million gallons per day (MGD) of untreated water available year-round, which is equivalent to 45,000 to 56,000 acre-feet per year, respectively. The District believes it unlikely there will be one water use option which "uses" all available water similar to the situation when the District served the two pulp mills. The final outcome will likely rely on a suite of water use options.

The District will be very protective of local interests – both long-term municipal needs as well as new commercial or industrial needs – when determining the volume of water available for a transfer outside the District or an instream flow dedication in the Mad River.

The final volume deemed available for new longer-term uses will be established in the context of the proposed use as well as requested term. The District would generally be willing to offer a larger volume for a shorter term, but would limit the volume available for longer-terms so as to protect local interests.

To support consideration of a transfer to another municipality, the District hopes to secure a partner who is willing to invest time, effort, and at some point, money to advance this consideration. The District's preference is to find a partner "close to home" in northern California, and preferably within the north coast region. The District communicated the water supply availability to all northern California public water agencies located on or near the coast, and developed a Term Sheet summarizing broad terms under which the District would be willing to consider a transfer.

The District proceeded to address how water can be transported to other municipalities outside its current service territory. The District initially considered only marine-based conveyance for two reasons: 1) feedback received during the community-based planning process, and 2) prior proposals the District received to sell water to third parties to ship in tankers or waterbags. The District partnered with the Humboldt Bay Harbor, Recreation and Conservation District and engaged Winzler & Kelly Consulting Engineers to complete a reconnaissance-level study that addressed the feasibility and costs of marine conveyance (e.g. tankers, barges or waterbags). The study determined the cost to be prohibitively high ($7,600 - $10,100/ acre-foot). This is significantly more than the current cost of water or new supplies under consideration by many municipalities.

After consultation with the Advisory Committee and stakeholder groups, the District decided to conduct a companion reconnaissance-level study to assess possible pipeline routes in three directions: 1) east then north to the Trinity River system, 2) east to the State water project, and 3) south to Mendocino and Sonoma Counties with service options to southern Humboldt. The District engaged GHD (formerly Winzler & Kelly) to assess the feasibility and develop cost estimates for the most viable routes. Seven potential pipeline routes were initially identified, and two pipeline routes were considered for further analysis.

The purpose of this report is to present several potential pipeline routes for transferring HBMWD water to potential customers and determine the construction, operation and maintenance costs, and rates associated with these pipelines. The report presents seven potential pipeline routes to transfer HBMWD water to potential customers to the north, south or east. Two of the seven alignments (an eastern route to the State Water Project and a Southern route following Kneeland and Alderpoint Roads to Lake Mendocino) were selected by the Board for further investigation and assessment. A potential add-on to the southern alignment to divert water to the Van Arsdale Reservoir/Potter Valley Diversion was also analyzed. WaterCAD models were developed for each alignment for 24-inch (10 MGD), 36-inch (20 MGD), 42-inch (30 MGD), and 48-inch (40 MGD) diameter pipe. Costs associated with permitting, design, land/ROW acquisition, construction, and operation and maintenance (O&M) were estimated for each alignment and pipe diameter. The estimated construction costs were then amortized over a 50-year period, assuming a bond rate of 5.5%, and converted into a cost per acre-foot of water. Added to these costs were the estimated O&M costs and the District's fee. Subtracted from the above-mentioned costs was the potential power offset generated by hydro turbines. Finally, the total costs were divided by the rate of water delivery to obtain a cost per acre-foot. The estimated capital costs and total per acre-foot costs are summarized in Table 1.

Table 1: Amortized[1] total cost per acre-foot

Item	East Route 24-inch	East Route 36-inch	East Route 42-inch	East Route 48-inch
[2]Total Construction Cost	$229,000,000	$336,000,000	$415,000,000	$491,000,000
[3]Total Cost/Acre-ft	$2,530-$2,630	$2,115-$2,215	$1,915-$2,015	$1,818-$1,918
Item	**South Route 24-inch**	**South Route 36-inch**	**South Route 42-inch**	**South Route 48-inch**
[2]Total Construction Cost	$376,000,000	$531,000,000	$650,000,000	$759,000,000
[3]Total Cost/Acre-ft	$3,092-$3,192	$2,405-$2,505	$2,107-$2,207	$1,950-$2,050
Item	**Van Arsdale Extension 24-inch**	**Van Arsdale Extension 36-inch**	**Van Arsdale Extension 42-inch**	**Van Arsdale Extension 48-inch**
[2]Total Construction Cost	$42,000,000	$64,000,000	$80,000,000	$91,000,000
[3]Total Cost/Acre-ft	$540-$640	$396-$496	$333-$433	$297-$397

As shown in Table 1, the cost varies from approximately $1,820 to $3,190/acre-foot, with the lowest cost being for the 48-inch pipeline along the eastern alignment, and the highest cost being for the 24-inch pipeline along the southern alignment. The larger 48-inch pipeline is the more cost-effective option for each of the alignments.

The $1,820-$3,190/acre-foot figures are considerably higher than what is currently being charged for domestic water in Sonoma and Mendocino Counties (approximately $100 to $1,500/acre-foot). There is also a current proposal to raise the height of the dam at Lake Mendocino to provide extra water to some of the entities in Sonoma and Mendocino Counties. The estimated construction costs for that project are $250 - $300 million. This additional source of water would likely be in competition with the District's available water for the potential users down south.

However, the $1,820-$3,190/acre-foot costs are comparable to desalinization costs, which are often cited as the potential source for additional water along the California coast. The 'generic' cost figures of $2,500 to $3,500 per acre-foot are routinely quoted as the cost of desalinization; however, an estimate in excess of $10,000 per acre-foot on a project currently under study is public knowledge.

GHD contacted multiple regulatory and permitting agencies and other stakeholders to gather information on the anticipated regulatory constraints. In general, stakeholders were receptive to the project, but most regulatory and permitting agencies were very reluctant to commit to any definitive

[1] A bond rate of 5.5% was assumed over a 50-year amortization period.
[2] Includes cost for construction, permitting, Land/ROW acquisition, and design.
[3] Includes costs of construction, O&M, energy savings from hydro turbines, and the District fee range ($200-$300/acre/ft)

comments prior to the completion of permit applications or CEQA documents. Additional consultation will need to occur with these agencies and other concerned stakeholders if the project moves forward.

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1. Introduction to HBMWD and its Water Resource Planning Process

1.1 Overview of HBMWD

The Humboldt Bay Municipal Water District (HBMWD or District) was formed in 1956 pursuant to the California Municipal Water District Act. The District was created to develop a regional water system that provides a reliable supply of drinking and industrial water to customers in the greater Humboldt Bay area of Humboldt County. The District operates at the wholesale level by providing drinking water to seven public agencies, who in turn, serve residents and businesses in the greater Humboldt Bay region. For almost 50 years, the District also supplied untreated water to two very large industrial customers (pulp mills) on the Samoa Peninsula.

The District operates and maintains two separate and distinct water delivery systems:

- an Industrial Water System, capable of supplying 60 MGD of untreated water to customer(s) on the Samoa Peninsula, and
- a Domestic Water System capable of supplying about 20 MGD of treated drinking water for the District's municipal customers.

These systems are dedicated for their respective uses (e.g. the industrial system cannot supply drinking water). The District can only provide about 20 MGD of drinking water unless significant infrastructure is added to the domestic water system.

From the early 1960s until 1999, the District had long-term contracts in place with two large industrial users (pulp mills) on the Samoa Peninsula. For much of this period, the entire 60 MGD capacity of the District's Industrial Water System was under contract to these mills. During this period, the mills regularly used 40 to 50 MGD, which was 4 to 5 times greater than the total municipal use. One pulp mill ceased operation in 1993. The second mill ceased operation in 2009 and remains closed today with no prospect of resuming operation.

The key challenge facing the District is the loss of its industrial customer base which has resulted in:

- a significant loss in revenues which shifted substantial costs to the municipal customers;
- an idled Industrial Water System; and
- under-utilization of the District's water rights which will be lost if not used again.

1.2 Overview of Water Resource Planning Process

In 2009, the Board of Directors initiated a community-based Water Resource Planning process to address the implications of losing the pulp mills.

The District's outreach to the community was wide-ranging and in-depth. To lead the process, the Board created an Advisory Committee comprised of three representatives from its Municipal Customer group, nine citizens representing multiple stakeholder perspectives, and two members of the Board. During a 14-month process, they gathered input from the public at 11 meetings, conducted an educational Water Workshop, and formed a Citizen's Study Group comprised of additional stakeholders and citizens randomly selected and invited from voter rolls. The District used television, radio, print media, the Internet, and presentations to stakeholder groups throughout the County to communicate.

The Advisory Committee accomplished much work. They:

- created a framework for evaluating water use options based on a list of values and priorities expressed by the public and participants in the planning process;
- provided outreach and education;
- gathered public and stakeholder input on water use options;
- conducted initial research on possible water use options;
- analyzed the options;
- provided recommendations to the District's Board of Directors in a capstone report.

The Board of Directors accepted the Advisory Committee's water use recommendation and established three goals to guide implementation. The three water use goals are to:

- protect the District's Water Rights
- generate revenues to contribute to the current operation and maintenance, and future capital improvements
- preserve the Mad River environment, and to enhance it if possible

The District segmented the recommended water use options into two tiers. The District is evaluating and trying to advance the top-tier options. The three options in the top-tier are:

- *Local* sales to commercial, industrial or agricultural users
- Transfer water to another public agency outside of the District for an authorized beneficial use (e.g. municipal) under a strict contract to protect the District's water rights and local interests
- Instream flow dedication in the Mad River for environmental benefit or enhancement pursuant to Section 1707 of the California Water Code.

1.3 Available Water Supply

The District has 40 to 50 million gallons per day (MGD) of untreated water available year-round, which is equivalent to 45,000- 56,000 acre-feet/year.

The District believes it unlikely there will be one water use option which "uses" all available water similar to the situation when the District served the two pulp mills. The final outcome will likely rely on a suite of water use options.

The District will be very protective of local interests – both long-term municipal needs as well as new commercial or industrial needs – when determining the volume of water available for a transfer outside the District or an instream flow dedication in the Mad River.

The final volume deemed available for new longer-term uses will be established in the context of the proposed use as well as requested term. The District would generally be willing to offer a larger volume for a shorter term, but would limit the volume available for longer-terms so as to protect local interests. There may be opportunities to consider unique packages – for example, combinations of short-term and long-term contracts (especially for transfers to another public agency). Such packages would protect the water supplies needed to meet local demands in a manner that is consistent with long-term, sustainable use of water in Humboldt County.

1.4 Status of Water Resource Planning Efforts

The District is actively advancing all three top-tier water use options.

To support local sales, the District has broadly communicated the availability of water to all local agencies and other business, civic, economic development and agricultural interests in Humboldt County. The District is supporting the Humboldt Bay Harbor, Recreation and Conservation District and its effort to repurpose the former pulp mill. Together, they hope to attract new businesses suited for this site that use water. The District is also advancing two projects to enhance its readiness to meet new service needs on the Samoa Peninsula.

To support consideration of an instream flow dedication, the District received a Fisheries Restoration Program Grant from the California Department of Fish and Wildlife to evaluate its feasibility. The District initiated a scoping process with Resource Agency staff and other resource professionals in our community to assess the feasibility and determine whether dedicated flows could provide environmental enhancement or benefit. The scoping partners determined that an instream flow dedication appears feasible; however, there are significant data and information gaps that need to be addressed to assess the potential effects and substantiate benefit. The District is soliciting input and support to address these issues and advance consideration.

To support consideration of a transfer to another municipality, the District hopes to secure a partner who is willing to invest time, effort and at some point, money to advance consideration. The District's preference is to find a partner "close to home" in northern California, and preferably within the north coast region. The District communicated the water supply availability to all northern California public water agencies located on or near the coast, and developed a Term Sheet summarizing broad terms under which the District would be willing to consider a transfer.

The District proceeded to address how water can be transported to other municipalities outside its current service territory. The District initially considered only marine-based conveyance for two reasons: 1) feedback received during the community-based planning process, and 2) prior proposals the District received to sell water to third parties to ship in tankers or waterbags. The District partnered with the Humboldt Bay Harbor, Recreation and Conservation District and engaged Winzler & Kelly Consulting Engineers to complete a reconnaissance-level study that addressed the feasibility and costs of marine conveyance (e.g. tankers, barges or waterbags). The study determined the cost to be prohibitively high ($7,600 - $10,100/ acre-foot). This is significantly more than the current cost of water or new supplies under consideration by many municipalities.

After consultation with the Advisory Committee and stakeholder groups, the District decided to conduct a companion reconnaissance-level study to assess possible pipeline routes in three directions: 1) east then north to the Trinity River system, 2) east to the State water project, and 3) south to Mendocino and Sonoma Counties with service options to southern Humboldt. The District engaged GHD (formerly Winzler & Kelly) to assess the feasibility and develop cost estimates for the most viable routes.

2. Introduction to Pipeline Route Reconnaissance-Level Study

As introduced above, the District engaged GHD to undertake a reconnaissance-level assessment for feasible pipeline routes to transfer water to potential customers, most likely municipalities in need of additional water supplies.

2.1 Purpose of this Study

The purpose of this Study is to develop and present alternative feasible pipeline routes to transfer HBMWD water to potential customers to the north, south or east of the District's current service territory.

The District's operations currently consist of the impoundment of wet weather flows at Ruth Lake, behind Matthews Dam located in Trinity County near the headwaters of the Mad River. Water is then released from the dam throughout the year, flows down the Mad River for the majority of its length, and then is diverted through the District's Ranney Wells (domestic water) or surface water intake structure (industrial water) at the District's Essex diversion facility located on the Mad River near Arcata. This unique water conveyance system provides extensive environmental enhancement to the Mad River throughout the year, and for that reason, and per the direction of the District's Board, all pipeline routes analysed initiate at the District's Essex diversion facilities.

This Study also presents WaterCAD model results and estimated permitting, design, construction, and operation and maintenance (O&M) costs for what appear to be two of the most feasible routes. It also presents the results of discussions with relevant stakeholders. It then develops a per acre-foot cost estimate for the delivery of water to allow the District and potential users to determine if the pipeline alternatives are cost-effective as compared to other options.

2.2 Scope

The scope of services in this project includes the tasks outlined in the November 12, 2013 letter to Carol Rische, HBMWD General Manager. As detailed in this letter, the scope of this project was to:

- Undertake a reconnaissance-level pipeline study, including the identification and review of alternative pipeline alignments
- Refine the alignment and develop cost estimates for the two pipeline routes that appear to be most feasible – one route is east and one route is south
- Consult with relevant stakeholders and potential purchasers of the District's water
- Develop WaterCAD models for four pipeline sizes (24-, 36-, 42-, and 48-inch) along the two preferred alignments, thereby providing information on capacity versus costs for a range of water delivery options
- Develop a Class 4 Opinion of Probable Construction Cost estimate for the four pipeline sizes along the two preferred alignments
- Estimate a cost per acre-foot for water for each pipeline size.

2.2.1 Limitations

The pipeline design detailed in this document should be considered a reconnaissance-level (10%) design. The design was focused on potential alignments and the feasibility of these alignments with respect to topographic relief, relatively stable geology, potential for acquiring right-of-way (ROW), limited river crossings, etc. A WaterCAD model was developed sufficiently enough to size pump stations and determine pipeline pressures, but detailed design of the pipeline and pump stations was not performed. The design was progressed to a sufficient level to prepare a Class 4 Cost Estimate.

The Cost Estimate is considered to be an Association for Advancement of Cost Engineering (AACE) Class 4 Cost Estimate. AACE defines a Class 4 Cost Estimate as: “Class 4 estimates are generally based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1 to 15% complete, and would comprise at a minimum the following: Plant capacity, block schematics, indicated layout, process flow diagrams for main process systems, and preliminary engineered process and utility equipment lists. Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side and +20% to +50% on the high side.”

Costs were developed in 2014 dollars and no consideration has been included for the time it will take to permit and construct any of the alternatives analyzed, or the subsequent inflationary pressure on the costs.

GHD prepared the reconnaissance-level cost estimate using information reasonably available to GHD and based on assumptions and judgments made by GHD as detailed in the applicable sections of this report. Variables that affect costs may be different than those used to prepare the Cost Estimate, and actual project costs are likely to change if evaluation and design of the pipeline routes advance. Unless otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. Furthermore, no field work, geotechnical assessments, topographic surveys, California Environmental Quality Act (CEQA) investigations, or permitting activities with any regulatory agencies were included as part of this scope of work. GHD does not guarantee that the project can or will be undertaken at a cost which is the same or less than the Cost Estimate.

3. Development of Pipeline Alignments

3.1 Identification and Review of Alternative Pipeline Alignments

GHD undertook an evaluation of potential pipeline routes for 24-, 36-, 42-, and 48-inch-diameter pipeline from the HBMWD industrial system, beginning near Essex and running to the north, south, or east. The District's operations currently consist of the impoundment of wet weather flows at Ruth Lake, behind Matthews Dam located in Trinity County near the headwaters of the Mad River. Water is then released from the dam throughout the year, flows down the Mad River for the majority of its length, and then is diverted through the District's Ranney Wells (domestic water) or surface water intake structure (industrial water) at the District's Essex diversion facility located on the Mad River near Arcata. The intent is to allow the existing water to continue to flow down the Mad River as it currently does and divert it at the Essex Facilities using the existing surface water intake structures. Doing so would allow for the continuation of the environmental benefits provided by the water flowing in the Mad River. New piping would then begin near the existing Essex Facility and proceed to the point of use. The District was not interested in evaluating diversion from the Mad River at any other point in the system, and controlled diversions are not currently available at any other point in the system.

As mentioned, 40 to 50 MGD of excess surface water is available for use; however, the District was only interested in the potential diversion of up to 40 MGD for use outside of the immediate area. Given the uncertainty on how much water a potential customer could utilize, and the range of construction and operation costs associated with pipelines of various sizes, pipelines sized to carry a range of flows were evaluated. The pipeline sizes evaluated including 24-, 36-, 42- and 48-inch diameters A 24-inch pipeline would convey approximately 10 MGD, a 36-inch pipeline would convey approximately 20 MGD, a 42-inch pipeline would convey approximately 30 MGD, and a 48-inch pipeline would convey approximately 40 MGD.

