Final Report

WISE Binney Connection Pipeline Alignment Study

Prepared for

South Metro WISE Authority

November 2, 2018

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Acknowledgements

The following project team was instrumental in a collaborative approach to develop the preferred alternative for the WISE Binney Connection Pipeline that will serve as guidance for the design of the selected alternative.

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This Technical Memorandum (TM) documents the results of the alignment study for the South Metro WISE Authority (SMWA) Binney Connection Pipeline that will allow water to be conveyed from the existing Binney Water Purification Facility (BWPF) to the existing WISE Smoky Hill Tank. Four alignment alternatives were evaluated based on cost and non-cost criteria in a structured decision framework process. The alternatives evaluation process followed a series of steps that identified the preferred alignment alternative.

1.0 Project Background

The proposed WISE Binney Connection Pipeline will convey flows from new pumping facilities located at or near the BWPF to the existing Smoky Hill Tank. The current WISE connection to the Aurora Water System has a maximum capacity of approximately 15 million gallons per day (mgd). By June 2021, the contract terms that allow for use of the Aurora Water distribution system to convey WISE water to SMWA expire, and a dedicated conveyance system with a capacity of at least 25 mgd and as much as 30 mgd is required. The new pumping facilities, described in TM *WISE Binney Connection Pump Station Study, CH2M, 2018*, will allow for SMWA and Denver Water to take blended or non-blended water from BWPF. The pipeline alignment alternatives evaluated ranged from approximately 4.6 miles to 5.3 miles of 42-inch pressurized steel pipeline.

1.1 Summary

This TM presents information developed to support selection of the preferred alignment for the WISE Binney Connection Pipeline. The following are key components of the alternative selection process:

- Development of alignment alternatives. Proposed pipeline alignments were developed in a collaborative process with SMWA, Aurora Water, Denver Water and other project stakeholders. The four pipeline alignment alternatives were developed in Geographic Information System (GIS) utilizing the City of Aurora (COA) property ownership layers, existing aerial photography, as-built information for the BWPF and Smoky Hill Tank, and COA utility information layers.
- Comparison of alternative alignments. Cost and non-cost characteristics of the alignment alternatives were evaluated. The cost-based criteria include conceptual level estimated construction costs and estimated right-of-way (ROW) acquisition costs. The non-cost criteria include land space requirements, operations and maintenance (O&M) considerations, permitting requirements, constructability, reliability (operational flexibility), and public acceptance. Input for the estimated ROW acquisition costs was provided by Transportation Resource Services, Inc. (TRS). A methodology for combining the cost and non-cost evaluations was developed and utilized for comparison of alignment alternatives.

2.0 Alternative Evaluation Process

A structured decision framework process was utilized for selection of the preferred pipeline alignment that followed a series of steps to identify the alignment alternative with the highest cost per benefit. The alternative evaluation decision framework process is shown schematically in Figure 2.1 and described in additional detail in the following sections.

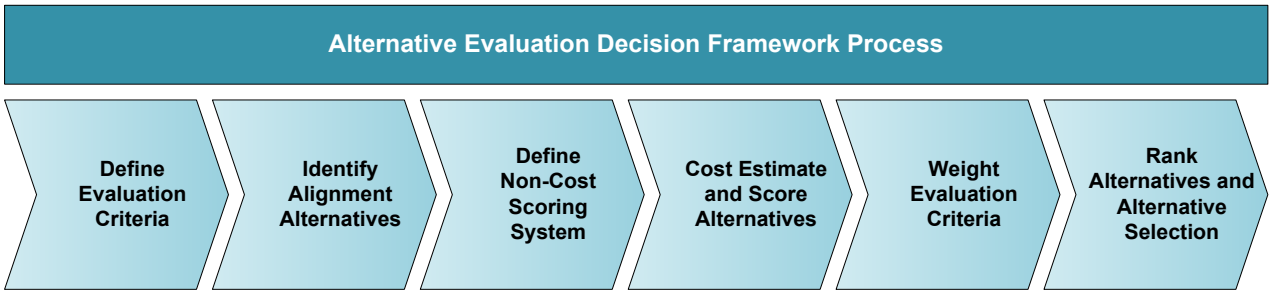


Figure 2.1: Alternative Evaluation Decision Framework Process

The alternative evaluation process included the following steps:

Define Evaluation Criteria – This step of the evaluation process was completed in a collaborative process at the initial alternative alignment review meeting. This step included selection of cost based and non-cost based alternative evaluation criteria. The cost-based criteria include conceptual level construction costs and estimated ROW acquisition costs. The non-cost criteria include land space requirements, O&M considerations, permitting requirements, constructability, reliability (operational flexibility, and public acceptance.

Identify Alignment Alternatives – This step of the evaluation process was also completed in a collaborate process at the initial alternative alignment review meeting. Four alignments were identified, the Northern Alignment, the Northern Power Alignment, the Central Alignment, and the Southern Alignment, which are described in detail in subsequent sections of this TM.

Define Non-Cost Scoring System – This step of the evaluation process includes defining the ratings that can be assigned to each alignment alternative for the non-cost criteria. More specifically, a performance scale was defined to systematically score each alignment against the identified non-cost criteria. For this evaluation, the alignments are assigned one of the following relative scores for each of the non-cost criteria: More Favorable “M”, Neutral “N”, Less Favorable “L”, or Negative “O.” The non-cost criteria and scoring performance scales are described in detail in subsequent sections of the TM.

Cost Estimate and Score Alternatives – This step of the evaluation process included development of conceptual level construction and ROW costs for each alternative. In addition, non-cost criteria scores were assigned to each alternative.

Weight Evaluation Criteria – The non-cost evaluation criteria were weighted based on the relative importance of addressing stakeholder priorities. The criteria weights were used to define tradeoffs between goals and to build a defensible foundation for ranking alternatives. The non-cost criteria were weighted by surveying project stakeholders. The result of this approach is that the criterion with the most “more favorable” ratings has the highest weighting. The criteria weighting was reviewed in the second alternative alignment review meeting.

Rank Alternatives and Alignment Selection – The alignment alternatives were then ranked based on a combination of the cost and non-cost weighting and scoring. Each alignment was assigned a relative benefit score based on how the alternative scored against each criterion. The benefit score is the sum of the products of the non-cost criteria weight and the performance score – the higher the score, the better the benefits. A cost per benefit was then calculated by dividing the project cost by the benefit score.

Consider Adverse Consequences of Selecting Alternative with Best Score – Before selecting the alternative with the best analytical score, the Project Team considered if there were reasons to believe that the structured decision-making process did not produce the best alternative. This step provides a final qualitative check of the structured decision process.

3.0 Alignment Alternatives

The four alignment alternatives considered in this evaluation were identified during the Alignment Conceptual Design Review Meeting on May 5, 2018. The alignments include a Northern Alignment, a Northern Power Alignment, a Central Alignment, and a Southern Alignment (Figure 3.1). Each alignment is composed of segments (Figure 3.2) that were individually analyzed and then compiled to determine final scoring of each alignment. The proposed alignments are described in the following sections. Horizontal alignments are shown on Figures 3.1 and 3.2, while corresponding horizontal and vertical profiles are shown in Figure 3.3 through Figure 3.6. Meetings were held with Aurora Parks, Recreation, and Open Space (PROS) Department, Aurora Planning Department, E-470 Public Authority, and Public Service Company of Colorado (PSCO) to review each alignment and avoid potential conflicts.