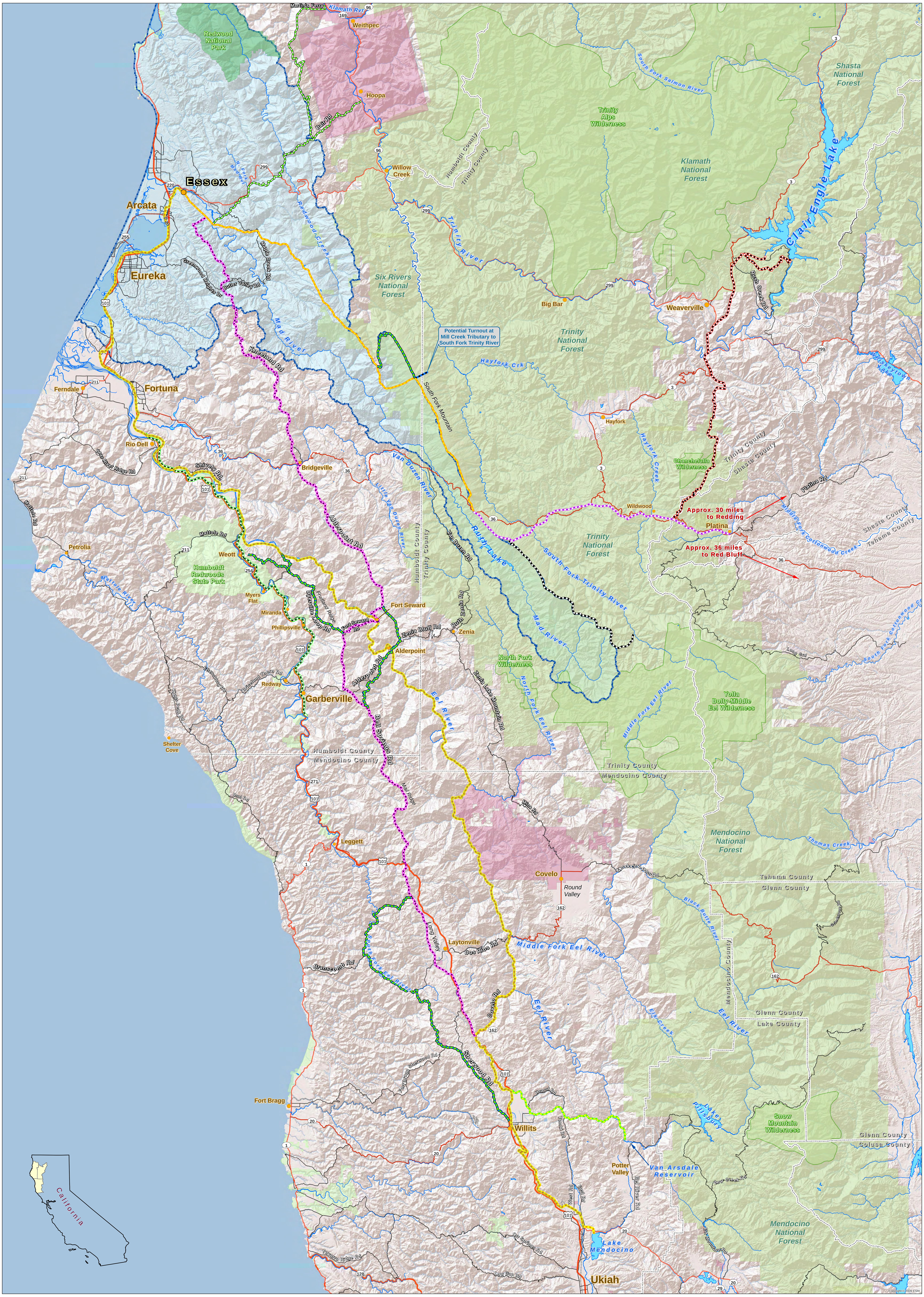
As detailed in Section 3.2, an initial screening was performed to determine general alignments for further assessment. The general alignments investigated were:

- South to Mendocino/Sonoma Counties
- North/East to the Klamath or Trinity River drainages
- East into the Federal or State Water Project

Alignments to the south were reviewed with the goal of delivering water to communities in Southern Humboldt, Mendocino and Sonoma counties. Alignments to the east were reviewed with the goal of discharging into the Federal Water Project at Trinity Lake/Clair Engle Reservoir, or the Sacramento River or other portions of the State Water Project. Alignments to the North were reviewed with the goal of discharging into the Trinity/Klamath system to improve water quality and offset upstream diversions.

3.2 Alternative Alignment Study

Three main alignments were developed to the south, one main alignment was developed to the east with a branch off to the north to Trinity Lake/Clair Engle Reservoir, and one main alignment was developed to the north/north-east to the Klamath/Trinity River Systems. These alignments are shown on Figure 1.



Legend	
Railroad Alignment (166.9 miles)	Essex to Hwy 36 (55.1 miles)
Alternate - Van Arsdale Reservoir (19.2 miles)	West End Rd to RR ROW @ 162 via Bells Springs Rd (131.4 miles)
101 Corridor - Essex to Benbow (82.6 miles)	Hwy 36 to Hwy 299, Trinity Dam (52.0 miles)
EB Hwy 36 to Platina (33.5 miles)	Hwy 36 toward Headwaters South Fork Trinity River
North Pipelines to Klamath River and/or Hoopa	Alignment Variations
Highway	100 ft Contours
Major Road	Rivers
Railroad	Lakes
Wilderness Area	Mad River-Redwood Creek Watershed
State Parks	Indian Trust Lands
National Forests	County Boundary

Paper Size ARCH E1

0 2 4 6 8 10
Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 10N

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Humboldt Bay Municipal Water District
Pipeline Reconnaissance Study

Overview: Development of Potential Pipeline Alignments

Job Number 8410954
Revision A
Date 22 May 2014

Figure 1

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Data source: California Spatial Library; Teleatlas; ESRI; USGS Seemless Server Created by:gldavidson

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3.2.1 Methodology

A desktop analysis was conducted to determine feasible alignments using paper USGS Quad maps as well as GIS. Potential alignments were reviewed taking into account the following factors, listed in their general level of priority:

- Topographic relief
- Geological stability
- Public or utility ROW availability including roadways
- Potential water demand of the customers along the route
- Environmental impacts (qualitative assessment only, e.g. "this alignment crosses 20 salmonid bearing streams, each of which will require a Dept. of Fish & Wildlife 1600 permit")
- Potential general impacts to cities, roads, railways, other major utilities
- Other constructability factors, including proximity to electrical service for pump stations and access roads for future operation and maintenance

3.2.2 Southern Routes

Three general alignments to the south were reviewed: one following Highway 101, one following the North Coast Railroad alignment, and one following ridgelines and a network of roads located farther inland. These alignments are shown on Figure 1 and are generally described below. Each of the south alignments would terminate in Mendocino County at the Van Arsdale Reservoir (Potter Valley Diversion on the Eel River) or Lake Mendocino. From these delivery points, water could be delivered to the Sonoma County Water Agency (SCWA) and various Mendocino County Water Agencies. Communities in Southern Humboldt County could also be serviced via diversions from the southern alignment.

Highway 101 Right-of-Way to Lake Mendocino

This alignment follows the North Coast Railroad alignment from the Essex facility towards the west until it intersects Highway 101. It then follows the Highway 101 alignment south. The pipeline would be installed in the highway median where available or off to the east or west of the highway depending on the topography. The California Department of Transportation (Caltrans) generally does not allow parallel easements within their ROW. Additionally, there are sections of this alignment, for example through Humboldt Redwoods State Park, where there would be no room for a pipeline either side of the highway and it would have to be installed within the road prism. Of additional significance, where the highway crosses the Eel River south of Garberville on the Confusion Hill Bridge, the existing canyon is very narrow and unstable. There is no room for a pipeline except hanging it from the Confusion Hill Bridge and placing it within the road prism. Given the frequent landslides in this area and the requirement to repair the existing roadway, it is highly unlikely that Caltrans would allow the installation of the pipeline through this section of Highway 101. The evaluation of this alignment was terminated at this point.

North Coast Railroad Right-of-Way to Lake Mendocino

This alignment would follow the North Coast Railroad alignment from Essex for approximately 180 miles south to its termination point.

The advantages of this alignment include:

- Access to Southern Humboldt County communities down to Alderpoint and Garberville
- Access to SCWA and the communities they feed with their system

- Access to Mendocino communities, including Laytonville, Willits, and Ukiah, as well as other water agencies that access Eel River, Lake Mendocino and Van Arsdale water
- North Coast Railroad Authority would likely allow use of their ROW
- Possible water quality benefits to Eel River depending on final operation

The additional constraints for this alignment include:

- Most unreliable of all routes due to unstable geology along large portion of route, particularly in the Eel River canyon between Dyerville and Covelo
- Very difficult to access central Eel River Valley for maintenance activities
- Increased maintenance costs due to likely increased failures
- May need to provide additional storage to allow balanced delivery to Lake Mendocino to optimize SCWA usage
- Longer than eastern routes, so more expensive to design and construct

West End Rd to Kneeland Rd to Alderpoint Road to Bell Springs Rd to Railroad to Lake Mendocino

This alignment extends from Essex south along West End Road, and then follows an electric transmission alignment up a ridge to Fickle Hill Road, then southerly along Fickle Hill Road to Kneeland Road, and southerly along Kneeland Road to a crossing of the Van Duzen River near Bridgeville. It would then follow Alderpoint Road southerly to a crossing of the Eel River near Fort Seward and then could either follow the Coonly/Alderpoint Road south-easterly to the ridge of New Harris above Garberville and its intersection with Bell Springs Road, or alternatively leave the river crossing at Fort Seward and traverse uphill westerly to Fruitland Road and thence southerly along Fruitland Road to New Harris and Bell Springs Road. The alignment would then follow Bell Springs Road to where it intersects with Highway 101. It would then pass through Long Valley past Laytonville, with an alternative route following Sherwood Road to bypass Long Valley. The alignment then intersects the North Coast Railroad alignment just north of Willits and would follow the railroad ROW south to Lake Mendocino with an alternate branch off to Van Arsdale Reservoir.

The advantages of this alignment include:

- Fairly straight-forward routing with existing road access
- Access to Southern Humboldt communities, including Bridgeville, Alderpoint and Garberville
- Access to SCWA and the communities they feed with their system
- Access to Mendocino communities including Laytonville, Willits, and Ukiah as well as other water agencies that access Eel River, Russian River, Lake Mendocino and Van Arsdale water
- Utilizes existing NCRA ROW on the southern end with their support
- Can also access Van Arsdale Reservoir/Potter Valley
- Possible benefits to the Eel River depending on final operation

The additional constraints for this alignment include:

- May need to provide additional storage to allow balanced delivery to Lake Mendocino to optimize SCWA usage
- Longer than eastern routes, so more expensive to design and construct

3.2.3 Eastern Routes

Southfork Mt. & Hwy 36 to Platina and into State Water Project

This alignment heads southeast from the Essex facilities along West End Road. The City of Eureka's old water main extends along this alignment and it may be possible to utilize that existing ROW for the proposed piping. It would follow that alignment to the Mad River Hatchery, cross the Mad River, and then traverse uphill and easterly to an interception with Snow Camp Road, following this road southerly past Snow Camp and existing roadway to Board Camp, then following existing Forest Service and logging company roads through Six Rivers National Forest heading to Pilot Ridge and South Fork Mountain Ridge. Once it gets to South Fork Mountain ridge, a spur could be directed to the South Fork of the Trinity River to supplement flows to the South Fork and main stem of the Trinity and the lower portion of the Klamath. The main pipeline route would follow South Fork Mountain ridge out to State Highway 36, where it would intersect with the PG&E natural gas ROW that generally follows the Highway 36 alignment to the east out to Platina in Shasta County, which is out of the Trinity Mountains and into the Central Valley. From Platina, it may be possible to discharge into Cottonwood Creek, which flows to the Sacramento River, or hard pipe it approximately another 30 miles to the Sacramento River, where it would be available for the State Water Project.

The advantages of this alignment include:

- Access to State Water Project, which provides access to Bay Area agencies (who are working together regionally and have ability to transfer or exchange water among themselves)
- Access to Sacramento-area agencies
- Given the size of the State Project, there is not as much need to "balance" water delivery or find storage
- Fairly straightforward routing with existing PG&E ROW to utilize

The additional constraints for this alignment include:

- Possibly numerous parties to negotiate with
- Need to determine terminus for delivery (stream, Sacramento River or other SWP facility). Terminating at a stream would provide for the shortest route, but it is unclear if regulatory agencies would allow Mad River water into such streams

Southfork Mt to Hwy 36 to Clair Engle Reservoir

The first portion of this alignment matches the previous route to Platina and the State Water Project. At approximately the Trinity/Shasta County border, the alignment would then turn towards the northeast following the ridge lines and Browns Creek/Deer Lick Springs roads to the Chanchelulla and Hayfork Divides out to State Highway 3 and follow that out to Highway 299 near Douglas City. It would then continue north along Highway 299/Highway 3 to Trinity Dam Boulevard and down into Claire Engle Lake, where it enters into the Federal Water Project.

The advantages of this alignment include:

- Access to the Federal Water Project with access to numerous agencies and agriculture users
- Clair Engle/Trinity Lake can act as storage, reducing need to "balance" water delivery or find storage

The additional constraints for this alignment include:

- Federal project would likely be more difficult to negotiate with Bureau and end-users
- Likely more local community concern and opposition
- Route off of Hwy 36 to Clair Engle will be difficult/expensive

3.2.4 Northern Routes

Trinity River at Hoopa or Klamath River downstream of Weitchpec

This alignment would begin the same as the eastern alignments and follow the old City of Eureka pipeline alignment along West End Road to the Mad River Hatchery. The alignment then crosses the Mad River and continues to the Northeast following Korbel, Maple Creek, and K&K Roads and then logging roads over Lord Ellis Summit. It then crosses Highway 299 and continues on Bair Road out along Redwood Creek. It continues along Bair Road out to Pine Ridge. The route to the Trinity River then crosses into the Hoopa Valley Indian Reservation, continuing on Bair Road to the Trinity River near Hoopa. The Klamath River alignment would head north where Bair Road crosses Pine Ridge and follow Pine Ridge north, past Hupa Mountain to French Camp and then follows French Camp Ridge until it turns east to Martin's Ferry and the Klamath River.

The advantages of this alignment(s) include:

- Flow augmentation to Lower Klamath/Trinity with likely environmental benefits
- Upper Klamath Basin users may support/be willing to pay for water
- Shorter pipeline than other options

The additional constraints for this alignment(s) include:

- Likely difficult to find someone to pay for the water
- Not sure regulatory agencies will allow Mad River water into the Trinity/Klamath
- Lower part of Klamath not where water is needed other than for environmental enhancement

3.3 Selection of Final Alignments for Additional Study

The alignments outlined above were reviewed with District staff and the Board to obtain feedback and ultimately select the final alignment to review in greater detail and develop estimates of probable construction cost. Along with the technical constraints, some of the other points of discussion are summarized below.

3.3.1 Local Usage

It is the preference of the HBMWD Board to use as much as possible of the available water supply "locally" within Humboldt County. Local use of the water has been and is currently being further assessed and promoted by HBMWD through partnership with multiple stakeholders including the current Municipal customers, Humboldt Bay Harbor and Recreation District, Humboldt State University, and Humboldt County, to name a few. Several potential users have been identified and the "local use" option continues to be advanced.

Some of the potential users in Mendocino County expressed their desire to have southern Humboldt communities as stakeholders in this process to help ensure that there would be local support for the project if a pipeline to the south were constructed.

As part of this assessment, the following communities were contacted as potential users:

- Fortuna
- Rio Dell
- Scotia
- Myers Flat
- Miranda
- Redway
- Garberville

Rio Dell expressed interest in access to the water to supplement their reliance on water from the Eel River or South Fork Eel River in dry years. Many of the other communities stated that they would need to review the economics prior to considering the option of obtaining District water. However, many of these communities currently rely on the Eel River for water, and future Eel River water supply shortages may require these communities explore additional options for water resources.

HBMWD's Policy Statement on the ultimate use of District water suggests that the use of water by any purchaser (i.e. public agency) who primarily needs water for growth and development would be adverse to the District's desired use. Therefore, it is desirable for this water to be used in some form by replacing existing sources, including flows previously diverted from other natural systems (e.g. the Eel River).

3.3.2 Preference for Location of Use

The District expressed a preference for the available water to be used within the North Coast region (e.g. southern Humboldt , Trinity, Mendocino, and Sonoma Counties).. HBMWD has had a long-term, productive relationship with the Sonoma County Water Agency (SCWA), another North Coast agency. This long-term relationship would facilitate discussions and negotiations on potential water delivery to Mendocino and Sonoma Counties. The view of Mendocino and Sonoma Counties as part of the North Coast "community" also makes delivery to them a preference and potentially a direct benefit to communities in southern Humboldt County. In addition to constructing the pipeline in closer proximity to southern Humboldt communities, there are potentially other advantages. For example, deliveries to Mendocino and Sonoma Counties could possibly offset the diversion from the Eel River at Van Arsdale (the Potter Valley Diversion). The offset of this diversion would have a direct benefit to Eel River flows and the communities in Humboldt County that depend on the Eel River as a water source.

3.3.3 Selection of Final Alignments

GHD presented a comparative table outlining the key features of the seven alignments (Table 2) at a Special Board meeting in March 2014. The advantages and constraints of the various alignments were discussed, and the Board and Public expressed their support and/or concerns with regards to the various alignments.

Although the three northern alignments would be the shortest routes (between 35-50 miles), the Board expressed concern that they would benefit another watershed at the possible expense of the Mad River. It was also discussed that these alignments might make it easier for the Central Valley Project to avoid relinquishing 50,000 acre-feet of water from the Trinity System that was contracted to Humboldt County, which has been a point of contention for years.

Of the two eastern alignments, the Board preferred the alignment terminating at the State Water Project at Platina (see Figure 2). The alignment terminating at Trinity Lake, which is part of the Federal Water Project, was not selected for further investigation. The Board agreed that this should be avoided because of the contractual obligations that would come from a municipality trying to do business with the federal government. The Board felt that it would be much easier to negotiate with the State Water Project entities.

Of the three southern alignments, the Board preferred the alignment that follows Kneeland, Alderpoint and Bell Springs Roads to the railway ROW to Van Arsdale or Lake Mendocino (see Figure 3). This route could use the existing roads for easement and maintenance access and is more geologically stable. There is no access to Fortuna or Rio Dell/Scotia, but other communities in Southern Humboldt and Northern Mendocino could be accommodated. The feasibility of the route along Highway 101 was deemed to be highly unlikely, given that Caltrans would not likely issue a longitudinal easement for the pipe installation, and likely would not allow for installation of the pipeline on the Confusion Hill Bridge, or other Caltrans bridges. The alignment following the railroad ROW along the entire length was considered to be impractical due to the geological instability and limited maintenance access. The expected high maintenance costs, given the frequent landslide, and difficulty of accessing the bridge, particularly in the Eel River canyon, as well as the numerous river and stream crossings required, removed this option from consideration.

Following more discussion, the Board agreed that the Eastern route to the State Water Project and the Southern route following Alderpoint Road be investigated for further assessment and development of design, permitting and construction costs.