3.1 Northern Alignment Alternative

The Northern Alignment Alternative, as shown in Figure 3.1, begins at the proposed lift station at BWPF, traveling north into the City of Aurora PROS property. The alignment parallels this property line between the open space and BWPF moving west, crossing S. Robertsdale Way and turning north to navigate around the existing Senac Creek Lift Station. This initial alignment is identical for all the alternatives and depending on the preferred pump station configuration selected, may be changed during design to go around the south of the lift station (instead of to the north) to reduce the total length of pipe. The alignment continues west before entering the public ROW within S. Powhatan Road and turning south. The alignment stays in this ROW before turning west to travel along the north end of another City of Aurora PROS property. Once reaching the end of this property, the alignment turns north within the ROW of S. Harvest Road. The alignment continues north before turning west and traveling within the ROW of E. Belleview Avenue. The alignment crosses S. Gun Club Road and enters the E-470 Public Authority property. Turning south, the alignment parallels the highway before connecting to the existing 42-inch WISE pipeline.

3.2 Northern Power Alignment Alternative

The Northern Power Alignment Alternative, shown on Figure 3.1, is similar to the Northern Alignment. Rather than turning north to follow S. Harvest Road, the alignment turns south and stays within S. Harvest Road ROW. The alignment then turns west into the PSCO easement/property, traveling parallel and adjacent to the existing power lines. The alignment crosses into the Sorrel Ranch HOA property, traveling just north of the subdivision, before entering the E-470 Public Authority property. Turning south, the alignment parallels E-470 before connecting to the existing 42-inch WISE Pipeline.

3.3 Central Alignment Alternative

The Central Alignment Alternative, as shown in Figure 3.1, begins at the proposed lift station at BWPF, traveling north into the City of Aurora open space property. The alignment parallels this property line between the open space and BWPF moving west, crossing S. Robertsdale Road and turning north to navigate around the existing Senac Creek Lift Station. The alignment continues west before entering the public ROW within S. Powhatan Road and turning south. The alignment stays in this ROW before turning west to travel along the north end of the City of Aurora property. The alignment turns south once adjacent to the future S. Harvest Road and continues south, turning west at E. Orchard Road. After crossing Murphy Creek, the alignment follows the southern property line of the Pomeroy/Gun Club Development before entering E-470 Public Authority property. Once in the E-470 property, the alignment turns south and parallels E-470 before connecting to the existing 42-inch WISE pipeline.

3.4 Southern Alignment Alternative

The Central Alignment Alternative, as shown in Figure 3.1, begins at the proposed lift station at BWPF, traveling north into the City of Aurora open space property. The alignment parallels this property line between the open space and BWPF moving west, crossing S. Robertsdale Road and turning north to navigate around the existing Senac Creek Lift Station. The alignment continues west before entering the public ROW within S. Powhatan Road and turning south. The alignment stays in this ROW before turning west to travel along the north end of the City of Aurora property. The alignment turns south once adjacent to the existing S. Harvest Road and continues south, turning west at E. Orchard. The alignment then turns south, crossing E. Orchard Road and entering the PSCO property limits. The alignment follows this property boundary, traveling south and then turning west towards S. Aurora Parkway. The alignment turns south, paralleling S. Aurora Parkway, before turning west and crossing to the south side of E. Smoky Hill Road. Paralleling E. Smoky Hill Road, the alignment travels west along the sidewalk/boulevard. The alignment then connects to the existing 42-inch WISE pipeline.

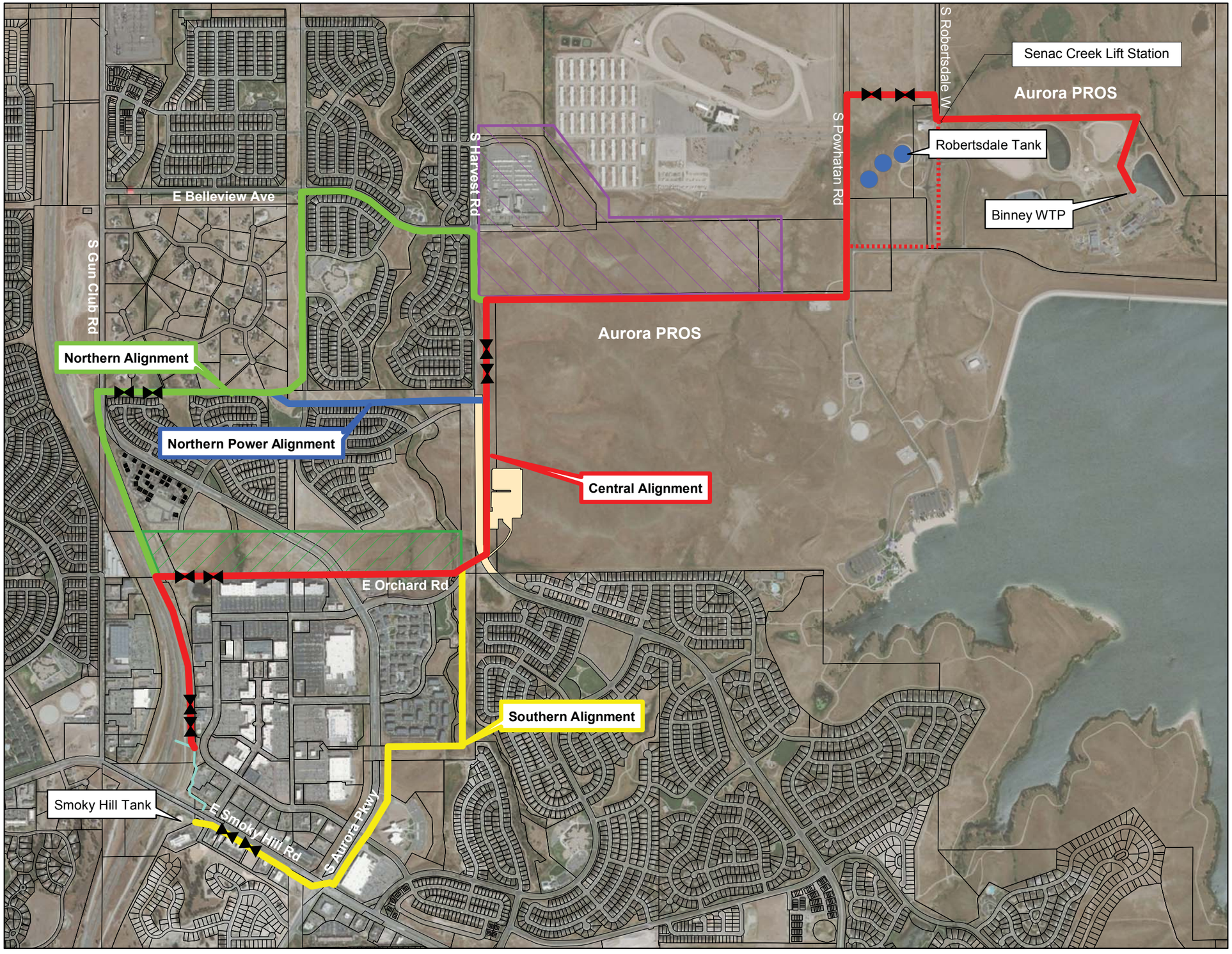


Figure 3.1: Alignment Segments
Binney Connection Alignment Study

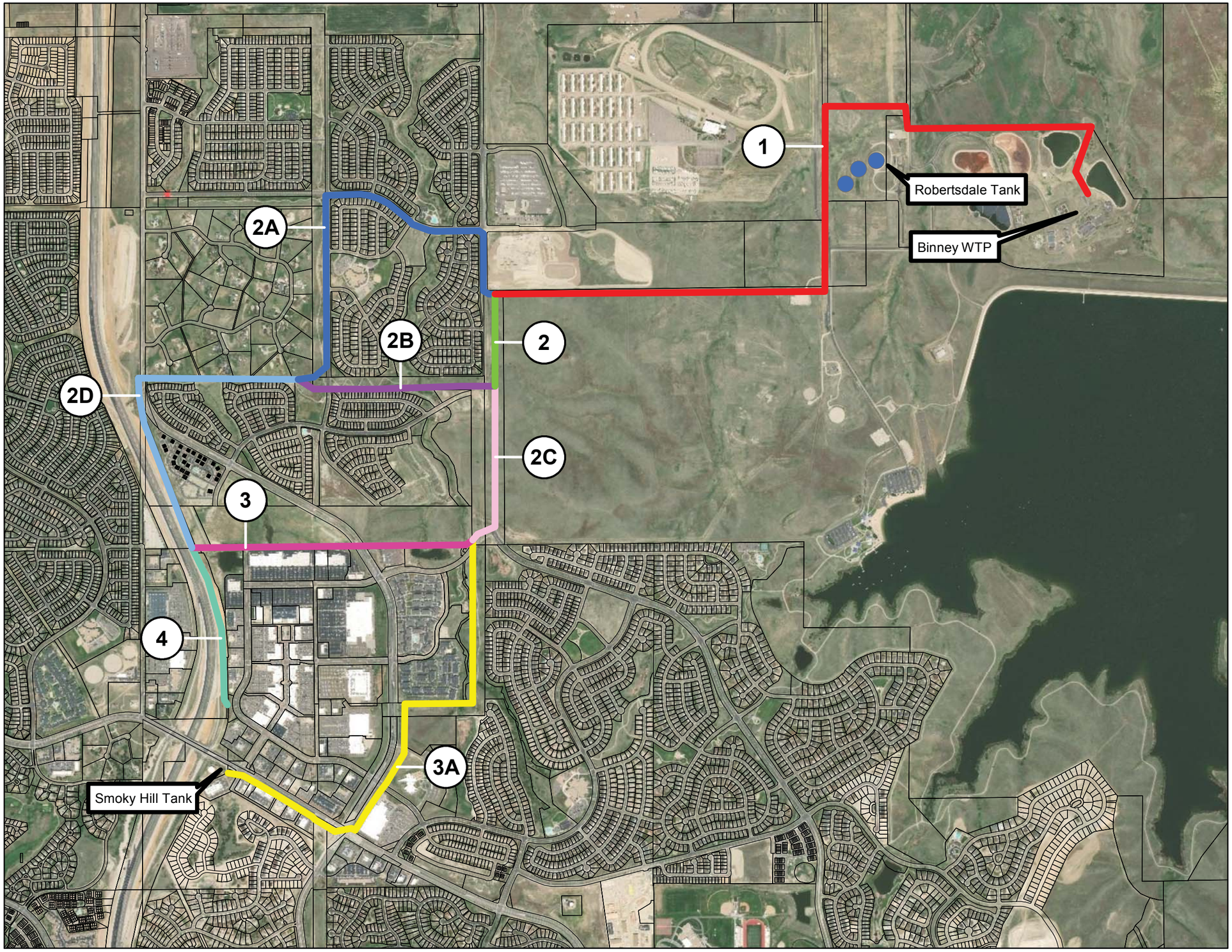
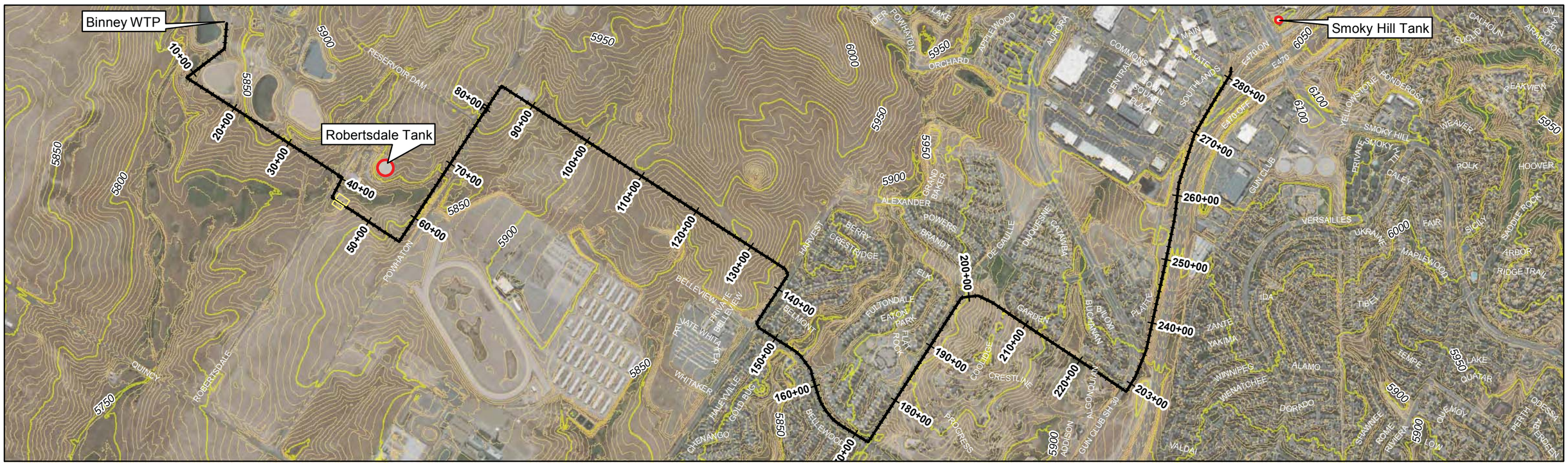
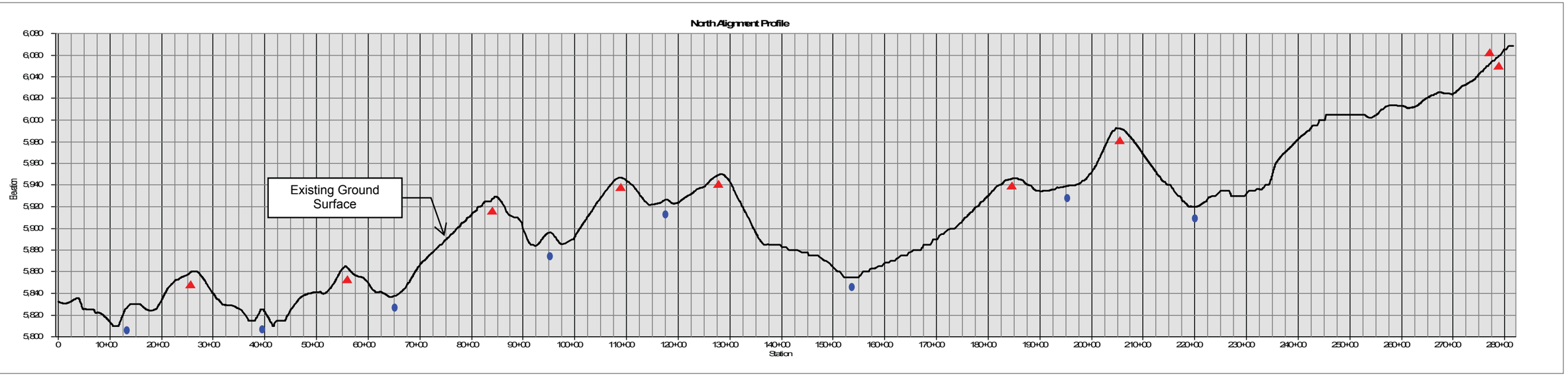