Table 2: Pipeline routing comparisons

Alignment	Terminus	Approximate Mileage (from Essex to End User)	Advantages	Constraints[1]
North or North-East to Klamath/Trinity River Systems				
To Klamath River downstream of Weitchpec	Lower Klamath River	50	• Flow augmentation to Lower Klamath with possible environmental benefits • Upper Klamath Basin users may pay for water	• Likely difficult to find someone to pay for the water • Not sure regulatory agencies will allow Mad water into the Klamath • Lower part of Klamath not where water is needed other than for environmental enhancement
To Trinity River just upstream of Hoopa	Mainstem of Trinity and Klamath below Weitchpec	35	• Flow augmentation to Trinity & Klamath with possible environmental benefits • Upper Klamath Basin users may pay for water • Shorter pipeline than other option and Trinity & Klamath Rivers get benefit	• Likely difficult to find someone to pay for the water • Not sure regulatory agencies will allow Mad water into the Trinity/Klamath • Need to get Tribal approval for route
Southfork Mt. to Mill Creek to South Fork of the Trinity	South Fork & Mainstem of Trinity River & Lower Klamath	40	• Flow augmentation to South Fork & mainstem Trinity and lower Klamath with possible environmental benefit • Could be part of pipeline route that continues to the east, and serves as place to discharge excess water	• Likely difficult to find someone to pay for the water • Not sure regulatory agencies will allow Mad water into the Trinity/Klamath

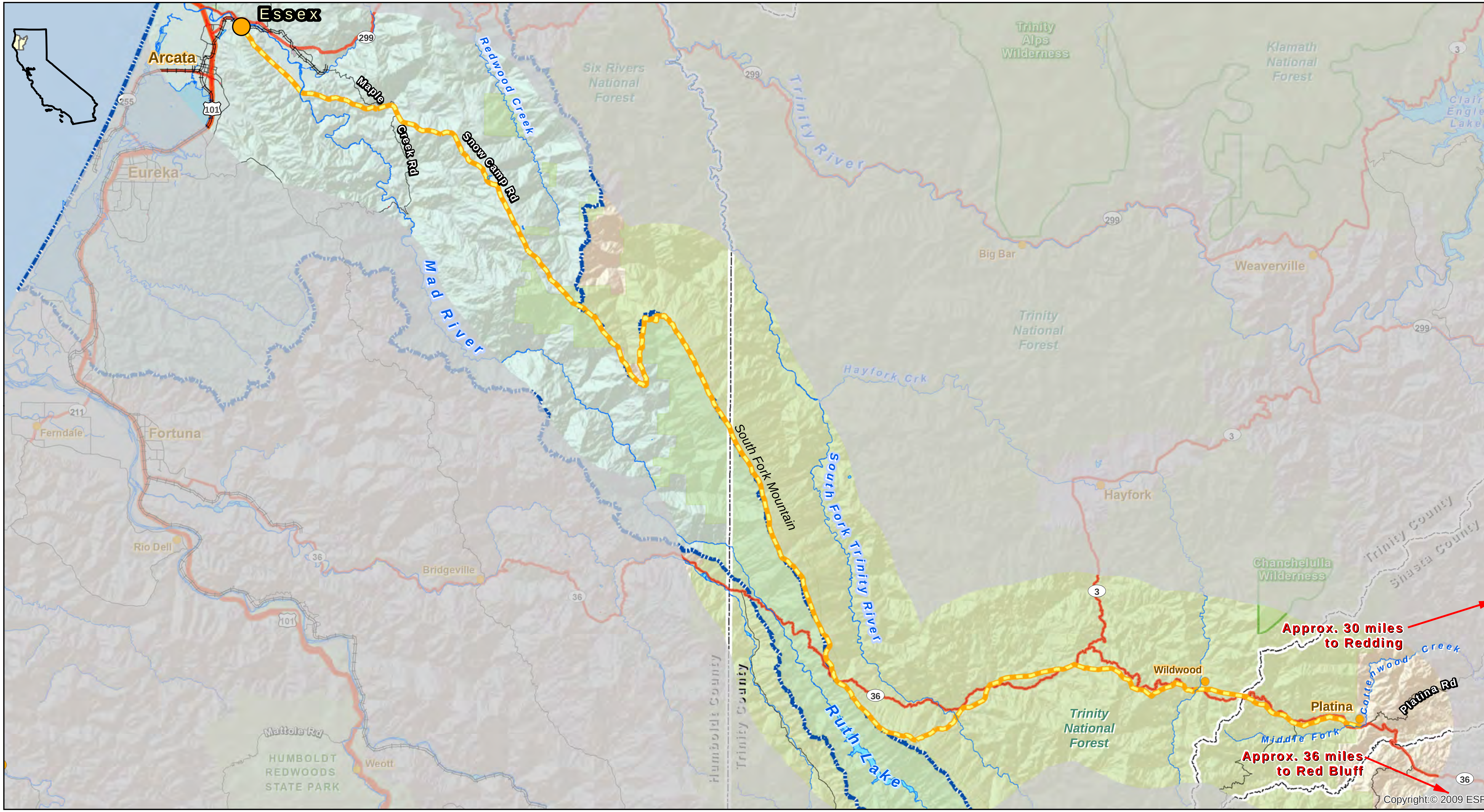
[1] Note that all alignments have similar constraints of extensive permitting requirements/costs, high construction costs, long lead time for planning/permitting/construction, etc.

Alignment	Terminus	Approximate Mileage (from Essex to End User)	Advantages	Constraints[1]
Eastern Routes				
Southfork Mt. & Hwy 36 to Platina and into State Water Project	State Water Project	90	• Access to State Water Project which provides access to Bay Area agencies (who are working together regionally and have ability to transfer or exchange water among themselves) • Possible access to Sacramento-area agencies • Given size of State Project, not as much need to "balance" water delivery or find storage • Fairly straightforward routing with existing PG&E ROW to utilize	• Possibly numerous parties to negotiate with • Need to determine terminus for delivery (stream, Sacramento River or other SWP facility). Stream would provide for shortest route but not sure if regulatory agencies will allow Mad water into such stream
Southfork Mt. to Hwy 36 to Clair Engle Reservoir	Federal Water Project	125	• Access to the Federal Water Project with access to numerous agencies and agriculture users • Clair Engle/Trinity Lake can act as storage, reducing need to "balance" water delivery or find storage	• Federal project would likely be more difficult to negotiate with Bureau and end-users • Likely more community concern and opposition • Route off of Hwy 36 to Clair Engle will be difficult/expensive

[1] Note that all alignments have similar constraints of extensive permitting requirements/costs, high construction costs, long lead time for planning/permitting/construction, etc.

Alignment	Terminus	Approximate Mileage (from Essex to End User)	Advantages	Constraints[1]
Southern Routes				
North Coast Railroad ROW to Lake Mendocino	Sonoma CWA, Mendocino Co. Water Agencies, and So. Humboldt Co.	180	• Access to So. Humboldt communities down to Phillipsville • North Coast Railroad Authority would support use of their ROW • Can also access Van Arsdale Reservoir/Potter Valley • Possible benefits to Eel River depending on final operation	• Most unreliable of all routes due to unstable geology along large portion of route • Very difficult to access central Eel River Valley • Increased maintenance costs • May need to provide additional storage to allow balanced delivery • Longer than eastern routes so more expensive to design and construct • Fewer large potential customers
Westend Rd to Kneeland Rd to Alderpoint Rd to Bell Springs Rd to Railroad to Lake Mendocino (or Van Arsdale/Potter Valley)	Sonoma CWA, Mendocino Co. Water Agencies, and So. Humboldt Co.	170	• Fairly straight forward routing with existing road access • Access to So. Humboldt communities • Utilize existing NCRA ROW on the southern end with their support • Possible benefits to Eel River depending on final operation	• May need to provide additional storage to allow balanced delivery • Longer than eastern routes so more expensive to design and construct • Fewer large potential customers

[1] Note that all alignments have similar constraints of extensive permitting requirements/costs, high construction costs, long lead time for planning/permitting/construction, etc.



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Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 10N

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West/East Alignment

Essex to Platina - West to East Alignment

Railroad

Highway; Freeway

Major Road

Rivers

Lakes

Wilderness Area

State Parks

National Forests

Mad River-Redwood Creek Watershed

Indian Trust Lands

County Boundary

GHD

Humboldt Bay Municipal Water District
Pipeline Reconnaissance Study

Job Number	8410954
Revision	A
Date	23 May 2014

Essex to Platina
West to East Pipeline Alignment

Figure 2

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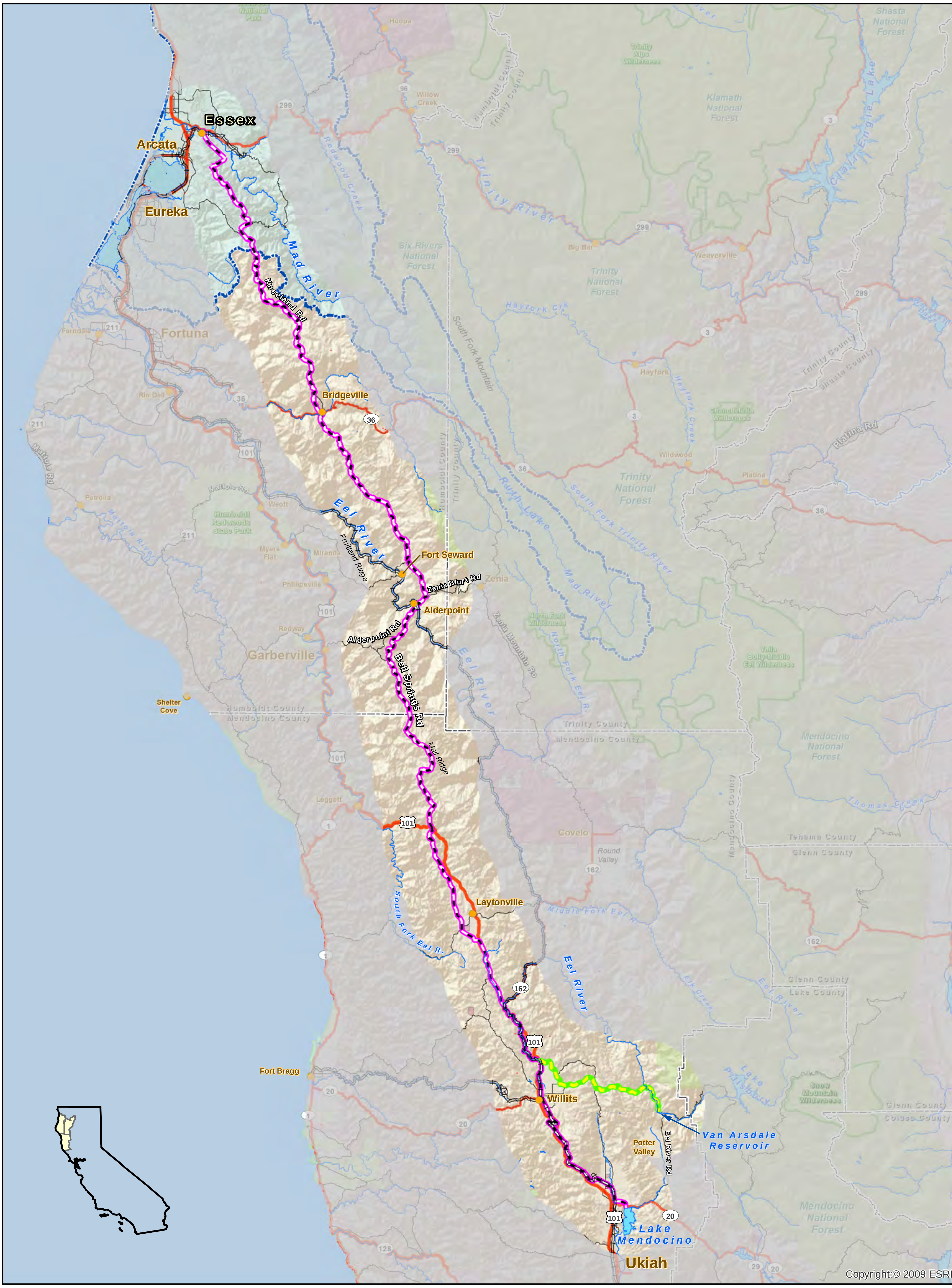

North/South Alignment

- North/South Pipeline Alignment (165 Miles)
- Alternate - Van Arsdale Reservoir (19 miles)
- Highway; Freeway
- Major Road
- Railroad
- Rivers
- Lakes
- Wilderness Area
- State Parks
- National Forests
- Mad River-Redwood Creek Watershed
- Indian Trust Lands
- County Boundary

Paper Size 11" x 17" (ANSI B)

0 5 10 15 20

Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 10N

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Humboldt Bay Municipal Water District
Pipeline Reconnaissance Study

Job Number 8410954
Revision A
Date 23 May 2014

North/South Pipeline Alignment — Figure 3

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4. Stakeholder Consultation

Limited stakeholder consultation was conducted with various regulatory and private entities to discuss aspects of potential alignments and the potential for regulatory acceptance of the project. The sections below list agencies that were contacted and provide a summary of the conversations. A table of the contacts made from each organization mentioned below can be found in Appendix B.

4.1 PG&E

When asked if PG&E would be amenable to HBMWD using their power line ROW or access road easements, they stated that PG&E's electric and gas transmission easement rights are specific to the transport of electricity or natural gas and do not include the right to install water pipes. Should there be desire to obtain a separate easement overlapping a PG&E easement, PG&E could work with the District on separation requirements and cathodic protection needs.

GHD also met with PG&E representatives to discuss requirements for providing power to the pump stations that would be required along either of the considered alignments. As discussed in Sections 5.1.2 and 6.1, pumping requirements will be substantial. The PG&E representatives and local PG&E staff were consulted with respect to whether the existing electrical infrastructure would support the delivery of these loads to a point where new infrastructure would be built to provide power to the pump stations. At the time of the completion of this report, this question had not been definitively answered, so although construction costs for the installation of new overhead power lines and substations for the pump stations have been included in the construction cost estimates detailed in Section 5, it was assumed that extensive upgrades to the existing PG&E infrastructure would not be required.

The rate structure for the purchasing of power for the pump station and selling back of power from the hydro turbines (see Section 5.1.3) was also discussed with PG&E. PG&E has various rates for customers depending on the amount of power that is used. The PG&E representatives were confident in the feasibility of this proposed pipeline project qualifying for the E20 Primary Firm rate (currently \$0.14/kWh). They also said that with the high power requirements of the pump stations (up to 9 MW), the E20 Transmission Firm rate (currently \$0.11/kWh) would very likely be applicable. However, to qualify for this rate, an application would have to be filed with the California Public Utilities Commission (CPUC), and this process typically takes one to one and a half years. PG&E would require a deposit to get more in-depth answers on the feasibility of getting power to the pump stations and associated costing information. For the operation costs presented in Section 5, it was assumed that the CPUC application would be filed and power costs would be \$0.11/kWh.

4.2 Bureau of Land Management (BLM)

BLM did not think it would be possible for pipeline alignments to pass through wilderness areas or any areas under the wild and scenic rivers designation. If it was going to be possible, their impression was that it would be very difficult to arrange, as mechanical works are not allowed through wilderness areas. There is not much BLM-managed land east of Arcata; however, there is a significant amount in the Mendocino vicinity. None of the proposed alignments would go through areas designated as "wilderness".

Any alignment would need to go through both the NEPA and CEQA permitting processes. If an alignment passes through BLM land, then BLM would be a cooperating agency as part of the environmental permitting process. Alignment selection needs to address potential impacts to ecology and cultural heritage. There would be no additional permitting requirements for pipeline maintenance that wouldn't have already been covered in the permitting and approval of the initial pipeline. BLM does have road construction and security standards.

The North-West Forest Plan (1994) covers both Forest Service and BLM land. BLM's opinion was that the Forest Service would have similar planning and environmental restrictions to BLM. A specific land allocation exists called "Late-Seral Reserves," which identify areas that are to be managed to be "turned back to old growth areas". These areas are precluded from development. None of the alignments would be located within Late Seral Reserve land allocations.

4.3 Caltrans

Caltrans has a policy that does not allow for any longitudinal easements for utilities within their ROW. Caltrans said that any exceptions to that policy cannot be approved on a District level and automatically go to Headquarters in Sacramento. Headquarters then puts together a committee to review the request. Generally the only exceptions are for those facilities that are critical (i.e. water/sewer, electricity) and in circumstances where there are no other alternatives to provide these services to a community other than the highway. Caltrans stressed that these decisions are not made at the District level and turn into much more of a political type approval. He recommended GHD contact Charlie Fielder, District 1 Director, if we were interested in exploring the "political" aspect of it further. GHD did not try to contact Mr. Fielder.

4.4 CA Department of Fish & Wildlife/U.S. Fish & Wildlife

4.4.1 CA Department of Fish and Wildlife

The Mad River is already a manipulated system. The Multi-species Habitat Conservation Plan (HCP) developed for the Mad River is the controlling policy document for the watershed that the District is required to operate within. The plan was developed with the pulp mill in operation and so already accounts for the upstream impacts of the Essex offtake. As long as the 60 MGD limit is not exceeded, the HCP will not be violated or impeded.

CDFW is currently undertaking a study on potential instream flow dedication for the 60MGD for the District in parallel to this investigation. CDFW has developed a white paper outlining their stance on out-of-basin transfers. A copy of this white paper was to be provided by CDFW, but it had yet to be obtained at the time of this Report. It is our understanding that the decision on out-of-basin transfers is generally made on a case-by-case basis.

4.4.2 US Fish and Wildlife Service

The US Fish and Wildlife Service was reluctant to make any comments at this early stage of the project.

4.5 State Water Resources Control Board

The California State Water Resources Control Board (SWRCB) identified two potential issues relating to this project, the first concerning water rights, and the second concerning water quality. The water rights issue would need to be discussed at the SWRCB level and the water quality issue addressed at the Regional Water Quality Control Board (RWQCB) level.

The SWRCB suggested that it would be worth initiating discussions with the RWQCB now to gain a better understanding of the potential level of review required for the project. RWQCB would also be able to provide some information on the likely timing of the permitting and review process.

Issues relating to the water right would depend largely on what type of water right the District has. One SWRCB contact suggested that making contact with a specialist water attorney would assist in the process with working with the SWRCB to prevent the District losing their water right.

Another SWRCB contact was reluctant to provide too much information or to speculate at this early/reconnaissance stage of the project. She stated that the SWRCB does not usually get involved at such an early stage of a project.

With respect to releasing Mad River water into the Eel River or Trinity/Sacramento Rivers, the SWRCB was not sure if it would be possible. They also did not offer an opinion on whether it would be possible to offset the PG&E diversions at Potter Valley with Mad River water. It would depend on how things are structured, as these issues are always system-specific and it depends on who is maintaining control of the water.

SWRCB input would be provided during the CEQA process and depend on the details of the Project Descriptions. SWRCB does not usually get involved in these projects until the CEQA comment phase. SWRCB thought that the fish agencies would be the primary commentators with respect to discharging Mad River water into other watersheds.

4.6 North Coast Railroad Association

The North Coast Railroad Association (NCRA) would be willing to provide access to their ROW. They see this project as having community benefit and also as a source of revenue for their organization. The ROW was developed in the late 1800s. There are some complications regarding segments that they own versus segments where they have use rights only. There are also some physical issues around the Eel River Canyon such as flooding and landslides. The NCRA ROW generally extends a minimum of 25 feet on either side of the tracks; in some cases it extends up to 50 feet on either side of the tracks.

Part of the NCRA mission is to restore rail service to Willits and eventually to Eureka. To do this they need revenue, and rental of their easement/ROW is one option of obtaining revenue.