Figure 3.2: Alignment Segments
Binney Connection Alignment Study



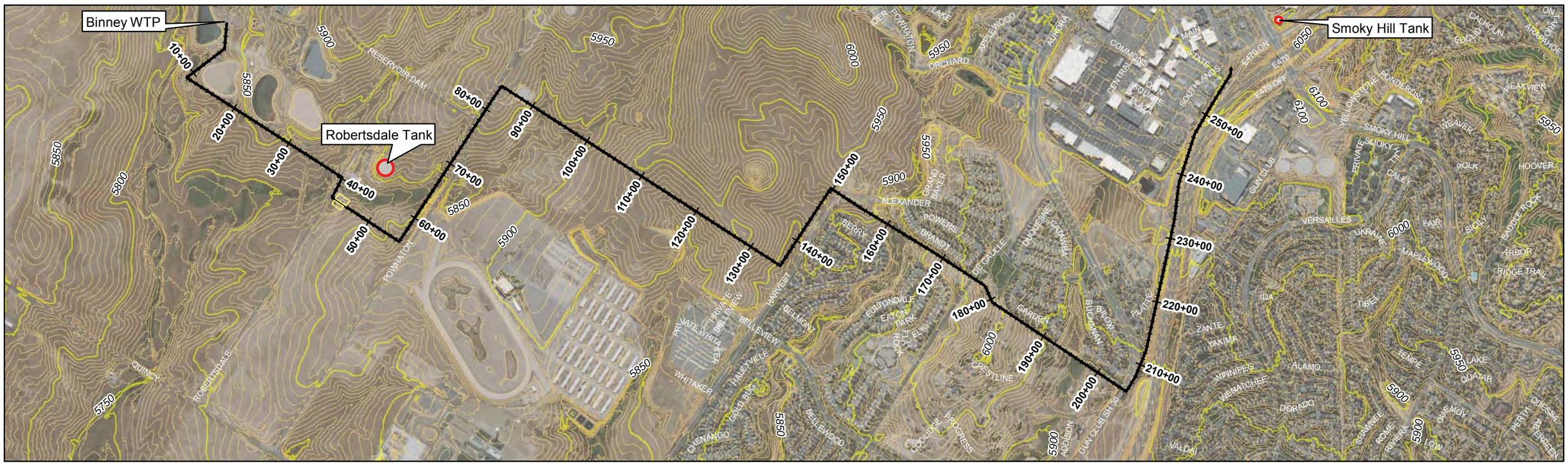


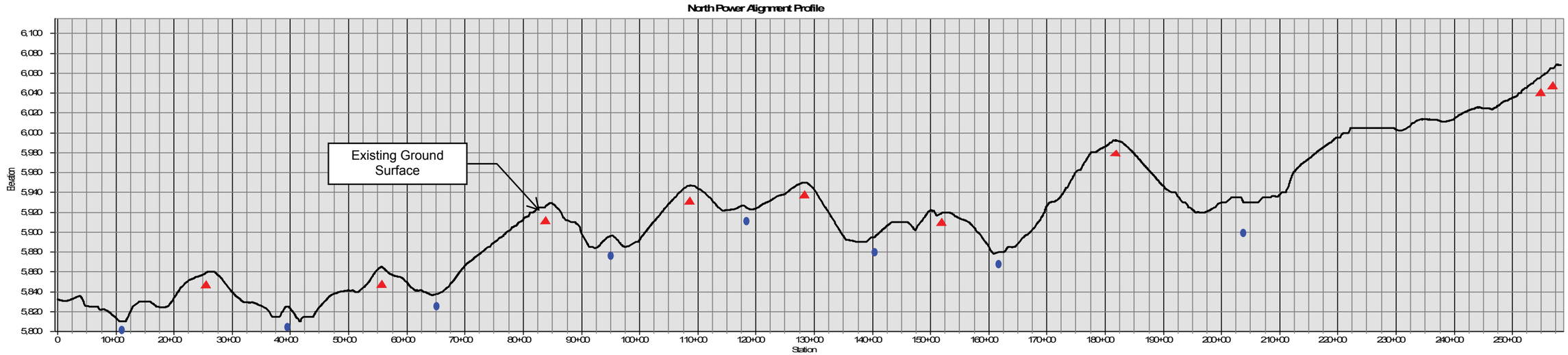
LEGEND

- Blow off valve
- Air release valve

0 750 1,500
Feet

Figure 3.3: Northern Alignment Profile
Binney Connection Alignment Study



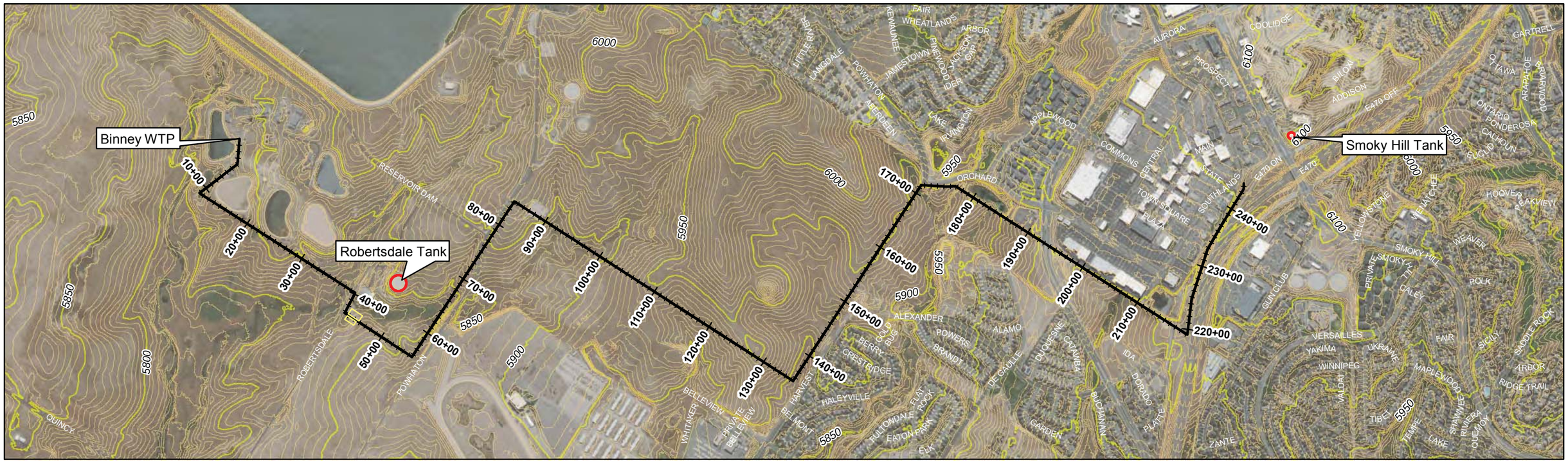


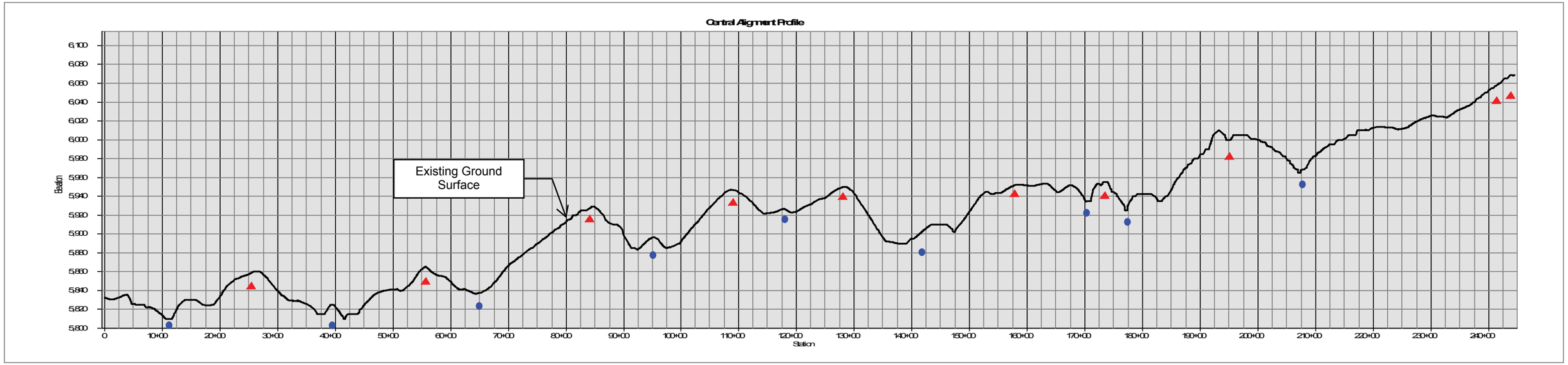
LEGEND

- Blow off valve
- Air release valve

0 750 1,500
Feet

Figure 3.4: Northern Power Profile
Binney Connection Alignment Study



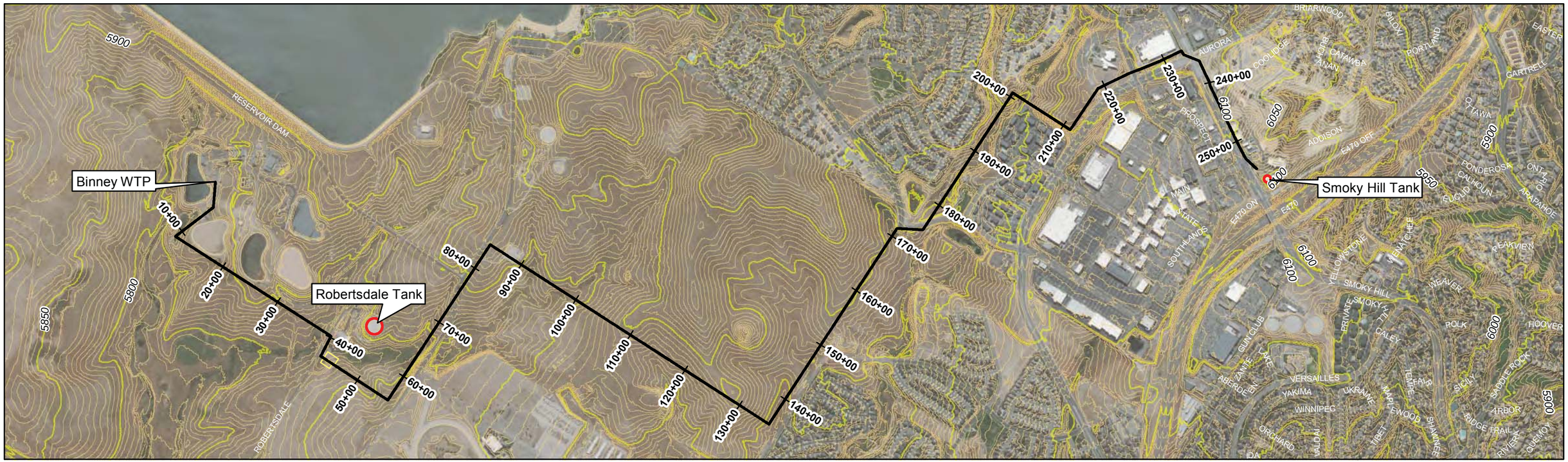


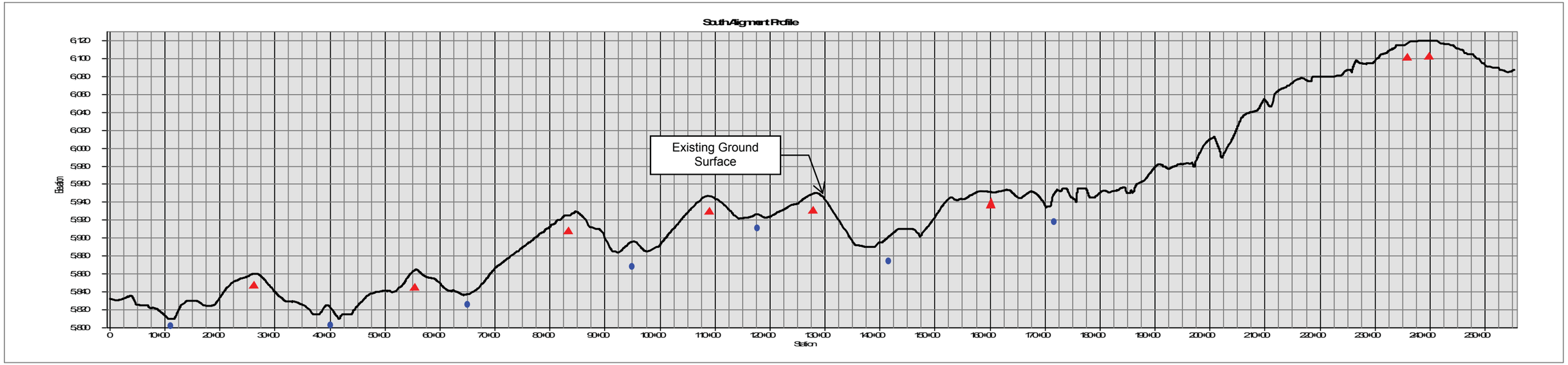
LEGEND

- Blow off valve
- Air release valve

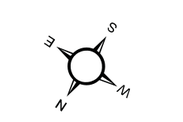
0 750 1,500
Feet

Figure 3.5: Central Profile
Binney Connection Alignment Study





LEGEND



0 750 1,500
Feet

Figure 3.6: South Profile
Binney Connection Alignment Study

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4.0 Capital and ROW Cost Criteria

The cost evaluation of the alignment alternatives included development of conceptual level construction cost estimates and quantifying ROW acquisition costs.

4.1 Capital Cost Calculation

Conceptual level construction cost estimates presented in this section are Class 5 Estimates, as defined by the Association for the Advancement of Cost Engineering International (AACE-International). It is normally expected that an estimate of this type would be accurate within -50 to +100 percent. This range implies that there is a high probability that the final project cost will fall within the range.

Unit prices were developed for the following installation scenarios:

Sloped E-470 - Pipeline adjacent to E-470 will be installed in a relatively narrow and sloped construction easement. Minimal flat surface is available for construction equipment and material lay down, reducing the construction productivity.

Sidewalk - Pipeline installed directly underneath or adjacent to existing sidewalk. Requires traffic lane closure for construction access and materials, but trenching is not in the road.

Roadway - Pipeline installed in traffic roadways, including both crossings and parallel segments. This type of construction assumes both trenched construction and pavement restoration.

Open Easement - Open easement is defined as any portion of land that is not developed. This will increase productivity and decrease overall construction and restoration costs.

The estimated cost developed for each category above is a dollar per linear foot amount. These costs were then applied to each alignment based on measurements taken via aerial imagery and judgement during field visits. Blow off valves, combination air/vacuum valves, and isolation valves were also added to these costs.

In addition to these unit costs, standard markups were applied for the following items:

- Contractor Overhead – 12 percent of the estimated construction cost.
- Contractor Profit – 5 percent of the estimated construction cost.
- Contractor Mobilization, Bonds, and Insurance – 5 percent of the estimated construction cost.
- Contingency – 30 percent of the estimated construction cost.

Detailed cost estimates are included in Appendix A. The total estimated construction cost for each alignment is shown in Table 4.1. Note these construction costs do not include engineering design efforts or services during construction. A more detailed estimate for the selected alternative is presented in this report in Section 9.

Table 4.1: Total Estimated Construction Cost

Alternative	Pipeline Length	Estimated Construction Cost*
Northern Alignment	5.3 miles	$ 18,800,000
Northern Power Alignment	4.9 miles	$ 17,000,000
Central Alignment	4.6 miles	$ 17,600,000
Southern Alignment	4.9 miles	$ 16,800,000

*Costs are a Class 5 estimate. Class 5 costs are considered accurate from -50% to +100%.

4.2 ROW Cost Calculation

Estimated ROW Costs for each alignment alternative were developed based on a 50-foot-wide permanent easement with the pipeline centered within the easement and an additional 50-foot wide temporary construction easement. Easement costs shown in Table 4.2 were provided by TRS. Figure 4.1 displays an aerial overview of these costs. See Appendix B for ROW Area and Landowners Potentially Impacted by each Alignment.

Table 4.2: Estimated ROW Costs

Surface Type	Agreement Type	Purchase Price	Permanent Easement	Temporary Easement
Aurora Open Space	Easement	$ 2.00/SF	$ 1.00/SF	$ 0.20/SF
Aurora Non-Open Space	Easement	$ 10.00/SF	$5.00/SF	$1.00/SF
E-470 Authority	License	$ 1.72/SF	$ 1.72/SF	$ 1.72/SF
Public Service Company of Colorado	License	$500/EA	$500/EA	$500/EA
Sorrel Ranch HOA Open Space	Easement	$2.00/SF	$1.00/SF	$0.20/SF
Pomeroy/Gun Club Development	Easement	$15.00/SF	$7.50/SF	$1.50/SF
Private Property Retail	Easement	$28.00/SF	$14.00/SF	$2.80/SF

The ROW area for each parcel was calculated for each alignment and is presented in Appendix B. The total ROW costs for each alignment are presented in Table 4.3.

Table 4.3: Total Estimated ROW Cost

Alternative	Estimated ROW Cost
Northern Alignment	$ 3,000,000
Northern Power Alignment	$ 3,400,000
Central Alignment	$ 5,500,000
Southern Alignment	$ 3,600,000

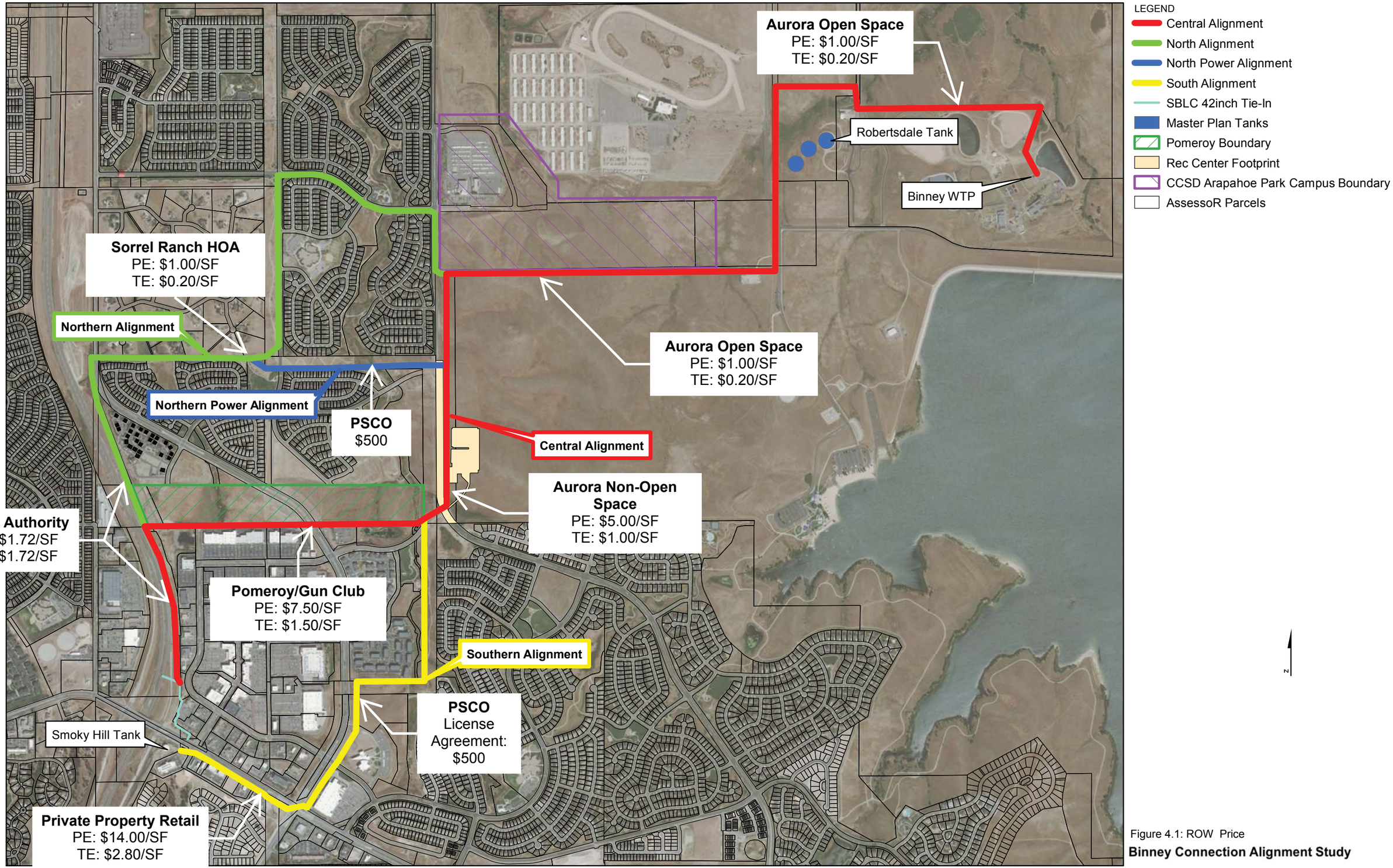


Figure 4.1: ROW Price

Binney Connection Alignment Study

5.0 Non-Cost Criteria

Non-cost criteria were also considered in the evaluation of the alignment alternatives. Criteria weights are a measure of the relative importance of each criterion to addressing stakeholder priorities. As described earlier in this TM, the criteria weights are based on a survey of project stakeholders and used to define tradeoffs between competing goals and build a defensible foundation for ranking the alignments based on their anticipated benefits. The selected non-cost criteria and respective weightings are shown in Table 5.1 below.