NCRA possesses a number of electronic maps depicting the NCRA ROW and ownership. They also have more detailed hard copies of maps at their office in Ukiah. GHD was provided with a general information map. NCRA also recommended communicating with Sonoma Marin Area Rail Transit (SMART) too, as they have easements south of Sonoma towards Napa. GHD did not try to contact SMART, as the pipeline will likely not extend that far south.

4.7 Bureau of Reclamation

From one contact's perspective, providing water to the Trinity or Sacramento systems is definitely worth investigating. Supply to the Trinity Reservoir would be helpful for a number of purposes, including augmentation of Klamath flows. It could provide temperature control in the main stem of the Trinity River downstream of the reservoir, helping conditions for Chinook Salmon. It could also provide temperature control within Clear Creek within the Sacramento system.

The Bureau's thoughts were that there was always value for extra water within the Trinity Reservoir. A dependable water supply for the Central Valley Project is always of use. Our contacts did not know of the business or reimbursement aspects of such an arrangement from the perspective of the Bureau.

Another contact saw no impediment from a water rights perspective to the project based on his understanding of the Water Code. He sees there being two options:

1. For HBMWD to keep the rights to the water and just sell it to an end user, the process would need to be seen as a transfer of water from HBMWD to the end user.
2. HBMWD could sell the rights altogether. This would be a permanent transfer option.

He thought that it would depend on who bought the water. The water rights holder would need to complete a change in the "points of use" and "purpose of use" of its water allocation. There might also be a chance that HBMWD could lose their right to the water due to abandonment (which he says the District is well aware of). He thought there might also be scenarios where the receiving county would receive half the water allocation. This would be done in conjunction with the State Water Resources Control Board. The Bureau suggested GHD contact the State Water Resources Control Board (See Section 4.5 of this Report).

Such a project is not unprecedented (another example is the Trinity River Diversion). The Bureau has a number of customers who would be interested in additional water, such as Westlands Water District. For some customers, the water could be added into the Sacramento system and could be allocated 100% to that customer. He was unsure who would have the money to buy the water.

The Wild and Scenic Rivers designation could present a problem. The Bureau of Reclamation recommended that GHD follow up with California Department of Fish and Wildlife to determine if the Mad River comes under this designation (it does not). The environmental considerations of discharging foreign water into a different system would need to go through the CEQA process.

The Bureau has no jurisdiction on the coast, so the Bureau had no comment to make on sending the water south to Mendocino or Sonoma Counties.

4.8 Green Diamond

The timber company Green Diamond owns considerable pieces of property located along the proposed Eastern Alignment. Mike Nelson, consulting planner to Green Diamond, is currently working on property management-related issues. He said that Green Diamond was generally receptive to working with HBMWD on the project. They are supportive, but would need to further discuss specific ROW requirements for any of their property that the pipeline would cross before they made a more definitive decision.

4.9 General

As outlined above and as anticipated, many of the regulatory agencies were reluctant to comment in depth on a project until it has been more fully developed and a permit application or CEQA document has been submitted. Therefore, a number of questions remain outstanding. It should also be noted that no effort was taken to reach out to the general public or many of the other potential stakeholders such as the Tribes or other landholders to discuss the potential alignments.

5. Reconnaissance-Level Design and Opinion of Probable Construction Cost Estimates

A reconnaissance-level design was developed for each of the two transmission routes selected by the Board: the eastern route to Platina and the southern route following Kneeland and Alderpoint Roads to Lake Mendocino (see Figure 2 and Figure 3). The southern alignment was further analyzed to include another diversion off the main line to Van Arsdale. The design was advanced to an approximately 10 percent design level, mainly to allow for the development of a Class 4 Cost Estimate. The design included the development of the pipeline alignment as well as a simplified water model to allow for the sizing of pumps and determine the need for pressure reducing valve (PRV) stations. The reconnaissance-level design was also used to determine the amount of hydro turbines that could be installed along each alignment, as well as an approximation of energy savings that would result from the use of turbines. The requirements for access and construction roads were also analyzed, as well as items such as the number of stream crossings, the number of highway crossings, the amount of pavement impacted, the length of electrical service required, etc. Further design and cost estimate assumptions are detailed later in this section. Each alternative was analyzed separately using 24-, 36-, 42-, and 48-inch pipe scenarios, with associated flows of 10, 20, 30, and 40 MGD, respectively.

The cost estimate developed for each alternative is considered to be an Association for Advancement of Cost Engineering (AACE) Class 4 Cost Estimate. AACE defines a Class 4 Cost Estimate as follows: “Class 4 estimates are generally based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1 to 15% complete, and would comprise at a minimum the following: Plant capacity, block schematics, indicated layout, process flow diagrams for main process systems, and preliminary engineered process and utility equipment lists. Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side and +20% to +50% on the high side.”

Aside from construction costs, estimates were also generated for permitting, engineering design, land/ROW acquisition, construction management, and O&M. Amortization tables were used to project annual costs out for the next 50 years. Energy savings from hydro turbines were then factored in with these costs to develop an estimated “per acre-foot” cost for the water.

5.1 Reconnaissance-Level Design and Model Development

To assist in the system design and cost estimating, a WaterCAD (hydraulic modeling software) model was developed for each alternative. An elevation profile was generated for each alignment utilizing GIS (see Figure 4, Figure 5, and Figure 6). These elevation profiles were then input into the WaterCAD model, but were smoothed out to include only the most prominent peaks and valleys, thereby simplifying the model.

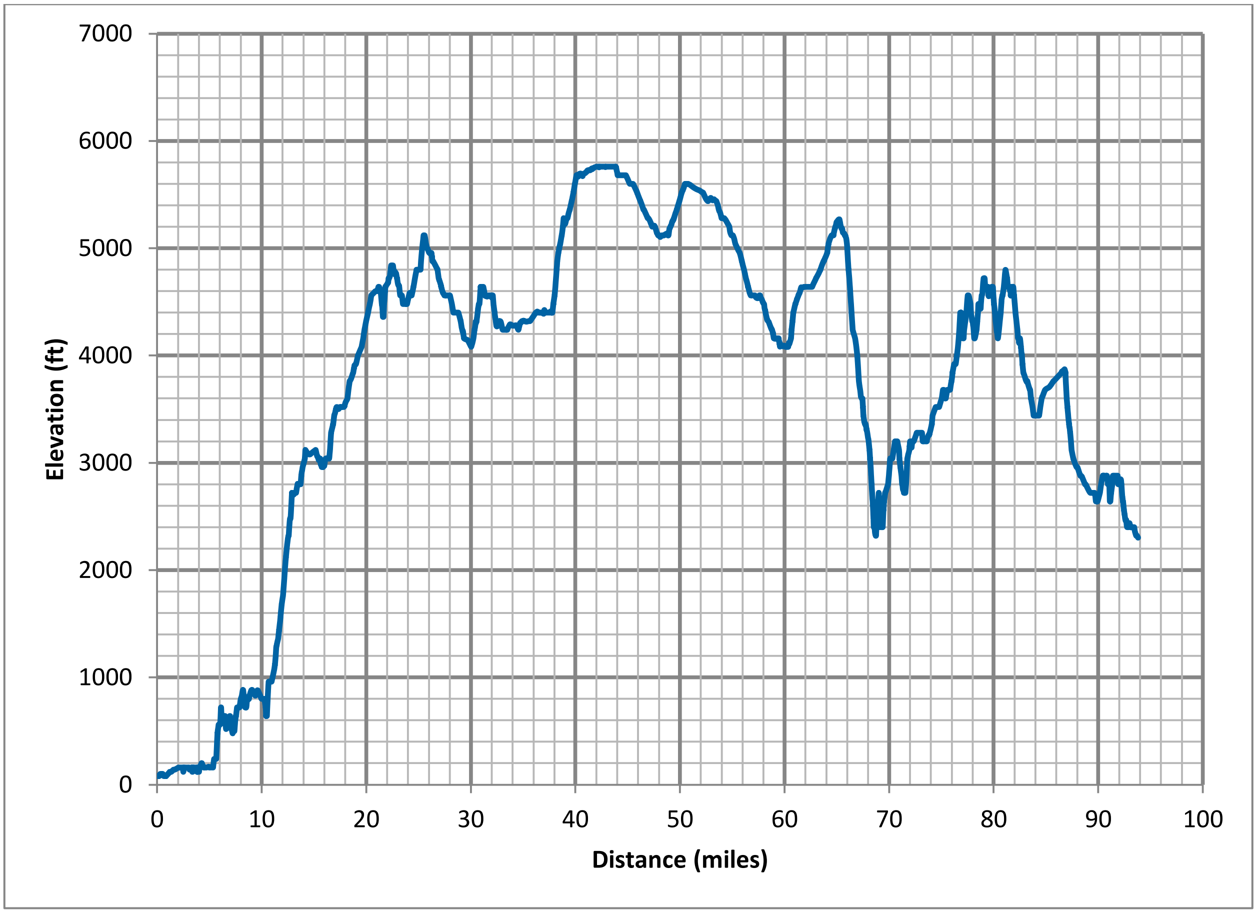

Figure 4: Elevation profile of East Alignment

The East Alignment begins at Essex and terminates at the State Water Project in Platina. It is roughly 90 miles long and ranges in elevation from approximately 80 feet to approximately 5760 feet. Pump stations were figured into the design for sections of elevation gain (e.g. from Essex to the top of South Fork Mountain), while PRV stations and hydro turbines were figured into the design for sections of elevation loss.

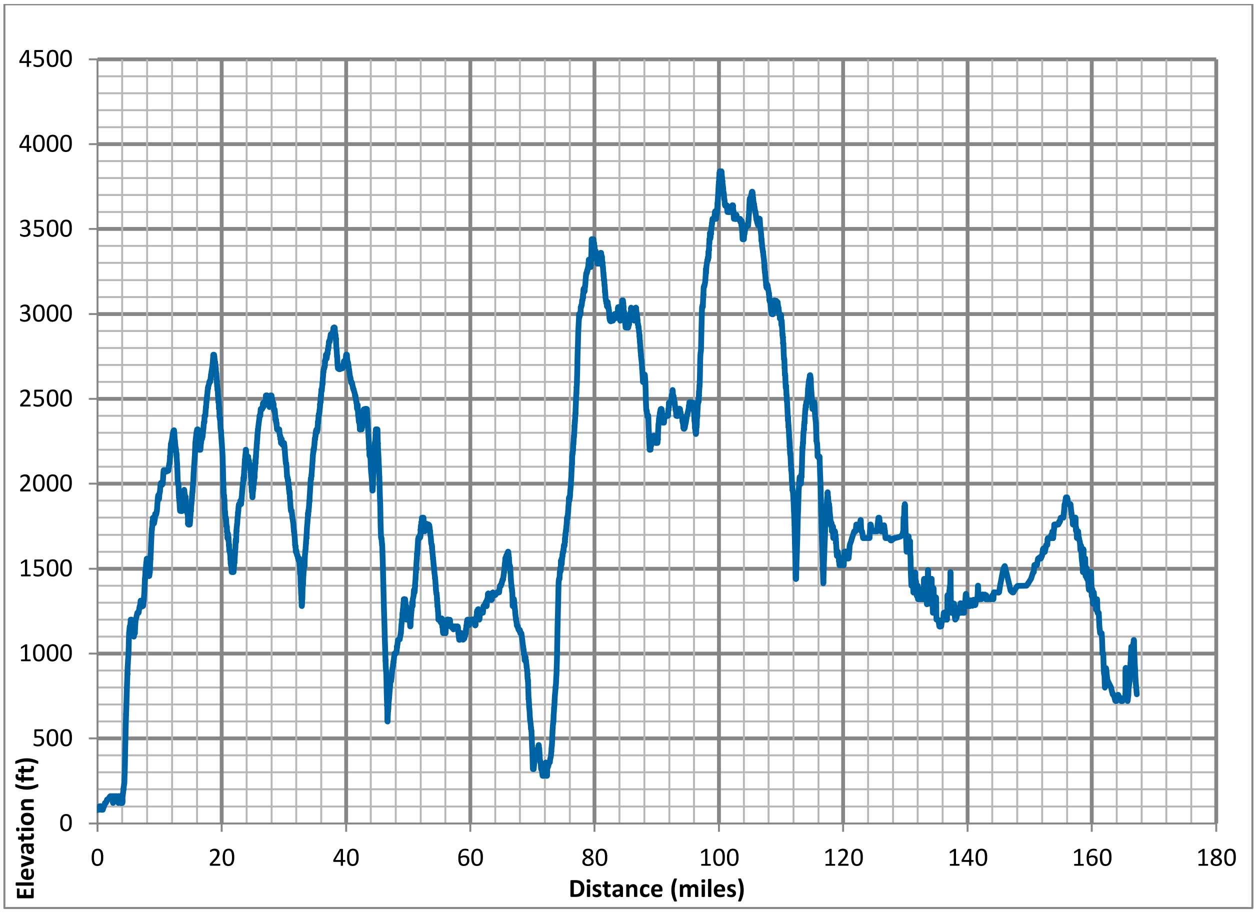

Figure 5: Elevation profile of South Alignment to Lake Mendocino

The South Alignment begins at Essex and terminates at Lake Mendocino. It is roughly 170 miles long and ranges in elevation from approximately 80 feet to approximately 3840 feet. The South Alignment has less elevation change than the East Alignment, which reduces the requirement for pump and PRV stations over a given distance. However, the South Alignment is almost twice as long as the East Alignment, increasing the overall construction costs.

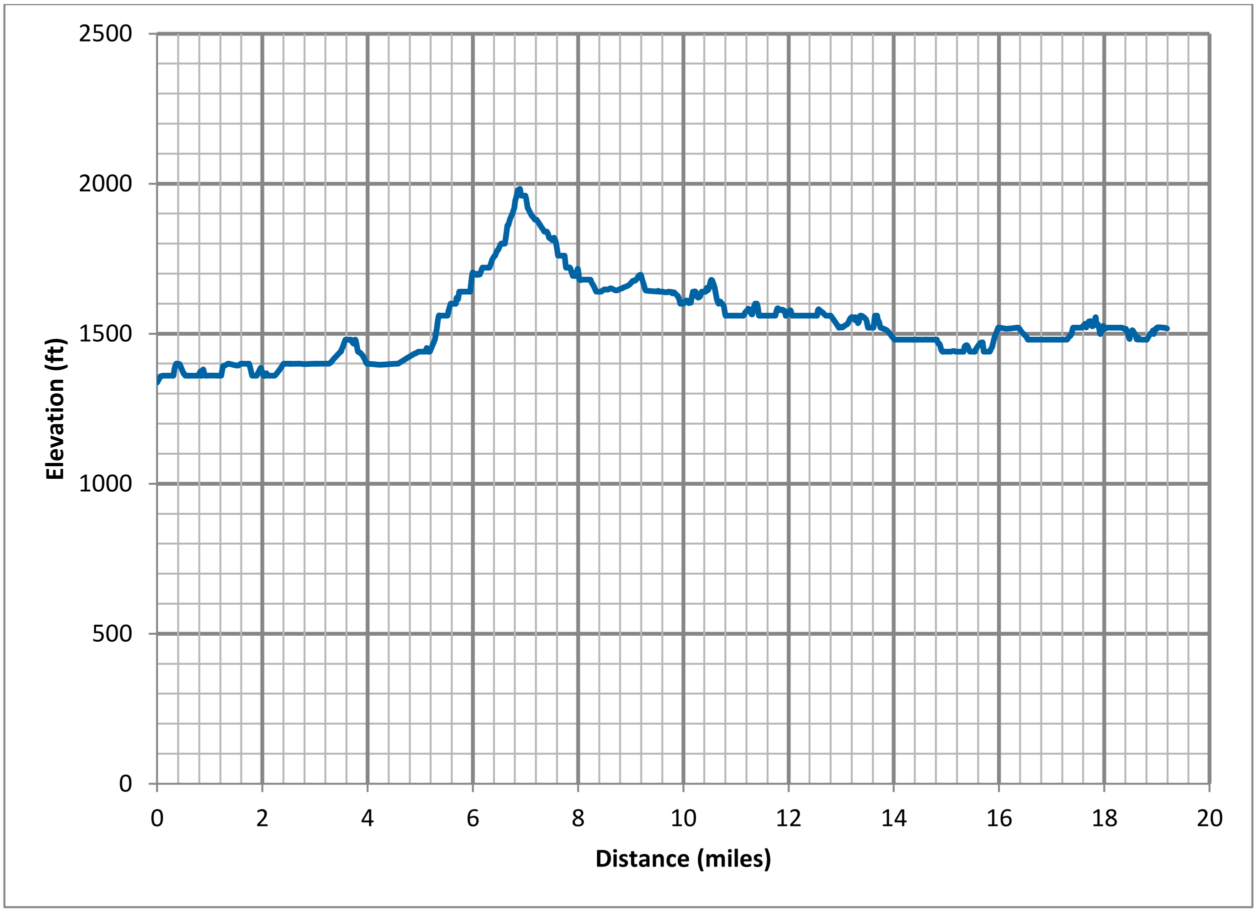

Figure 6: Elevation profile of the Van Arsdale extension

The Van Arsdale extension branches off from the main southern alignment toward Potter Valley/Van Arsdale Reservoir at approximately mile 144 of the alignment.

5.1.1 Model Assumptions and Limitations

The models were developed with the following assumptions and limitations:

- Inputting all of the points generated in the GIS elevation profile analysis into the WaterCAD model was computationally infeasible. Therefore, the elevation profiles were smoothed out slightly and only extreme high and low points were considered in the model.
- Friction losses due to fittings and valves were assumed to be negligible compared to the elevation head and skin friction losses.
- A detailed pipeline was not designed, and the location of various fittings, elbows, and isolation valves was ignored.
- The models consisted of the elevations at high points and low points, and the length of pipe in between these points. Pump and PRV stations were then added as detailed in the following bullet points and Section 5.1.2.
- Pumps were sized to deliver as much total dynamic head (TDH) at as high of a flow as possible, while limiting system pressures to the maximum working pressure allowable for the

type of pipe being proposed. Similarly, the number of PRV stations was also determined by the type of pipe being proposed in a given scenario.

- The last pump station in a section of elevation gain was sized to deliver a pressure in the pipe at the following high point of approximately 10 psi (see Section 5.1.2 for discussion of system pressures). This would minimize the amount of PRV stations required on the subsequent section of elevation loss.
- The last PRV station in each section of elevation loss was designed so that the pressure at the following low point would be the maximum working pressure of the material of pipe being analyzed. This would minimize the amount of pumps required on the subsequent section of elevation gain.

5.1.2 Pipe Materials and Pump Stations

To assess the most cost-effective approach for the pipe materials to be used, an analysis was performed for each alternative evaluating the size and number of pumps required for the pipe material proposed. Using fewer pumps that delivered a higher TDH at a given point in the system necessitated the use of more expensive pipe with higher pressure ratings (e.g. welded steel or DIP). Conversely, using less expensive, DR 25 PVC pipe (rated at 165 psi) for the entire length of each alternative required the use of more pumps that delivered a lower TDH. In sections of elevation loss, more PRV stations would be required when using PVC as opposed to ductile iron or steel.

For each alignment alternative, three pressure scenarios were analyzed for each pipe size: one scenario limited the maximum pressure in the system to 165 psi (maximum working pressure of JM Eagle's DR 25 PVC), the second limited the pressure in the system to 350 psi (maximum working pressure of US Pipe's Class 350 DIP), and the third limited system pressures to 610 psi (maximum working pressure of steel pipe that was considered). For the maximum 165 psi scenario, DR 25 PVC pipe could be used for the entire length of each alignment alternative. For the maximum 350 psi scenario, a combination of DIP, HDPE, and PVC was used in the cost estimate. For the maximum 610 psi scenario, a combination of welded steel pipe, DIP, HDPE, and PVC was used. Pressures in the system were assumed to decrease in a linear manner in sections of elevation gain and increase in a linear manner in sections of elevation loss. Using this assumption in conjunction with system pressure results generated from WaterCAD models, the lengths associated with the various types of pipe could be calculated for each alternative, and associated costs could be determined.

With the significant elevation changes and pipe lengths associated with the alignment alternatives, it was necessary to obtain accurate costs associated with pumping the water. Based on contact with pump suppliers, a few feasible pumps that would be appropriate for these applications were selected. It was determined that a TDH of 1400 ft (corresponds to approximately 610 psi) could be delivered while pumping at a rate of 2.5 MGD, and the motor would be running at 750 hp. Two other pumps considered would each pump at 5 MGD and deliver maximum pressures to the system of 350 psi and 165 psi, with motors running at 855 hp and 385 hp, respectively.

With pumps of this size, annual energy costs proved to be a key factor when determining the cost-effectiveness of each scenario analyzed. Using DIP or welded steel pipe in the models significantly reduced the number of pumps required as opposed to using only PVC. This reduction in pumps corresponded to reductions in energy costs, as well as a reduction in the cost of purchasing and installing the pumps themselves.

5.1.3 Hydro Turbines

Hydro turbines were considered in the design to help recoup energy and offset operational costs associated with running pumps. After contacting various hydroelectric system manufacturers, it was deemed feasible to install pump turbines along sections of elevation loss for the 24- and 36-inch (10 and 20 MGD) scenarios. Francis turbines could be installed along sections of elevation loss for the 42- and 48-inch (30 and 40 MGD) scenarios. The type of turbine used for a given scenario depends on the flow rates and system pressures present. PVC pipe was used in all sections of elevation loss for every scenario, except for the segment of pipe after the last turbine in a given section of elevation loss. For example, for the "maximum 350 psi" analysis, sections of elevation loss were designed such that a turbine system was installed at every point where the system reached 165 psi. After the last turbine in a given section, pressures were allowed to reach 350 psi to minimize pumping requirements for the subsequent section of elevation gain. Although hydro turbines would reduce system pressures, PRV stations were still factored into the cost estimate, as they would be necessary as a backup should a turbine fail.

5.2 Class 4 Opinion Construction Costs

The model results, including pump sizing and numbers of PRV stations, were used to develop a reconnaissance-level quantity takeoff and Class 4 Cost Estimate for each alignment alternative (see Table 3 – Table 14). Cost estimates were prepared in 2014 dollars and were developed utilizing RS Means cost tables, vendor quotes, recently completed contractor cost estimates for similar projects, and engineering judgment. It was felt that a generally conservative approach was taken in the development of costs, and a 20% contingency was added to the overall costs. It should be noted that these costs are in 2014 dollars, and no consideration has been included for the time it would take to permit and construct any of these alternatives, or the subsequent inflationary pressure on the costs.

Costs that were considered for each alignment included the following: mobilization/demobilization, construction staking, traffic control, erosion and sediment control, clearing and grubbing, construction of access roads, sawcutting, removal and replacement of asphalt, trench excavation & backfill, pipe bedding, installation of pipe and fittings, valves, pump stations, thrust blocks, highway and stream crossings, installation of power lines to pump stations and hydro turbines, land, and ROW and easement acquisition.

The path of each alignment route was broken up into various segments: those that were within an existing paved roadway, those outside of an existing paved roadway, those that required clearing/grubbing, and those that required the construction of access roads for construction and future maintenance requirements.

After evaluating the three pressure scenarios for the different pipe sizes for each alignment alternative, it was determined that using welded steel pipe to allow system pressures to get up to higher pressures was the most cost-effective approach. In this scenario, steel pipe was generally used where pressures were the highest (i.e. immediately after pump stations and near the end of sections of elevation loss). Pressure was assumed to increase in a linear manner in sections of elevation loss and decrease in a linear manner in sections of elevation gain. DIP, HDPE, and PVC pipe were then used in sections where it was feasible, given system pressures. Although the costs associated with pipe were higher for this scenario than the other pressures scenarios, pump and PRV station costs were considerably lower. With less pumps required, the estimated annual energy cost was also significantly lower. A more detailed analysis of this assessment would of course need to be performed in subsequent pipeline design development, and it is possible that a more cost-effective approach could be developed with a detailed analysis of each pipeline segment.

Table 3: Class 4 Opinion of Probable Construction Cost – East Alignment, 24-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$15,500,000	$15,500,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	450	AC	$10,000	$4,500,000
3	Access Roads	38	MI	$70,000	$2,700,000
4	Culverts	400	EA	$830	$340,000
5	Pipe Installation (Within Roadway)	1,220	LF	$178	$300,000
6	Pipe Installation (Outside of Roadway)	495,100	LF	$143	$70,800,000
7	Fittings and Valves	1	LS	$5,010,000	$5,100,000
8	Stream Crossings	3,300	LF	$450	$1,500,000
9	Highway Crossings	6	EA	$100,000	$600,000
10	PRV Stations	13	EA	$70,000	$1,000,000
11	Hydro Turbines	13	EA	$800,000	$10,400,000
12	Pump Stations	6	EA	$3,597,000	$21,600,000
13	Overhead Electrical to Pump Stations and Turbines	343,200	LF	$25	$8,600,000
	Construction Subtotal				**$142,940,000**
	Permitting (10% of Construction Subtotal)				$14,500,000
	Engineering (10% of Construction Subtotal)				$14,500,000
	Land/ROW Acquisition (10% of Consruction Subtotal)				$14,500,000
	Construction Management (10% of Construction Subtotal)				$14,500,000
	Contingency (20% of Construction Subtotal)				$28,511,920
	Base Bid Total Opinion of Probable Construction Cost				**$229,000,000**

Table 4: Class 4 Opinion of Probable Construction Cost – South Alignment, 24-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$24,125,000	$24,200,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	260	AC	$10,000	$2,600,000
3	Access Roads	71	MI	$70,000	$5,000,000
4	Culverts	750	EA	$830	$630,000
5	Pipe Installation (Within Roadway)	440,880	LF	$185	$81,600,000
6	Pipe Installation (Outside of Roadway)	440,880	LF	$150	$66,200,000
7	Fittings and Valves	1	LS	$9,235,000	$9,300,000
8	Stream Crossings	6,500	LF	$450	$3,000,000
9	Highway Crossings	6	EA	$100,000	$600,000
10	PRV Stations	14	EA	$70,000	$1,000,000
11	Hydro Turbines	14	EA	$800,000	$11,200,000
12	Pump Stations	7	EA	$2,644,000	$18,600,000
13	Overhead Electrical to Pump Stations and Turbines	422,400	LF	$25	$10,600,000
	Construction Subtotal				**$234,530,000**
	Permitting (10% of Construction Subtotal)				$23,500,000
	Engineering (10% of Construction Subtotal)				$23,500,000
	Land/ROW Acquisition (10% of Consruction Subtotal)				$23,500,000
	Construction Management (10% of Construction Subtotal)				$23,500,000
	Contingency (20% of Construction Subtotal)				$47,080,800
	Base Bid Total Opinion of Probable Construction Cost				**$376,000,000**

Table 5: Class 4 Opinion of Probable Construction Cost – Van Arsdale Extension, 24-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$2,889,000	$2,900,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	40	AC	$10,000	$400,000
3	Access Roads	7	MI	$70,000	$500,000
4	Culverts	74	EA	$830	$70,000
5	Pipe Installation (Within Roadway)	79,200	LF	$170	$13,470,000
6	Pipe Installation (Outside of Roadway)	26,400	LF	$130	$3,500,000
7	Fittings and Valves	1	LS	$2,060,000	$2,100,000
8	Stream Crossings	1,550	LF	$450	$700,000
9	Highway Crossings	1	EA	$100,000	$100,000
10	PRV Stations	3	EA	$70,000	$300,000
11	Hydro Turbines	3	EA	$800,000	$2,400,000
12	Pump Stations	0	EA	$3,130,000	$0
13	Overhead Electrical to Pump Stations and Turbines	21,120	LF	$25	$600,000
	Construction Subtotal				**$27,040,000**
	Permitting (10% of Construction Subtotal)				$2,500,000
	Engineering (10% of Construction Subtotal)				$2,500,000
	Land/ROW Acquisition (10% of Consruction Subtotal)				$2,500,000
	Construction Management (10% of Construction Subtotal)				$2,500,000
	Contingency (20% of Construction Subtotal)				$5,312,600
	Base Bid Total Opinion of Probable Construction Cost				**$42,000,000**

Table 6: Class 4 Opinion of Probable Construction Cost – East Alignment, 36-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$15,500,000	$15,500,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	450	AC	$10,000	$4,500,000
3	Access Roads	38	MI	$70,000	$2,700,000
4	Culverts	400	EA	$830	$340,000
5	Pipe Installation (Within Roadway)	1,220	LF	$300	$400,000
6	Pipe Installation (Outside of Roadway)	495,100	LF	$260	$128,800,000
7	Fittings and Valves	1	LS	$6,510,000	$6,600,000
8	Stream Crossings	3,300	LF	$600	$2,000,000
9	Highway Crossings	6	EA	$120,000	$800,000
10	PRV Stations	13	EA	$160,000	$2,100,000
11	Hydro Turbines	13	EA	$1,600,000	$20,800,000
12	Pump Stations	6	EA	$6,463,000	$38,800,000
13	Overhead Electrical to Pump Stations and Turbines	343,200	LF	$25	$8,600,000
	Construction Subtotal				**$231,940,000**
	Permitting (10% of 24-inch Construction Subtotal)				$14,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$14,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$14,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$14,500,000
	Contingency (20% of Construction Subtotal)				$46,101,980
	Base Bid Total Opinion of Probable Construction Cost				**$336,000,000**

Table 7: Class 4 Opinion of Probable Construction Cost – South Alignment, 36-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$24,125,000	$24,200,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	260	AC	$10,000	$2,600,000
3	Access Roads	71	MI	$70,000	$5,000,000
4	Culverts	750	EA	$830	$630,000
5	Pipe Installation (Within Roadway)	440,880	LF	$300	$132,300,000
6	Pipe Installation (Outside of Roadway)	440,880	LF	$260	$114,700,000
7	Fittings and Valves	1	LS	$11,565,000	$11,600,000
8	Stream Crossings	6,500	LF	$600	$3,900,000
9	Highway Crossings	6	EA	$120,000	$800,000
10	PRV Stations	14	EA	$160,000	$2,300,000
11	Hydro Turbines	14	EA	$1,600,000	$22,400,000
12	Pump Stations	7	EA	$4,687,000	$32,900,000
13	Overhead Electrical to Pump Stations and Turbines	422,400	LF	$25	$10,600,000
	Construction Subtotal				**$363,930,000**
	Permitting (10% of 24-inch Construction Subtotal)				$23,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$23,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$23,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$23,500,000
	Contingency (20% of Construction Subtotal)				$72,806,400
	Base Bid Total Opinion of Probable Construction Cost				**$531,000,000**

Table 8: Class 4 Opinion of Probable Construction Cost – Van Arsdale Extension, 36-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$2,889,000	$2,900,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	40	AC	$10,000	$400,000
3	Access Roads	7	MI	$70,000	$500,000
4	Culverts	74	EA	$830	$70,000
5	Pipe Installation (Within Roadway)	79,200	LF	$310	$24,560,000
6	Pipe Installation (Outside of Roadway)	26,400	LF	$265	$7,000,000
7	Fittings and Valves	1	LS	$2,680,000	$2,700,000
8	Stream Crossings	1,550	LF	$600	$1,000,000
9	Highway Crossings	1	EA	$120,000	$200,000
10	PRV Stations	3	EA	$160,000	$500,000
11	Hydro Turbines	3	EA	$1,600,000	$4,800,000
12	Pump Stations	0	EA	$6,230,000	$0
13	Overhead Electrical to Pump Stations and Turbines	21,120	LF	$25	$600,000
	Construction Subtotal				**$45,230,000**
	Permitting (10% of 24-inch Construction Subtotal)				$2,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$2,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$2,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$2,500,000
	Contingency (20% of Construction Subtotal)				$8,990,800
	Base Bid Total Opinion of Probable Construction Cost				**$64,000,000**

Table 9: Class 4 Opinion of Probable Construction Cost – East Alignment, 42-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$15,500,000	$15,500,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	450	AC	$10,000	$4,500,000
3	Access Roads	38	MI	$70,000	$2,700,000
4	Culverts	400	EA	$830	$340,000
5	Pipe Installation (Within Roadway)	1,220	LF	$375	$500,000
6	Pipe Installation (Outside of Roadway)	495,100	LF	$330	$163,400,000
7	Fittings and Valves	1	LS	$9,000,000	$9,000,000
8	Stream Crossings	3,300	LF	$750	$2,500,000
9	Highway Crossings	6	EA	$140,000	$900,000
10	PRV Stations	13	EA	$200,000	$2,600,000
11	Hydro Turbines	13	EA	$2,400,000	$31,200,000
12	Pump Stations	6	EA	$9,330,000	$56,000,000
13	Overhead Electrical to Pump Stations and Turbines	343,200	LF	$25	$8,600,000
	Construction Subtotal				**$297,740,000**
	Permitting (10% of 24-inch Construction Subtotal)				$14,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$14,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$14,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$14,500,000
	Contingency (20% of Construction Subtotal)				$59,495,520
	Base Bid Total Opinion of Probable Construction Cost				**$415,000,000**

Table 10: Class 4 Opinion of Probable Construction Cost – South Alignment, 42-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$24,125,000	$24,200,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	260	AC	$10,000	$2,600,000
3	Access Roads	71	MI	$70,000	$5,000,000
4	Culverts	750	EA	$830	$630,000
5	Pipe Installation (Within Roadway)	440,880	LF	$380	$167,600,000
6	Pipe Installation (Outside of Roadway)	440,880	LF	$335	$147,700,000
7	Fittings and Valves	1	LS	$16,045,000	$16,100,000
8	Stream Crossings	6,500	LF	$750	$4,900,000
9	Highway Crossings	6	EA	$140,000	$900,000
10	PRV Stations	14	EA	$200,000	$2,800,000
11	Hydro Turbines	14	EA	$2,400,000	$33,600,000
12	Pump Stations	7	EA	$6,730,000	$47,200,000
13	Overhead Electrical to Pump Stations and Turbines	422,400	LF	$25	$10,600,000
	Construction Subtotal				**$463,830,000**
	Permitting (10% of 24-inch Construction Subtotal)				$23,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$23,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$23,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$23,500,000
	Contingency (20% of Construction Subtotal)				$92,620,800
	Base Bid Total Opinion of Probable Construction Cost				**$650,000,000**

Table 11: Class 4 Opinion of Probable Construction Cost – Van Arsdale Extension, 42-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$2,889,000	$2,900,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	40	AC	$10,000	$400,000
3	Access Roads	7	MI	$70,000	$500,000
4	Culverts	74	EA	$830	$70,000
5	Pipe Installation (Within Roadway)	79,200	LF	$395	$31,290,000
6	Pipe Installation (Outside of Roadway)	26,400	LF	$345	$9,200,000
7	Fittings and Valves	1	LS	$4,070,000	$4,100,000
8	Stream Crossings	1,550	LF	$750	$1,200,000
9	Highway Crossings	1	EA	$140,000	$200,000
10	PRV Stations	3	EA	$200,000	$600,000
11	Hydro Turbines	3	EA	$2,400,000	$7,200,000
12	Pump Stations	0	EA	$9,330,000	$0
13	Overhead Electrical to Pump Stations and Turbines	21,120	LF	$25	$600,000
	Construction Subtotal				**$58,260,000**
	Permitting (10% of 24-inch Construction Subtotal)				$2,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$2,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$2,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$2,500,000
	Contingency (20% of Construction Subtotal)				$11,522,000
	Base Bid Total Opinion of Probable Construction Cost				**$80,000,000**

Table 12: Class 4 Opinion of Probable Construction Cost – East Alignment, 48-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$15,500,000	$15,500,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	450	AC	$10,000	$4,500,000
3	Access Roads	38	MI	$70,000	$2,700,000
4	Culverts	400	EA	$830	$340,000
5	Pipe Installation (Within Roadway)	1,220	LF	$445	$600,000
6	Pipe Installation (Outside of Roadway)	495,100	LF	$400	$198,100,000
7	Fittings and Valves	1	LS	$11,250,000	$11,300,000
8	Stream Crossings	3,300	LF	$900	$3,000,000
9	Highway Crossings	6	EA	$160,000	$1,000,000
10	PRV Stations	13	EA	$240,000	$3,200,000
11	Hydro Turbines	13	EA	$3,000,000	$39,000,000
12	Pump Stations	6	EA	$12,197,000	$73,200,000
13	Overhead Electrical to Pump Stations and Turbines	343,200	LF	$25	$8,600,000
	Construction Subtotal				**$361,040,000**
	Permitting (10% of 24-inch Construction Subtotal)				$14,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$14,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$14,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$14,500,000
	Contingency (20% of Construction Subtotal)				$72,065,260
	Base Bid Total Opinion of Probable Construction Cost				**$491,000,000**

Table 13: Class 4 Opinion of Probable Construction Cost – South Alignment, 48-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$24,125,000	$24,200,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	260	AC	$10,000	$2,600,000
3	Access Roads	71	MI	$70,000	$5,000,000
4	Culverts	750	EA	$830	$630,000
5	Pipe Installation (Within Roadway)	440,880	LF	$450	$198,400,000
6	Pipe Installation (Outside of Roadway)	440,880	LF	$405	$178,600,000
7	Fittings and Valves	1	LS	$20,015,000	$20,100,000
8	Stream Crossings	6,500	LF	$900	$5,900,000
9	Highway Crossings	6	EA	$160,000	$1,000,000
10	PRV Stations	14	EA	$240,000	$3,400,000
11	Hydro Turbines	14	EA	$3,000,000	$42,000,000
12	Pump Stations	7	EA	$8,773,000	$61,500,000
13	Overhead Electrical to Pump Stations and Turbines	422,400	LF	$25	$10,600,000
	Construction Subtotal				**$553,930,000**
	Permitting (10% of 24-inch Construction Subtotal)				$23,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$23,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$23,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$23,500,000
	Contingency (20% of Construction Subtotal)				$110,835,200
	Base Bid Total Opinion of Probable Construction Cost				**$759,000,000**

Table 14: Class 4 Opinion of Probable Construction Cost – Van Arsdale Extension, 48-inch

Item No.	Description	Quantity	Units	Unit Cost	Total
1	Mobilization/Demobilization, Staking, Traffic Control, Erosion Control	1	LS	$2,889,000	$2,900,000
2	Clearing/Grubbing (for Pipeline and Access Roads)	40	AC	$10,000	$400,000
3	Access Roads	7	MI	$70,000	$500,000
4	Culverts	74	EA	$830	$70,000
5	Pipe Installation (Within Roadway)	79,200	LF	$455	$36,040,000
6	Pipe Installation (Outside of Roadway)	26,400	LF	$405	$10,700,000
7	Fittings and Valves	1	LS	$5,030,000	$5,100,000
8	Stream Crossings	1,550	LF	$900	$1,400,000
9	Highway Crossings	1	EA	$160,000	$200,000
10	PRV Stations	3	EA	$240,000	$800,000
11	Hydro Turbines	3	EA	$3,000,000	$9,000,000
12	Pump Stations	0	EA	$12,430,000	$0
13	Overhead Electrical to Pump Stations and Turbines	21,120	LF	$25	$600,000
	Construction Subtotal				**$67,710,000**
	Permitting (10% of 24-inch Construction Subtotal)				$2,500,000
	Engineering (10% of 24-inch Construction Subtotal)				$2,500,000
	Land/ROW Acquisition (10% of 24-inch Construction Subtotal)				$2,500,000
	Construction Management (10% of 24-inch Construction Subtotal)				$2,500,000
	Contingency (20% of Construction Subtotal)				$13,441,200
	Base Bid Total Opinion of Probable Construction Cost				**$91,000,000**

Table 3 – Table 14 above are summarized versions of the tables given in Appendix A. See Appendix A for a further breakdown of line items and associated costing information.