Table 5.1: Non-Cost Evaluation Criteria and Weighting

Criteria	Description	Relative Weighting
Land Requirements	This category is a quantitative assessment of the amount of land required for an alternative and provides an assessment of the complexity and timeliness of obtaining easements/right-of-way for the project. The quantitative measurement is the total square footage of easement required for the pipeline. The number of parcels/property owners impacted by the alignment is also considered.	16%
Operations and Maintenance	This category includes quantitative assessment of the anticipated operations and maintenance requirements for the pipeline. This category also includes a qualitative evaluation of the relative difficulty to access the pipeline for both routine and major maintenance and/or repair work, the number of required air and blow-off values, as well as the amount of cathodic protection required. Surge considerations were indirectly considered based on the number of air valves required. Surge considerations were also captured in the Pump Station alternatives assessment.	26%
Permitting	This category is related to a qualitative assessment of potentially difficult permitting issues associated with an alternative. Also, any unique permits or permits with extensive review periods or documentation reduced the relative rating in this category.	11%
Constructability	This category is a preliminary assessment of known construction challenges such as space available for construction, construction access constraints, and power supply availability/location. The presence of these items results in increased risk that the construction costs could be higher than originally estimated.	21%
Reliability (Operational Flexibility)	This category addresses the reliability of the alternative from an operations perspective including the future connectivity to the ECCV line and the ability to flow water backwards from Smoky Hill Tank to the Rangeview Connection.	21%
Public Acceptance	This category covers the full range of potential issues that might make a pipeline alignment difficult to implement. Consideration of the potential risk to implementing the project due to any unfavorable situation should be captured by the ratings used for this category.	5%

Performance scales were constructed to provide a scoring system in which each alternative can be evaluated. The scoring system for each non-cost criterion is “M” = More Favorable, “N” = Neutral, “L” = Less Favorable, and “O” = Negative. The numerical values assigned to each of these scores are identified in Table 5.2.

Table 5.2: Non-Cost Criterion Performance Scale and Numerical Values

Performance Scale	Numerical Value
"M" = More Favorable	1.0
"N" = Neutral	0.7
"L" = Less Favorable	0.4
"O" = Negative	0.1

5.1 Land Requirements

The Land Requirements non-cost criterion represents an assessment of the amount of land required for each alignment. This is quantified by the total square footage of easement required for the pipeline and the number of parcels/owners impacted.

Table 5.3: Land Requirements Assigned Scores

Alternative	Assigned Score	Description
Northern Alignment	"L" Less Favorable	The Northern Alignment includes: - Crossing 23 parcels with a total of 10 owners. - A total easement requirement of 65 acres.
Northern Power Alignment	"L" Less Favorable	The Northern Power Alignment includes: - Crossing 23 parcels with a total of 11 owners. - A total easement requirement of 59 acres.
Central Alignment	"N" Neutral	The Central Alignment includes: - Crossing 16 parcels with a total of 9 owners. - A total easement requirement of 56 acres.
Southern Alignment	"N" Neutral	The Southern Alignment includes: - Crossing 16 parcels with a total of 10 owners. - A total easement requirement of 59 acres.

5.2 Operations and Maintenance

The Operations and Maintenance non-cost criterion addresses the relative annual maintenance for the pipeline and the relative difficulty of access to the pipeline by system operations staff. Annual maintenance is rated by number of appurtenances while accessibility is determined by comparing the length of pipeline readily accessible to the total length of pipeline. Accessible pipeline is defined as pipeline in designated open spaces as compared to roadways where traffic control would be necessary for maintenance activities.

5.2.1 Cathodic Protection

Cathodic protection (CP) of each alignment was also considered where corrosion is suspected to be an issue, specifically at gas transmission line crossings and power line crossings.

Gas transmission lines are required to have CP on the pipeline per the Code of Federal Regulations. Corrosion due to interference from CP systems is highly likely when metallic pipelines cross other cathodically protected structures like the gas transmission pipelines that are in the area of the proposed

Binney Pipeline. The metallic pipeline will pick up stray current from the cathodically protected gas transmission pipelines and discharge this excess current at some distance away from the pickup location. Where current discharges from the unprotected pipeline, corrosion is likely to occur at a rate proportional to the amount of current leaving the pipe. Some of the more popular methods to mitigate interference include installing electrical isolation fittings, installing a mitigation bond, strategic application of additional coatings, installing a metallic shield, or installing a galvanic anode cathodic protection system on the Binney Pipeline.

Power lines located in close proximity to the Binney Pipeline and running parallel to the pipe can induce AC currents on the pipeline. Of greater concern from a corrosion perspective is where the pipeline crosses or is perpendicular to the power line. At these perpendicular locations, AC voltage can leave the pipeline to follow the power line path taking ferric or ferrous ions with it through the soil. Where these ions leave the pipe, metal loss occurs.

Mitigating AC power line corrosion due to conductive coupling can be accomplished using screening electrodes that intercept the current. These would typically consist of lengths of zinc ribbon connected directly to the pipeline and installed between the pipeline and the power line at all crossings and perpendicular sections between the pipe and powerline.

5.2.2 Appurtenances

The number of appurtenances along the alternative alignments also impacts the assigned score, including the number of combination air/vacuum valves (CARVs), blow off valves, and isolation valves. Air valves are critical appurtenances in pipelines and serve five principal functions:

1. Expulsion of air from the pipeline during filling operations.
2. Intake of air into the pipeline to replace water during draining operations.
3. Intake of air into the pipeline during emergencies, such as a pipe break, to prevent vacuum conditions from occurring that might damage the pipe.
4. Expulsion of accumulated air that has been entrained with or that comes out of solution from the pumped water in the pipeline.
5. Surge protection through the controlled expulsion and/or intake of air during transient conditions associated with rapid changes in flow velocity. For a more detailed surge analysis see TM *WISE Binney Pump Station Study, CH2M, 2018*.

Determining the optimum number of CARVs and their location along a pipeline is not an exact science; it relies upon the engineering judgment of the design team, working with the owner. Some guidance is provided by AWWA, valve manufacturer technical publications, and research findings. AWWA M-11 presents a brief discussion on the topic that is largely derived from a slightly more developed discussion found in *Air-Release, Air/Vacuum, and Combination Air Valves,* AWWA Manual of Water Supply Practices M-51 (AWWA M-51, 2004). For the purpose of this alternative evaluation, it is assumed that CARVs will be installed at only prominent high points along the pipeline. During design, CARVs are sized to allow sufficient air entry into the pipeline at a design flow rate such that the pressure differential across the orifice is no more than 5 psi. At a pressure differential of 7 psi, the air flow approaches sonic conditions (choked) and cannot increase and at those velocities can create loud whistle sounds that are undesirable by those whom reside along the pipeline.