5.2.1 East Alignment

The beginning portion of the East Alignment would follow the existing City of Eureka waterline easement, but then quickly begin climbing into forested areas, some of which are fairly steep. This area would require clearing and grubbing and the construction of some access roads, graded to the steeper incline. However, this alignment generally remains in close proximity to existing roads, including a large number of logging roads. Once the alignment reaches Highway 36, it will begin to follow the PG&E natural gas line easement and will require less clearing and grubbing and access road construction. The entire alignment is relatively hard to access, and hauling and disposal of materials will be more expensive. The climb up South Fork ridge will also require an estimated five pump stations (an additional pump station would also be required farther along the alignment). Power will of course also have to be brought into these stations, and it was assumed that power to all the stations would be provided via overhead electrical cables. Estimates were made for the length of run to the nearest distribution lines, and electrical substations were sized and included in the cost estimate. Stream crossings for the east alignment are relatively few but do include the Mad River, the South Fork of the Trinity River, Hayfork Creek, and the middle fork of Cottonwood Creek. It was assumed that each of these crossings would be horizontally directionally drilled. The costs for the eastern alignment were ended at Platina. If the State Water Resources Control Board and other regulatory agencies would allow it, the discharge would go into Cottonwood Creek at this point, which flows into the Sacramento River located approximately 20 miles to the east. If this would not be allowed, approximately 30 miles of additional pipe would be installed along Platina Road to the Sacramento River. This installation would be relatively easy compared to the majority of the other installation along this alignment, and would be able to flow by gravity to the river.

5.2.2 South Alignment

The Southern alignment follows roadways for an assumed 50% of its length. Whenever possible, the pipe would be installed outside of the paved section; however, given the alignment of many of these roads, that will not always be possible. Costs were included for pavement removal and re-paving. This increases the pavement demolition and replacement costs when compared to the East alignment, but greatly reduces the number of access and maintenance roads that would have to be constructed. The elevation gain along this alignment is also less than the eastern alignment; however, the south alignment is longer, and the number of required pump stations was estimated at seven. Access to the power grid would also be required for these stations. Roughly 20% of the alignment would require clearing and grubbing, and approximately 70 miles of access roads would be required. This alignment would also have to cross the Van Duzen River at Bridgeville, the Eel River at Alderpoint, as well as approximately 20 other smaller streams. It was assumed that all these crossings would be horizontally directionally drilled. The pipe would also have to cross Highway 101 at multiple locations and Highway 20 at one location. It was assumed that all of these crossings would have to be jack and bored under the highway.

The extension out to Van Arsdale Reservoir/the Potter Valley Diversion would generally follow roadways (Reynolds Hwy, Canyon Rd, Tomki Rd, Gibson, Ridgeway Hwy), which will require pavement demo and repair, but cut down on the clearing and grubbing and access road construction requirements. This portion of the alignment does cross a ridgeline and drop down into Tomki Creek and may need to be pumped over both of these ridges to get to the reservoir. It will also have to cross some of the minor drainages that flow into Tomki Creek, but there are no major river crossings.

5.2.3 Costing Assumptions

As mentioned, this is a Class 4 Cost estimate, and many assumptions were required to develop the costs. Some of the key assumptions include:

- 2014 dollars, with no cost escalation for inflation added
- Mobilization/demobilization
  - East Alignment: assumed seven working months per year (140 days), work completed in six years, and $1,500,000 for each occurrence of mobilization/demobilization
  - South Alignment: assumed four crews each constructing 500 feet of pipeline per day (total of 440 working days for 167 miles of pipeline). Also assumed seven working months per year (140 days), work completed in four years, four crews, and four mobilization/demobilization occurrences for each crew at $750,000 each
- A survey crew would stake 2,000 ft/day at $450/hr
- Traffic control
  - East Alignment: assumed 840 total working days, a traffic control would be necessary half of the days, and $400/hr for a traffic control crew
  - South Alignment: assumed traffic control would be necessary for 330 of the 440 working days (75%). Assumed four traffic control crews at $400/hr per crew
- Erosion and sediment control would be approximately 2.5% of the total construction cost for the 24-inch pipe scenario (this number was also used for the 36-, 42-, and 48-inch pipe scenario for each alignment)
- Any necessary clearing/grubbing would be 30 feet wide across the length of clearing/grubbing areas
- Access roads, where required, would be 12 feet wide
  - Culverts would be required for every 500 feet of access road
  - A crew of two laborers, one operator, and one bulldozer rental would cost $3,480 per day, and this crew could construct 600 feet of access road per day
  - Screened pit run gravel would be used for access road construction
- When trenching within the roadway, existing asphalt would be sawcut prior to excavation.
- Removed asphalt could be disposed/recycled at no cost other than the cost to haul it. It was assumed the length of the haul was 40 miles
- A trench box would be used during trench excavation
- Trenches would be two feet wider than the associated pipe (one foot of clearance on each side), there would be 6” of pipe bedding, and five feet of cover
- 10% of the native material encountered would not be suitable backfill, and imported fill would be required
- Half of the trenching for the south alignment would be within the roadway

- 1,200 feet of the trenching for the east alignment would be within the roadway
- For trenches outside of the roadway:
  - Native material would be used as backfill to the top of the trench (except for the 10% of the time when native material is unsuitable for backfill)
  - 25% of the difference between the amount of excavated native and the amount of native used for backfill would need to be hauled offsite
- For trenches within the roadway:
  - Screened pit run gravel would be used as backfill for the top 18 inches of trench
  - All native material not used as backfill would be hauled away
- Pipe material would be chosen according to system pressures at any given location (e.g. welded steel pipe would be used at all locations where pressures would be over 350 psi). A combination of welded steel, DIP, HDPE, and PVC pipe was used in the cost estimate for each alternative. The amount of each type of pipe used was dependent upon how system pressures changed with the elevation profile of each alignment, and costs associated with materials and installation changed accordingly.
- Material and installation cost for fittings would be 5% of the total pipe cost for 24-inch pipe and 3% of the total cost for 36-, 42-, and 48-inch pipe
- The design would include directionally drilling under each stream that was encountered. Stream crossings would require 100 feet of directional drilling on either side of the stream
- The design would include jacking and boring under each Caltrans highway crossing
- The number of air relief valves was determined by counting the number of high points on the elevation profile of each alignment
- There would be one butterfly valve per mile of pipe
- Cost of purchasing PRVs was doubled to include the construction of a PRV station
- One cubic yard of concrete would be required for thrust blocks per thousand linear feet of pipe
- There would be one redundant pump at each pump station that would not typically be in use
- Cost of purchasing a pump was doubled to include installation
- Construction of a concrete block pump house would cost $30,000
- A substation would need to be constructed at each pump station, and the cost of the substation would be the equivalent of $75,000 per pump
- The energy cost associated with pumping would be $0.11 per kWh (current PG&E E20 transmission firm rate)
- Major upgrades to the PG&E transmission system to provide power service to the new substations for the pumps would not be necessary
- There would be a credit from PG&E of $0.04 per kWh for power that would be generated by hydro turbines
  - Pump turbines (10 and 20 MGD cases) were assumed to be 78% efficient

- Francis turbines (30 and 40 MGD cases) were assumed to be 86.5% efficient

- It would cost $25/LF (roughly $130,000 per mile) to run overhead electrical lines to pump stations and hydro turbines
  - East alignment: there would be 65 miles of overhead electrical installation
  - South alignment: there would be 80 miles of overhead electrical installation
- The cost of purchasing a hydro turbine was doubled to include installation
- Paving would cost $150/ton
- Engineering would be 10% of the total construction cost for the 24-inch pipeline scenario for each alignment alternative
- Permitting would be 10% of the total construction cost for the 24-inch pipeline scenario for each alignment alternative
- Land/ROW acquisition would be 10% of the total construction cost for the 24-inch pipeline scenario for each alignment alternative
- Construction management would be 10% of the total construction cost for the 24-inch pipeline scenario for each alignment alternative
- A 20% contingency was added to the construction subtotal

Detailed construction costs are included in Appendix A and are summarized below in Table 15.

Table 15: Summary of Costs Associated with Each Alternative (in millions of dollars)

Item	East Route 24-inch	East Route 36-inch	East Route 42-inch	East Route 48-inch
Construction	$143	$232	$298	$361
Permitting	$15	$15	$15	$15
Engineering	$15	$15	$15	$15
Land/ROW Acquisition	$15	$15	$15	$15
Construction Management	$15	$15	$15	$15
Contingency	$29	$46	$59	$72
Total	**$229**	**$336**	**$415**	**$491**
Item	**South Route 24-inch**	**South Route 36-inch**	**South Route 42-inch**	**South Route 48-inch**
Construction	$235	$364	$464	$554
Permitting	$24	$24	$24	$24
Engineering	$24	$24	$24	$24
Land/ROW Acquisition	$24	$24	$24	$24
Construction Management	$24	$24	$24	$24
Contingency	$47	$73	$93	$111
Total	**$376**	**$531**	**$650**	**$759**
Item	**Van Arsdale Extension 24-inch**	**Van Arsdale Extension 36-inch**	**Van Arsdale Extension 42-inch**	**Van Arsdale Extension 48-inch**
Construction	$27	$45	$58	$68
Permitting	$3	$3	$3	$3
Engineering	$3	$3	$3	$3
Land/ROW Acquisition	$3	$3	$3	$3
Construction Management	$3	$3	$3	$3
Contingency	$5	$9	$12	$13
Total	**$42**	**$64**	**$80**	**$91**

With the East alignment being shorter than the South alignment, the overall construction cost would be significantly lower. If the Van Arsdale Extension were constructed, it would likely be an addition to the South alignment. The costs listed in Table 15 do not include O&M costs. O&M costs are included in the projected costs in Section 6.

5.3 Greenhouse Gas Emissions

A greenhouse gas (GHG) emissions study was completed as part of this Report (Table 16).

Table 16: GHG emissions

Pipe Size	Alignment	Annual Energy Used (MWh)	Annual GHG Emissions (Metric Tons)
24-inch	East	70,400	14,200
	South	54,100	10,900
	Van Arsdale	-	-
36-inch	East	137,700	27,800
	South	98,000	19,800
	Van Arsdale	-	-
42-inch	East	194,100	39,000
	South	137,100	27,600
	Van Arsdale	-	-
48-inch	East	258,200	52,100
	South	181,100	36,500
	Van Arsdale	-	-

GHG emissions were calculated using an emission factor of 444.62 lbs per MWh. The use of hydro turbines was factored in to offset GHG emissions for each alternative.

6. Annual Projected Cost

6.1 Annual Operation and Maintenance Costs for Pump Stations

The greatest cost associated with operation and maintenance of the delivery pipeline (at least in the short-term) would be the electrical costs associated with pumping. Floway Pumps has software that will estimate the annual electrical costs associated with their pumps. The pumps that were selected for each of the alternatives were input into these models and the electrical costs calculated. The given efficiencies of each pump (ranging from 82% to 84%) were utilized in the model, but a complete wire to water efficiency was not estimated. Electrical costs were assumed to be $0.11/kWh.

The software then generated an annual energy cost, and an assumed maintenance cost of $10,000 per pump was added to this energy cost. Due to the amount of water that would be pumped and the elevation gains in each alignment, annual energy costs would be very high. The energy costs for the pumps that were used ranged from about $280,000 annually per pump (385 hp pump) to $615,000 annually per pump (855 hp pump). 88 total pumps were used for the east alignment (with up to 16 pumps per pump station), while 80 pumps were used for the south alignment. The most cost-effective set of pumps was used at each pump station, choosing from the three pump models that were used in the modeling and design (these pumps are described in Section 5.1.2).

Power regeneration figures from hydro turbines were used to offset pump operational costs. One turbine system that would reduce the system pressure from 165 psi to 10 psi would produce approximately 1600 kW at a flow of 40 MGD (assuming Francis turbines were 86.5% efficient). For the various alignments and flow rates, power regeneration was calculated to be between 30-35% of the power necessary for pumping. The payback period for the construction of the hydro turbines would be about seven years for the South alignment, and about six years for the East alignment. The difference in payback periods is due to the potential for hydro turbine construction as it relates to changes in elevation.

6.2 Annual Cost for System Maintenance

Using current wage scale information obtained from the District, budgetary numbers were derived for the annual maintenance of the system as a whole. An assumed annual cost of $2 million ($1 million for a full-time crew and $1 million for necessary equipment) was factored in to the annual projected cost figures.

6.3 Amortization of Construction Capital Costs & Estimated Water Cost Per Acre-foot

To determine the estimated cost of water per acre-foot for each alignment, the construction costs were amortized over a 50-year lifespan. A bond rate of 5.5% was assumed over the 50 years. It should be noted that in order to amortize over a 50-year term, this would also necessitate at least a 50-year contract term for the water sales, and it is likely that any potential customer would request an even longer contract term to ensure that their investment is fully recouped. The amortized construction costs were then divided by the 10, 20, 30, and 40 MGD rates to generate a per acre-foot cost for the water. The amortized construction costs, interest paid, and converted costs per acre-foot for construction are shown in Table 17.

Similarly, the annual O&M costs were divided by the 10, 20, 30, and 40 MGD rates to calculate a per acre-foot cost for O&M. This was then added to the construction costs and the District's fee. The District's fee has been set as a range of $200-$300 per acre-foot to cover the cost of the District's regional water system in Trinity and Humboldt Counties, as well as an additional increment to compensate the District for use of the water outside of Humboldt County.

The energy cost offset from the turbines was then subtracted, yielding the overall estimated costs per acre-foot for the water delivered to the end point of each alignment (Table 18).

Table 17: Amortized[1] construction cost per acre-foot

Item	East Route 24-inch	East Route 36-inch	East Route 42-inch	East Route 48-inch
Construction, Permitting, ROW, and Design	$229,000,000	$336,000,000	$415,000,000	$491,000,000
Monthly Payment	$1,121,746	$1,645,881	$2,032,859	$2,405,141
Total Interest Paid	$444,047,681	$651,528,475	$804,715,229	$952,084,765
Total Paid Const. Costs	$673,047,681	$987,528,475	$1,219,715,229	$1,443,084,765
Construction Cost/Acre-ft	**$1,202**	**$882**	**$726**	**$644**
Item	**South Route 24-inch**	**South Route 36-inch**	**South Route 42-inch**	**South Route 48-inch**
Construction, Permitting, ROW, and Design	$376,000,000	$531,000,000	$650,000,000	$759,000,000
Monthly Payment	$1,841,819	$2,601,079	$3,183,996	$3,717,927
Total Interest Paid	$729,091,388	$1,029,647,679	$1,260,397,347	$1,471,756,286
Total Paid Const. Costs	$1,105,091,388	$1,560,647,679	$1,910,397,347	$2,230,756,286
Construction Cost/Acre-ft	**$1,973**	**$1,393**	**$1,137**	**$996**
Item	**Van Arsdale Extension 24-inch**	**Van Arsdale Extension 36-inch**	**Van Arsdale Extension 42-inch**	**Van Arsdale Extension 48-inch**
Construction, Permitting, ROW, and Design	$42,000,000	$64,000,000	$80,000,000	$91,000,000
Monthly Payment	$205,735	$313,501	$391,876	$445,759
Total Interest Paid	$81,441,059	$124,100,662	$155,125,827	$176,455,629
Total Paid Const. Costs	$123,441,059	$188,100,662	$235,125,827	$267,455,629
Construction Cost/Acre-ft	**$220**	**$168**	**$140**	**$119**

[1] A bond rate of 5.5% was assumed over a 50-year amortization period.

Table 18: Amortized[1] total cost per acre-foot

Item	East Route 24-inch	East Route 36-inch	East Route 42-inch	East Route 48-inch
Construction Cost/Acre-ft	$1,202	$882	$726	$644
O&M Cost/Acre-ft	$1,265	$1,176	$1,146	$1,131
Energy Savings from Turbines/Acre-ft	-$136	-$142	-$157	-$157
Cost/Acre-ft	**$2,330**	**$1,915**	**$1,715**	**$1,618**
District Fee/Acre-ft	$200-$300	$200-$300	$200-$300	$200-$300
Total Cost/Acre-ft	**$2,530-$2,630**	**$2,115-$2,215**	**$1,915-$2,015**	**$1,818-$1,918**
Item	**South Route 24-inch**	**South Route 36-inch**	**South Route 42-inch**	**South Route 48-inch**
Construction Cost/Acre-ft	$1,973	$1,393	$1,137	$996
O&M Cost/Acre-ft	$1,029	$939	$910	$895
Energy Savings from Turbines/Acre-ft	-$110	-$128	-$140	-$141
Cost/Acre-ft	**$2,892**	**$2,205**	**$1,907**	**$1,750**
District Fee/Acre-ft	$200-$300	$200-$300	$200-$300	$200-$300
Total Cost/Acre-ft	**$3,092-$3,192**	**$2,405-$2,505**	**$2,107-$2,207**	**$1,950-$2,050**
Item	**Van Arsdale Extension 24-inch**	**Van Arsdale Extension 36-inch**	**Van Arsdale Extension 42-inch**	**Van Arsdale Extension 48-inch**
Construction Cost/Acre-ft	$220	$168	$140	$119
O&M Cost/Acre-ft	$179	$89	$60	$45
Energy Savings from Turbines/Acre-ft	-$59	-$62	-$67	-$67
Cost/Acre-ft	**$340**	**$196**	**$133**	**$97**
District Fee/Acre-ft	$200-$300	$200-$300	$200-$300	$200-$300
Total Cost/Acre-ft	**$540-$640**	**$396-$496**	**$333-$433**	**$297-$397**

[1] A bond rate of 5.5% was assumed over a 50-year amortization period.

As shown in Table 18, the total per acre-foot cost ranges from approximately $1,820 to $3,190/acre-foot, with the lowest cost being for the 48-inch pipeline along the eastern alignment, and the highest cost being for the 24-inch pipeline along the southern alignment. The south alignment is generally more expensive to construct than the east alignment because it is significantly longer. However, the O&M costs for the south alignment are lower than those of the east alignment. Even though slightly more pump stations would be required along the south alignment, there is less TDH to overcome, and the number and size of pumps is less. As pipeline size increases, each alignment alternative becomes more cost-effective. Although the total construction and O&M costs increase with increasing pipe size, they do not increase proportionally to the amount of water that could be delivered by increasing the pipe size.

The $1,820-$3,190/acre-foot figures are considerably higher than what is currently being charged for domestic water in Sonoma and Mendocino Counties (approximately $100 to $1,500/acre-foot). There is also a current proposal to raise the height of the dam at Lake Mendocino to provide extra water to some of the entities in Sonoma and Mendocino Counties. The estimated construction costs for that project are $250 - $300 million. This additional source of water would likely be in competition with the District's available water for the potential users down south.

However, the $1,820-$3,190/acre-foot costs are comparable to costs for desalinized water, which is often cited as the potential source for additional water along the California coast. The 'generic' cost figures of $2,500 to $3,500 per acre-foot are routinely quoted as the cost of desalinization; however, an estimate in excess of $10,000 per acre-foot on a project currently under study is public knowledge. There are many factors that impact the overall costs of desalinization, including the potential size of the plant (smaller plants have much higher unit costs), the intake and concentrate discharge locations, feed water quality, proximity to electrical infrastructure, proximity to water distribution system, etc., and the magnitude of the cost impacts of each of these factors can be significant and cumulative. In addition, in California, the permitting and regulatory costs associated with intake and effluent discharge facilities can be very high, and only time and the implementation of various projects will prove actual costs. While there are several desalinization plants in the planning stage in California, none have been successfully built to date, and several have run into serious technical, environmental, and political issues that may terminate the projects.

One of the other significant factors that may make transportation a more favorable option than desalinization is the reduced capital cost requirements. For example, RBF Consulting recently completed a Technical Memorandum dated October 5, 2011 and titled "Cost Analysis of Water Supply Alternatives". The Memorandum looked at the cost for several alternatives to "solve the water supply deficit in CAW's Coastal Division" (i.e. the area in and around Monterey/Carmel). Capital costs ranged from $362M for the proposed 10 MGD Monterey Desalination project (considerably more than the anticipated costs for the 24-inch pipeline projects described in this Report) to $583M for a Deep Water Desalination plant at Moss Landing.

The ongoing operations and maintenance costs for a desalinization plant would also be quite high, estimated to be $13.2M/year by RBF for the Monterey Desalination project. Although operation costs for the pipeline option are not insignificant, and maintenance would be required on the pipeline and pumping facilities, the operation and maintenance costs for the pipeline are anticipated to be comparable to those of a desalination plant. Although a life cycle cost analysis is beyond the scope of this report, it is likely that a life cycle cost comparison of the pipeline vs. desalinization would be very favorably weighted toward the pipeline option.

Summary

As part of the Humboldt Bay Municipal Water District's (HBMWD or District) Water Resource Planning efforts, GHD has been engaged to undertake a reconnaissance-level assessment for feasible pipeline routes to transfer excess HBMWD water to potential customers to the south or east of their Essex Diversion Facility. The District has a Water Right to 75 million gallons per day (MGD), which has historically included 60 MGD of industrial or unfiltered and untreated surface water from the Mad River, diverted at their Pump Station 6, Surface Water Diversion Station at Essex, near Arcata, CA. This water was previously provided to and utilized at the pulp mills on the Samoa Peninsula in their industrial processes. The first mill closed in 1994-95, and the second mill closed in 2010-11. The closure of the mills had a large financial impact on the District's operations. The District's right to this water is also in jeopardy when it comes up for permit renewal in 2029 if the water is not utilized. With the closure of the mills, loss of associated water sales revenue, and possible jeopardization of the Water Right, HBMWD has begun to look for alternative customers or uses for this water.

The purpose of this report is to present a number of potential pipeline routes for transferring HBMWD water to potential customers and determine whether the construction and operation and maintenance costs associated with these pipelines would yield "acceptable" water rates for the customers and the District. This report presents seven potential pipeline routes to transfer HBMWD water to potential customers to the north, south or east of the Essex Diversion Facility. Two of the seven alignments (an eastern route to the State Water Project and a southern route following Kneeland and Alderpoint Roads to Lake Mendocino) were selected by the Board for further investigation and assessment. A potential add-on to the southern alignment to divert water to the Van Arsdale Reservoir/Potter Valley Diversion was also analyzed. WaterCAD models were developed for each alignment for 24-inch (10 MGD), 36-inch (20 MGD), 42-inch (30 MGD), and 48-inch (40 MGD) diameter pipe. Costs associated with permitting, design, land/ROW acquisition, and construction were estimated for each alignment and pipe diameter. The estimated construction costs were then amortized over a 50-year period, assuming a bond rate of 5.5%, and converted in a cost per acre-foot of water. Added to these costs were the estimated operation and maintenance costs and the District's fee. Subtracted from these was the potential offset generated by hydro turbines. The District's fee was set as a range of $200-$300 per acre foot to cover the cost of the District's regional water system in Trinity and Humboldt Counties, as well as an additional increment to compensate the District for use of the water outside of Humboldt County. Finally, these costs were divided by the rate of water delivery to obtain a cost per acre-foot. The estimated construction costs and total per acre-foot costs are summarized in Table 19.

Table 19: Amortized[1] total cost per acre-foot

Item	East Route 24-inch	East Route 36-inch	East Route 42-inch	East Route 48-inch
Construction Cost/Acre-ft	$1,202	$882	$726	$644
O&M Cost/Acre-ft	$1,265	$1,176	$1,146	$1,131
Energy Savings from Turbines/Acre-ft	-$136	-$142	-$157	-$157
Cost/Acre-ft	**$2,330**	**$1,915**	**$1,715**	**$1,618**
District Fee/Acre-ft	$200-$300	$200-$300	$200-$300	$200-$300
Total Cost/Acre-ft	**$2,530-$2,630**	**$2,115-$2,215**	**$1,915-$2,015**	**$1,818-$1,918**
Item	**South Route 24-inch**	**South Route 36-inch**	**South Route 42-inch**	**South Route 48-inch**
Construction Cost/Acre-ft	$1,973	$1,393	$1,137	$996
O&M Cost/Acre-ft	$1,029	$939	$910	$895
Energy Savings from Turbines/Acre-ft	-$110	-$128	-$140	-$141
Cost/Acre-ft	**$2,892**	**$2,205**	**$1,907**	**$1,750**
District Fee/Acre-ft	$200-$300	$200-$300	$200-$300	$200-$300
Total Cost/Acre-ft	**$3,092-$3,192**	**$2,405-$2,505**	**$2,107-$2,207**	**$1,950-$2,050**
Item	**Van Arsdale Extension 24-inch**	**Van Arsdale Extension 36-inch**	**Van Arsdale Extension 42-inch**	**Van Arsdale Extension 48-inch**
Construction Cost/Acre-ft	$220	$168	$140	$119
O&M Cost/Acre-ft	$179	$89	$60	$45
Energy Savings from Turbines/Acre-ft	-$59	-$62	-$67	-$67
Cost/Acre-ft	**$340**	**$196**	**$133**	**$97**
District Fee/Acre-ft	$200-$300	$200-$300	$200-$300	$200-$300
Total Cost/Acre-ft	**$540-$640**	**$396-$496**	**$333-$433**	**$297-$397**

As shown in Table 19, the cost varies from approximately $1,820 to $3,190/acre-foot, with the lowest cost being for the 48-inch pipeline along the eastern alignment, and the highest cost being for the 24-inch pipeline along the southern alignment. The larger 48-inch pipeline is the more cost-effective option for each of the alignments.

The $1,820-$3,190/acre-foot figures are considerably higher than what is currently being charged for domestic water in Sonoma and Mendocino Counties (approximately $100 to $1,500/acre-foot). There is also a current proposal to raise the height of the dam at Lake Mendocino to provide extra water to some of the entities in Sonoma and Mendocino Counties. The estimated construction

[1] A bond rate of 5.5% was assumed over a 50-year amortization period.

costs for that project are $250 - $300 million. This additional source of water would likely be in competition with the District's available water for the potential users down south.

However, the $1,820-$3,190/acre-foot costs are comparable to desalinization costs, which are often cited as the potential source for additional water along the California coast. The 'generic' cost figures of $2,500 to $3,500 per acre-foot are routinely quoted as the cost of desalinization; however, an estimate in excess of $10,000 per acre-foot on a project currently under study is public knowledge. One of the other significant factors that may make transportation a more favorable option than desalinization is the reduced capital cost requirements. For example, RBF Consulting recently completed a Technical Memorandum dated October 5, 2011 and titled "Cost Analysis of Water Supply Alternatives". The Memorandum looked at the cost for several alternatives to "solve the water supply deficit in CAW's Coastal Division" (i.e. the area in and around Monterey/Carmel). Capital costs ranged from $362M for the proposed 10 MGD Monterey Desalination project to $583M for a Deep Water Desalination plant at Moss Landing, considerably more than the anticipated costs for the 10 MGD pipeline projects given in this Report. The ongoing operation and maintenance costs for a desalinization plant would also be quite high, estimated to be $13.2M/year by RBF for the Monterey Desalination project. Although operation costs for the pipeline option are not insignificant, and maintenance would be required on the pipeline and pumping facilities, the operation and maintenance costs for the pipeline are anticipated to be comparable to those of a desalination plant. Although a life cycle cost analysis is beyond the scope of this report, it is likely that a life cycle cost comparison of the pipeline versus desalinization would be very favorably weighted toward the pipeline option.

As part of this investigation, GHD also contacted a number of regulatory and permitting agencies, Southern Humboldt County communities, and other stakeholders to gather information on the anticipated regulatory constraints, as well as the interest in the District's water by Southern Humboldt Communities. In general, stakeholders were receptive to the project, but most regulatory and permitting agencies were very reluctant to commit to any definitive comments prior to the completion of permit applications or CEQA documents. Extensive additional consultation would still need to occur with these agencies and other concerned stakeholders if the project moves forward.

Appendices

Appendix A –Cost Estimating Spreadsheets

Appendix A contains more detailed costing information for each of the alignments than that given in the main Report. Summarized versions of the tables contained in this appendix are given in Section 5.2. This appendix details all of the items that were considered in generating the tables given in Section 5.2.

Table A-1: South Alignment Quantities

Item No.	Description	Unit	Quantity			
			24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	LS	1	1	1	1
2	Construction Staking	LS	1	1	1	1
3	Traffic Control	LS	1	1	1	1
4	Erosion & Sediment Control	LS	1	1	1	1
5	Clearing/Grubbing (for Pipeline and Access Roads)	AC	260	260	260	260
6	Access Roads - Rough Grading	MI	71	71	71	71
7	Culverts	EA	750	750	750	750
8	Pit Run Gravel for Access Roads	CY	111,100	111,100	111,100	111,100
9	Sawcutting (3" thick asphalt)	LF	882,000	882,000	882,000	882,000
10	Hauling of Removed Asphalt	CY	24,500	28,600	30,600	32,700
11	Trench Excavation	CY	980,000	1,388,000	1,617,000	1,861,000
12	Pipe Bedding (sand), includes hauling cost and compaction	CY	65,300	81,600	89,800	98,000
13	Material and Installation Cost for Pipe	LF	883,000	883,000	883,000	883,000
14	Material and Installation Cost for Fittings	LS	1	1	1	1
15	Trench Backfilling and Compacting with Native Material (in roadway)	CY	278,000	374,000	425,000	477,000
16	Trench Backfilling and Compacting with Native Material (outside roadway)	CY	366,000	484,000	546,000	609,000
17	Imported Backfill (Assuming 10% of native not suitable)	CY	64,400	85,800	97,100	108,600
18	Hauling of Excess Native (in roadway)	CY	211,867	319,978	383,280	453,747
19	Hauling of Excess Native (outside roadway)	CY	30,967	52,494	65,570	80,437
20	Pit Run for Trenches (in roadway, includes compaction)	CY	98,000	122,500	134,700	147,000
21	Stream Crossings	LF	6,500	6,500	6,500	6,500
22	Highway Crossings	EA	6	6	6	6
23	ARVs	EA	120	120	120	120
24	Butterfly Valves	EA	167	167	167	167
25	PRV Stations	EA	14	14	14	14
26	Hydro Turbines	EA	14	14	14	14
27	Pump Stations	EA	7	7	7	7

28	Overhead Electrical to Pump Stations and Turbines	LF	422,400	422,400	422,400	422,400
29	Substations (Pump Stations)	EA	7	7	7	7
30	Concrete Delivery and Placement (thrust blocks)	CY	880	880	880	880
31	Paving	TON	66,132	74,399	78,532	82,665

Table A-2: South Alignment Unit Costs

Item No.	Description	Unit	Unit Cost			
			24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	LS	$12,000,000	$12,000,000	$12,000,000	$12,000,000
2	Construction Staking	LS	$3,000,000	$3,000,000	$3,000,000	$3,000,000
3	Traffic Control	LS	$4,125,000	$4,125,000	$4,125,000	$4,125,000
4	Erosion & Sediment Control	LS	$5,000,000	$5,000,000	$5,000,000	$5,000,000
5	Clearing/Grubbing (for Pipeline and Access Roads)	AC	$10,000	$10,000	$10,000	$10,000
6	Access Roads - Rough Grading	MI	$31,000	$31,000	$31,000	$31,000
7	Culverts	EA	$830	$830	$830	$830
8	Pit Run Gravel for Access Roads	CY	$25	$25	$25	$25
9	Sawcutting (3" thick asphalt)	LF	$2	$2	$2	$2
10	Hauling of Removed Asphalt	CY	$18	$18	$18	$18
11	Trench Excavation	CY	$10	$10	$10	$10
12	Pipe Bedding (sand), includes hauling cost and compaction	CY	$50	$50	$50	$50
13	Material and Installation Cost for Pipe	LF	$125	$224	$294	$358
14	Material and Installation Cost for Fittings	LS	$5,524,700	$5,945,130	$7,794,690	$9,495,990
15	Trench Backfilling and Compacting with Native Material (in roadway)	CY	$10	$10	$10	$10
16	Trench Backfilling and Compacting with Native Material (outside roadway)	CY	$10	$10	$10	$10
17	Imported Backfill (Assuming 10% of native not suitable)	CY	$25	$25	$25	$25
18	Hauling of Excess Native (in roadway)	CY	$10	$10	$10	$10
19	Hauling of Excess Native (outside roadway)	CY	$10	$10	$10	$10
20	Pit Run for Trenches (in roadway, includes compaction)	CY	$25	$25	$25	$25
21	Stream Crossings	LF	$450	$600	$750	$900
22	Highway Crossings	EA	$100,000	$120,000	$140,000	$160,000
23	ARVs	EA	$10,000	$12,000	$20,000	$25,000
24	Butterfly Valves	EA	$15,000	$25,000	$35,000	$45,000
25	PRV Stations	EA	$70,000	$160,000	$200,000	$240,000
26	Hydro Turbines	EA	$800,000	$1,600,000	$2,400,000	$3,000,000
27	Pump Stations	EA	$2,344,000	$4,087,000	$5,830,000	$7,573,000
28	Overhead Electrical to Pump Stations and Turbines	LF	$25	$25	$25	$25
29	Substations (Pump Stations)	EA	$300,000	$600,000	$900,000	$1,200,000

30	Concrete Delivery and Placement (thrust blocks)	CY	$260	$260	$260	$260
31	Paving	TON	$150	$150	$150	$150

Table A-3: South Alignment Total Costs

Item No.	Description	Total Cost			
		24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	$12,000,000	$12,000,000	$12,000,000	$12,000,000
2	Construction Staking	$3,000,000	$3,000,000	$3,000,000	$3,000,000
3	Traffic Control	$4,125,000	$4,125,000	$4,125,000	$4,125,000
4	Erosion & Sediment Control	$5,000,000	$5,000,000	$5,000,000	$5,000,000
5	Clearing/Grubbing (for Pipeline and Access Roads)	$2,600,000	$2,600,000	$2,600,000	$2,600,000
6	Access Roads - Rough Grading	$2,202,000	$2,202,000	$2,202,000	$2,202,000
7	Culverts	$623,000	$623,000	$623,000	$623,000
8	Pit Run Gravel for Access Roads	$2,778,000	$2,778,000	$2,778,000	$2,778,000
9	Sawcutting (3" thick asphalt)	$1,800,000	$1,800,000	$1,800,000	$1,800,000
10	Hauling of Removed Asphalt	$500,000	$600,000	$600,000	$600,000
11	Trench Excavation	$9,800,000	$13,880,000	$16,170,000	$18,610,000
12	Pipe Bedding (sand), includes hauling cost and compaction	$3,265,000	$4,080,000	$4,490,000	$4,900,000
13	Material and Installation Cost for Pipe	$110,494,000	$198,171,000	$259,823,000	$316,533,000
14	Material and Installation Cost for Fittings	$5,530,000	$5,950,000	$7,800,000	$9,500,000
15	Trench Backfilling and Compacting with Native Material (in roadway)	$2,780,000	$3,740,000	$4,250,000	$4,770,000
16	Trench Backfilling and Compacting with Native Material (outside roadway)	$3,660,000	$4,840,000	$5,460,000	$6,090,000
17	Imported Backfill (Assuming 10% of native not suitable)	$1,610,000	$2,145,000	$2,428,000	$2,715,000
18	Hauling of Excess Native (in roadway)	$2,120,000	$3,200,000	$3,840,000	$4,540,000
19	Hauling of Excess Native (outside roadway)	$310,000	$525,000	$656,000	$805,000
20	Pit Run for Trenches (in roadway, includes compaction)	$2,500,000	$3,100,000	$3,400,000	$3,700,000
21	Stream Crossings	$2,925,000	$3,900,000	$4,875,000	$5,850,000
22	Highway Crossings	$600,000	$720,000	$840,000	$960,000
23	ARVs	$1,200,000	$1,440,000	$2,400,000	$3,000,000
24	Butterfly Valves	$2,505,000	$4,175,000	$5,845,000	$7,515,000
25	PRV Stations	$980,000	$2,240,000	$2,800,000	$3,360,000
26	Hydro Turbines	$11,200,000	$22,400,000	$33,600,000	$42,000,000
27	Pump Stations	$16,408,000	$28,609,000	$40,810,000	$53,011,000
28	Overhead Electrical to Pump Stations and Turbines	$10,560,000	$10,560,000	$10,560,000	$10,560,000
29	Substations (Pump Stations)	$2,100,000	$4,200,000	$6,300,000	$8,400,000

30	Concrete Delivery and Placement (thrust blocks)	$229,000	$229,000	$229,000	$229,000
31	Paving	$10,000,000	$11,200,000	$11,800,000	$12,400,000
	Total	**$235,404,000**	**$364,032,000**	**$463,104,000**	**$554,176,000**

Table A-4: East Alignment Quantities

Item No.	Description	Unit	Quantity			
			24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	LS	1	1	1	1
2	Construction Staking	LS	1	1	1	1
3	Traffic Control	LS	1	1	1	1
4	Erosion & Sediment Control	LS	1	1	1	1
5	Clearing/Grubbing (for Pipeline and Access Roads)	AC	450	450	450	450
6	Access Roads - Rough Grading	MI	38	38	38	38
7	Culverts	EA	400	400	400	400
8	Pit Run for Access Roads (includes compaction)	CY	59,600	59,600	59,600	59,600
9	Sawcutting (3" thick asphalt)	LF	2,000	2,000	2,000	2,000
10	Hauling of Removed Asphalt	CY	70	80	85	90
11	Trench Excavation	CY	551,000	781,000	910,000	1,048,000
12	Pipe Bedding (sand), includes hauling cost and compaction	CY	36,800	46,000	50,600	55,100
13	Material and Installation Cost for Pipe	LF	495,300	495,300	495,300	495,300
14	Material Cost for Fittings	LS	1	1	1	1
15	Trench Backfilling and Compacting with Native Material (in roadway)	CY	770	1,040	1,180	1,320
16	Trench Backfilling and Compacting with Native Material (outside road)	CY	411,000	544,000	613,000	684,000
17	Imported Backfill (Assuming 10% of native not suitable for pipe zone)	CY	41,177	54,504	61,418	68,532
18	Hauling of Excess Native (in roadway)	CY	586	880	1,057	1,256
19	Hauling of Excess Native (outside roadway)	CY	34,778	58,831	73,671	90,303
20	Pit Run for Trenches (in roadway, includes compaction)	CY	270	340	375	405
21	Stream Crossings	LF	3,300	3,300	3,300	3,300
22	Highway Crossings	EA	6	6	6	6
23	ARVs	EA	70	70	70	70
24	Butterfly Valves	EA	94	94	94	94
25	PRV Stations	EA	13	13	13	13
26	Hydro Turbines	EA	13	13	13	13

27	Pump Stations	EA	6	6	6	6
28	Overhead Electrical to Pump Stations and Turbines	LF	343,200	343,200	343,200	343,200
29	Substations (Pump Stations)	EA	6	6	6	6
30	Concrete Delivery and Placement (thrust blocks)	CY	500	500	500	500
31	Paving	TON	183	206	217	229

Table A-5: East Alignment Unit Costs

Item No.	Description	Unit	Unit Cost			
			24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	LS	$9,000,000	$9,000,000	$9,000,000	$9,000,000
2	Construction Staking	LS	$1,500,000	$1,500,000	$1,500,000	$1,500,000
3	Traffic Control	LS	$1,500,000	$1,500,000	$1,500,000	$1,500,000
4	Erosion & Sediment Control	LS	$3,500,000	$3,500,000	$3,500,000	$3,500,000
5	Clearing/Grubbing (for Pipeline and Access Roads)	AC	$10,000	$10,000	$10,000	$10,000
6	Access Roads - Rough Grading	MI	$31,000	$31,000	$31,000	$31,000
7	Culverts	EA	$830	$830	$830	$830
8	Pit Run for Access Roads (includes compaction)	CY	$25	$25	$25	$25
9	Sawcutting (3" thick asphalt)	LF	$2	$2	$2	$2
10	Hauling of Removed Asphalt	CY	$18	$18	$18	$18
11	Trench Excavation	CY	$10	$10	$10	$10
12	Pipe Bedding (sand), includes hauling cost and compaction	CY	$50	$50	$50	$50
13	Material and Installation Cost for Pipe	LF	$117	$223	$290	$354
14	Material Cost for Fittings	LS	$2,898,700	$3,311,040	$4,307,160	$5,261,010
15	Trench Backfilling and Compacting with Native Material (in roadway)	CY	$10	$10	$10	$10
16	Trench Backfilling and Compacting with Native Material (outside road)	CY	$10	$10	$10	$10
17	Imported Backfill (Assuming 10% of native not suitable for pipe zone)	CY	$25	$25	$25	$25
18	Hauling of Excess Native (in roadway)	CY	$10	$10	$10	$10
19	Hauling of Excess Native (outside roadway)	CY	$10	$10	$10	$10
20	Pit Run for Trenches (in roadway, includes compaction)	CY	$25	$25	$25	$25
21	Stream Crossings	LF	$450	$600	$750	$900
22	Highway Crossings	EA	$100,000	$120,000	$140,000	$160,000
23	ARVs	EA	$10,000	$12,000	$20,000	$25,000
24	Butterfly Valves	EA	$15,000	$25,000	$35,000	$45,000
25	PRV Stations	EA	$70,000	$160,000	$200,000	$240,000
26	Hydro Turbines	EA	$800,000	$1,600,000	$2,400,000	$3,000,000
27	Pump Stations	EA	$3,297,000	$5,863,000	$8,430,000	$10,997,000
28	Overhead Electrical to Pump Stations and Turbines	LF	$25	$25	$25	$25
29	Substations (Pump Stations)	EA	$300,000	$600,000	$900,000	$1,200,000

30	Concrete Delivery and Placement (thrust blocks)	CY	$260	$260	$260	$260
31	Paving	TON	$150	$150	$150	$150

Table A-6: East Alignment Total Costs

Item No.	Description	Total Cost			
		24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	$9,000,000	$9,000,000	$9,000,000	$9,000,000
2	Construction Staking	$1,500,000	$1,500,000	$1,500,000	$1,500,000
3	Traffic Control	$1,500,000	$1,500,000	$1,500,000	$1,500,000
4	Erosion & Sediment Control	$3,500,000	$3,500,000	$3,500,000	$3,500,000
5	Clearing/Grubbing (for Pipeline and Access Roads)	$4,500,000	$4,500,000	$4,500,000	$4,500,000
6	Access Roads - Rough Grading	$1,175,000	$1,175,000	$1,175,000	$1,175,000
7	Culverts	$332,000	$332,000	$332,000	$332,000
8	Pit Run for Access Roads (includes compaction)	$1,490,000	$1,490,000	$1,490,000	$1,490,000
9	Sawcutting (3" thick asphalt)	$4,000	$4,000	$4,000	$4,000
10	Hauling of Removed Asphalt	$1,300	$1,500	$1,600	$1,700
11	Trench Excavation	$5,510,000	$7,810,000	$9,100,000	$10,480,000
12	Pipe Bedding (sand), includes hauling cost and compaction	$1,840,000	$2,300,000	$2,530,000	$2,755,000
13	Material and Installation Cost for Pipe	$57,974,000	$110,368,000	$143,572,000	$175,367,000
14	Material Cost for Fittings	$2,900,000	$3,320,000	$4,310,000	$5,270,000
15	Trench Backfilling and Compacting with Native Material (in roadway)	$8,000	$11,000	$12,000	$14,000
16	Trench Backfilling and Compacting with Native Material (outside road)	$4,110,000	$5,440,000	$6,130,000	$6,840,000
17	Imported Backfill (Assuming 10% of native not suitable for pipe zone)	$1,030,000	$1,363,000	$1,536,000	$1,714,000
18	Hauling of Excess Native (in roadway)	$6,000	$9,000	$11,000	$13,000
19	Hauling of Excess Native (outside roadway)	$348,000	$589,000	$737,000	$904,000
20	Pit Run for Trenches (in roadway, includes compaction)	$6,800	$8,500	$9,400	$10,200
21	Stream Crossings	$1,485,000	$1,980,000	$2,475,000	$2,970,000
22	Highway Crossings	$600,000	$720,000	$840,000	$960,000
23	ARVs	$700,000	$840,000	$1,400,000	$1,750,000
24	Butterfly Valves	$1,410,000	$2,350,000	$3,290,000	$4,230,000
25	PRV Stations	$910,000	$2,080,000	$2,600,000	$3,120,000
26	Hydro Turbines	$10,400,000	$20,800,000	$31,200,000	$39,000,000
27	Pump Stations	$19,782,000	$35,178,000	$50,580,000	$65,982,000
28	Overhead Electrical to Pump Stations and Turbines	$8,580,000	$8,580,000	$8,580,000	$8,580,000
29	Substations (Pump Stations)	$1,800,000	$3,600,000	$5,400,000	$7,200,000

30	Concrete Delivery and Placement (thrust blocks)	$130,000	$130,000	$130,000	$130,000
31	Paving	$27,500	$30,900	$32,600	$34,400
	Total	**$142,559,600**	**$230,509,900**	**$297,477,600**	**$360,326,300**

Table A-7: Van Arsdale Extension Quantities

Item No.	Description	Unit	Quantity			
			24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	LS	1	1	1	1
2	Construction Staking	LS	1	1	1	1
3	Traffic Control	LS	1	1	1	1
4	Erosion & Sediment Control	LS	1	1	1	1
5	Clearing/Grubbing (for Pipeline and Access Roads)	AC	40	40	40	40
6	Access Roads - Rough Grading	MI	7	7	7	7
7	Culverts	EA	74	74	74	74
8	Pit Run Gravel for Access Roads	CY	11,000	11,000	11,000	11,000
9	Sawcutting (3" thick asphalt)	LF	158,000	158,000	158,000	158,000
10	Hauling of Removed Asphalt	CY	4,400	5,100	5,500	5,900
11	Trench Excavation	CY	117,000	166,000	194,000	223,000
12	Pipe Bedding (sand), includes hauling cost and compaction	CY	7,800	9,800	10,800	11,700
13	Material and Installation Cost for Pipe	LF	105,600	105,600	105,600	105,600
14	Material and Installation Cost for Fittings	LS	1	1	1	1
15	Trench Backfilling and Compacting with Native Material (in roadway)	CY	50,000	68,000	77,000	86,000
16	Trench Backfilling and Compacting with Native Material (outside roadway)	CY	22,000	29,000	33,000	37,000
17	Imported Backfill (Assuming 10% of native not suitable)	CY	7,200	9,700	11,000	12,300
18	Hauling of Excess Native (in roadway)	CY	38,000	56,667	68,200	81,200
19	Hauling of Excess Native (outside roadway)	CY	1,833	3,139	3,850	4,683
20	Pit Run for Trenches (in roadway, includes compaction)	CY	17,600	22,000	24,200	26,400
21	Stream Crossings	LF	1,550	1,550	1,550	1,550
22	Highway Crossings	EA	-	-	-	-
23	ARVs	EA	120	120	120	120
24	Butterfly Valves	EA	20	20	20	20
25	PRV Stations	EA	3	3	3	3
26	Hydro Turbines	EA	3	3	3	3
27	Pump Stations	EA	-	-	-	-
28	Overhead Electrical to Pump Stations and Turbines	LF	21,120	21,120	21,120	21,120

29	Substations (Pump Stations)	EA	-	-	-	-
30	Concrete Delivery and Placement (thrust blocks)	CY	110	110	110	110
31	Paving	TON	11,880	13,365	14,108	14,850

Table A-8: Van Arsdale Extension Unit Costs

Item No.	Description	Unit	Unit Cost			
			24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	LS	$1,437,000	$1,437,000	$1,437,000	$1,437,000
2	Construction Staking	LS	$359,000	$359,000	$359,000	$359,000
3	Traffic Control	LS	$494,000	$494,000	$494,000	$494,000
4	Erosion & Sediment Control	LS	$599,000	$599,000	$599,000	$599,000
5	Clearing/Grubbing (for Pipeline and Access Roads)	AC	$10,000	$10,000	$10,000	$10,000
6	Access Roads - Rough Grading	MI	$31,000	$31,000	$31,000	$31,000
7	Culverts	EA	$830	$830	$830	$830
8	Pit Run Gravel for Access Roads	CY	$25	$25	$25	$25
9	Sawcutting (3" thick asphalt)	LF	$2	$2	$2	$2
10	Hauling of Removed Asphalt	CY	$18	$18	$18	$18
11	Trench Excavation	CY	$10	$10	$10	$10
12	Pipe Bedding (sand), includes hauling cost and compaction	CY	$50	$66	$66	$66
13	Material and Installation Cost for Pipe	LF	$105	$230	$303	$357
14	Material and Installation Cost for Fittings	LS	$556,800	$730,140	$960,450	$1,129,440
15	Trench Backfilling and Compacting with Native Material (in roadway)	CY	$10	$10	$10	$10
16	Trench Backfilling and Compacting with Native Material (outside roadway)	CY	$10	$10	$10	$10
17	Imported Backfill (Assuming 10% of native not suitable)	CY	$25	$25	$25	$25
18	Hauling of Excess Native (in roadway)	CY	$10	$10	$10	$10
19	Hauling of Excess Native (outside roadway)	CY	$10	$10	$10	$10
20	Pit Run for Trenches (in roadway, includes compaction)	CY	$25	$25	$25	$25
21	Stream Crossings	LF	$450	$600	$750	$900
22	Highway Crossings	EA	$100,000	$120,000	$140,000	$160,000
23	ARVs	EA	$10,000	$12,000	$20,000	$25,000
24	Butterfly Valves	EA	$15,000	$25,000	$35,000	$45,000
25	PRV Stations	EA	$70,000	$160,000	$200,000	$240,000
26	Hydro Turbines	EA	$800,000	$1,600,000	$2,400,000	$3,000,000
27	Pump Stations	EA	$2,830,000	$5,630,000	$8,430,000	$11,230,000
28	Overhead Electrical to Pump Stations and Turbines	LF	$25	$25	$25	$25
29	Substations (Pump Stations)	EA	$300,000	$600,000	$900,000	$1,200,000

30	Concrete Delivery and Placement (thrust blocks)	CY	$260	$260	$260	$260
31	Paving	TON	$150	$150	$150	$150

Table A-9: Van Arsdale Extension Total Costs

Item No.	Description	Total Cost			
		24-inch	36-inch	42-inch	48-inch
1	Mobilization/Demobilization	$1,437,000	$1,437,000	$1,437,000	$1,437,000
2	Construction Staking	$359,000	$359,000	$359,000	$359,000
3	Traffic Control	$494,000	$494,000	$494,000	$494,000
4	Erosion & Sediment Control	$599,000	$599,000	$599,000	$599,000
5	Clearing/Grubbing (for Pipeline and Access Roads)	$400,000	$400,000	$400,000	$400,000
6	Access Roads - Rough Grading	$217,000	$217,000	$217,000	$217,000
7	Culverts	$62,000	$62,000	$62,000	$62,000
8	Pit Run Gravel for Access Roads	$275,000	$275,000	$275,000	$275,000
9	Sawcutting (3" thick asphalt)	$400,000	$400,000	$400,000	$400,000
10	Hauling of Removed Asphalt	$100,000	$100,000	$100,000	$200,000
11	Trench Excavation	$1,170,000	$1,660,000	$1,940,000	$2,230,000
12	Pipe Bedding (sand), includes hauling cost and compaction	$390,000	$651,000	$718,000	$778,000
13	Material and Installation Cost for Pipe	$11,136,000	$24,338,000	$32,015,000	$37,648,000
14	Material and Installation Cost for Fittings	$560,000	$740,000	$970,000	$1,130,000
15	Trench Backfilling and Compacting with Native Material (in roadway)	$500,000	$680,000	$770,000	$860,000
16	Trench Backfilling and Compacting with Native Material (outside roadway)	$220,000	$290,000	$330,000	$370,000
17	Imported Backfill (Assuming 10% of native not suitable)	$180,000	$243,000	$275,000	$308,000
18	Hauling of Excess Native (in roadway)	$380,000	$570,000	$690,000	$820,000
19	Hauling of Excess Native (outside roadway)	$19,000	$32,000	$39,000	$47,000
20	Pit Run for Trenches (in roadway, includes compaction)	$500,000	$600,000	$700,000	$700,000
21	Stream Crossings	$698,000	$930,000	$1,163,000	$1,395,000
22	Highway Crossings	$0	$0	$0	$0
23	ARVs	$1,200,000	$1,440,000	$2,400,000	$3,000,000
24	Butterfly Valves	$300,000	$500,000	$700,000	$900,000
25	PRV Stations	$210,000	$480,000	$600,000	$720,000
26	Hydro Turbines	$2,400,000	$4,800,000	$7,200,000	$9,000,000
27	Pump Stations	$0	$0	$0	$0
28	Overhead Electrical to Pump Stations and Turbines	$528,000	$528,000	$528,000	$528,000
29	Substations (Pump Stations)	$0	$0	$0	$0

30	Concrete Delivery and Placement (thrust blocks)	$29,000	$29,000	$29,000	$29,000
31	Paving	$1,800,000	$2,100,000	$2,200,000	$2,300,000
	Total	**$26,563,000**	**$44,954,000**	**$57,610,000**	**$67,206,000**

Appendix B –List of Contacts

Company	Contact Name	Position	Contact History
PG & E	Ernie Ralston	Corporate Environmental Planner	Exchanged email on 1/3/2014. Ernie provided additional contact information for Neva Geldard to discuss the Potter Valley project
	Neva Geldard		Contacted by telephone on 1/22/14. Voicemail not returned
	Alison Talbott	Local Public Relations	
BLM	Lynda Roush	Field Manager	Contacted by telephone on 1/15/2014. Voicemail not returned
	David Fuller	Planning and Environmental Coordinator	Contacted by telephone on 1/17/2014. See Section 3.2 for summary of discussion.
Caltrans	Keith Witte	Local Encroachment Permitting Agent for District	Contacted by telephone on 1/10/2014. See Section 3.3 for summary of discussion.
CA Department of Fish & Wildlife	Mark Wheetley	Senior Biology Specialist	Contacted by telephone 4/30/2014. See Section 3.4 for summary of discussion.
U.S. Fish & Wildlife	Conor Shae	Fluvial Geomorphologist	Conor Shae and Kathleen Brubaker contacted by telephone 5/7/2014. See Section 3.4 for summary of discussion.
	Kathleen Brubaker	Endangered Species Program Lead	
State Water Resources Control Board		Water Quality Division	Water Quality Division contacted by telephone 1/15/2014 & 5/14/2014. Voicemail not returned
	Yvonne West	Attorney – Enforcement Division	Enforcement Division contacted by telephone 1/15/2014 & 5/14/2014. See Section 3.5 for summary of discussion
	Kathy Mrowka		Contacted by telephone 2/10/2014. See below for summary of discussion
North Coast Railroad Association	Mitch Stogner	Executive Director	Spoke to reception by telephone on 1/15/2014. Reception provided an email address for Douglas McCorkle.
	Douglas McCorkle	Property Specialist	Contacted 1/21/2014, see Section 3.6 for summary of discussion
Bureau of Reclamation	Ray Sahlberg	Water Rights Officer	Contacted by telephone 1/15/2014. See Section 3.7 for summary of discussion.
	Don Reck	Environmental Resources Officer, Fish Ecology	Contacted by telephone 1/15/2014. See Section 3.7 for summary of discussion.
Green Diamond	Mike Nelson	Consulting Planner - LACO	Contacted. See Section 3.8 for summary of discussion.

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		Name	Signature	Name	Signature	Date

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