Blowoff structures are installed at low points along the pipeline. They are used to drain the pipe when routine maintenance is required or when breaks or leaks occur. During design, it will be important to

consider blowoff design criteria such as maximum blowoff piping discharge velocity and flows. Outfall locations and the elevation of discharge will vary and depend on the outfall channel. Limiting maximum blowoff piping discharge velocity is critical to protect the discharge channel from erosion and channel-forming flows. The approximate location of CARVs and blowoff valves can be seen on the alignment profiles in Figure 3.3 through Figure 3.6.

Isolation valves locations have been strategically identified to provide double isolation for future manned entry for maintenance and repairs. An approximate location of these valves can be seen in Figure 3.1.

Table 5.4: Operations and Maintenance Assigned Scores

Alternative	Assigned Score	Description
Northern Alignment	"L" Less Favorable	The Northern Alignment includes: - 9 CARVs, 8 BOs, 6 isolation valves. - Total pipeline length of 5.3 miles. - 81% of accessible pipeline, 5,320 feet of less accessible pipeline - *Cathodic Protection Considerations:* o 2 power line crossings. o 3 gas transmission line crossings.
Northern Power Alignment	"L" Less Favorable	The Northern Power Alignment includes: - 9 CARVs, 8 BOs, 6 isolation valves. - Total pipeline length of 4.9 miles. - 80% of accessible, 5,180 feet of less accessible pipeline - *Cathodic Protection Considerations:* o 1 power line crossing and approximately 2,500 feet of pipeline parallel to power line. o 3 gas transmission line crossings.
Central Alignment	"N" Neutral	The Central Alignment includes: - 10 CARVs, 9 BOs, 6 isolation valves. - Total pipeline length of 4.6 miles. - 80% of accessible, 4,900 feet of less accessible pipeline - *Cathodic Protection Considerations:* o 1 power line crossing. o 2 gas transmission line crossings.
Southern Alignment	"O" Negative	The Southern Alignment includes: - 8 CARVs, 7 BOs, 4 isolation valves. - Total pipeline length of 4.9 miles. - 73% of accessible, 7,000 feet of less accessible pipeline - *Cathodic Protection Considerations:* o 4 power line crossings and approximately 5,500 feet of pipeline parallel to power line. o 2 gas transmission line crossings.

5.3 Permitting

The Permitting non-cost criterion represents a qualitative assessment of potentially difficult permitting issues associated with each alignment. Any unique permits or permits with extensive review periods or documentation reduce the relative rating in this criterion. The permitting non-cost scores and descriptive reasoning are identified in Table 5.5. A comprehensive list of potentially applicable permits and stakeholders is identified in Appendix C.

Table 5.5: Permitting Assigned Scores

Alternative	Assigned Score	Description
Northern Alignment	"L" Less Favorable	The Northern Alignment includes: - No identified cultural resource impacts. - An estimated total of 40 linear feet of creek crossings. - Roadway closure permits required for collector/arterial streets. - No 1041, Land Use Intergovernmental Agreements (IGA), or material changes to Aurora Reservoir Master Plan.
Northern Power Alignment	"N" Neutral	The Northern Power Alignment includes: - No identified cultural resource impacts. - An estimated total of 50 linear feet of creek crossings. - Roadway closure permits required for residential streets only. - No 1041, Land Use Intergovernmental Agreements (IGA), or material changes to Aurora Reservoir Master Plan.
Central Alignment *(and Alternate Loop)*	"N" Neutral	The Central Alignment includes: - No identified cultural resource impacts. - An estimated total of 90 linear feet of creek crossings. - Roadway closure permits required for residential streets only. - No 1041, Land Use Intergovernmental Agreements (IGA), or material changes to Aurora Reservoir Master Plan.
Southern Alignment	"O" Negative	The Southern Alignment includes: - Crossing of cultural land known as "Smoky Hill Trail" along the south side of Smoky Hill Road (see Figure 5.1). - An estimated total of 150 linear feet of creek crossings. - Roadway closure permits required for major roadways - No 1041, Land Use Intergovernmental Agreements (IGA), or material changes to Aurora Reservoir Master Plan.

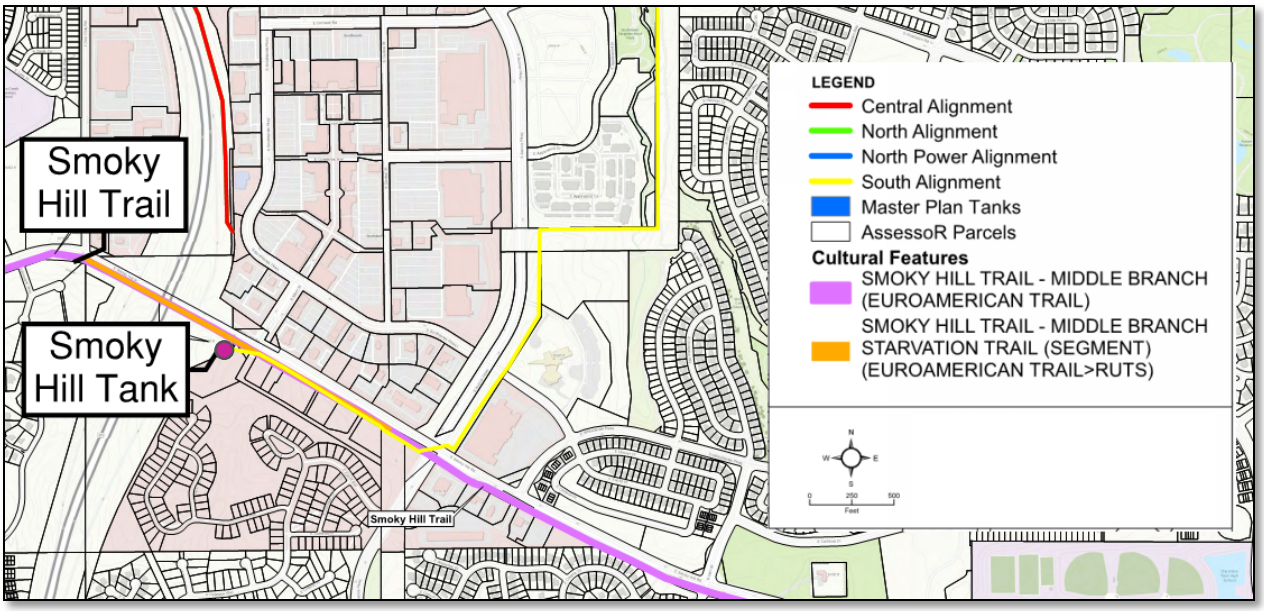


Figure 5.1: Cultural Impacts along the Southern Alignment

5.4 Constructability

The Constructability non-cost criterion represents a preliminary assessment of known construction challenges such as space available for construction, construction access constraints, and geotechnical challenges. The estimated costs presented herein include a basic allowance for lower productivity areas along the alignment. In addition, areas with identified constructability challenges also have greater risk of even higher costs. The constructability score captures that risk.

To determine existing geotechnical conditions, alignments were overlaid on the Colorado Geological Survey and U.S. Geological Survey Map of the Piney Creek Quadrangle, see Appendix D – Geotechnical Map.

Table 5.6: Constructability Assigned Scores

Alternative	Assigned Score	Description
Northern Alignment	"O"	The Northern Alignment includes:
	Negative	- No geotechnical challenges. Subsurface conditions along this alignment include artificial fill consisting of rip rap, engineered fill, and refuse placed during construction, in addition to alluvial deposits. Bedrock is not expected to be a concern at installation depths of 5-20 feet. - No major dewatering challenges. - Three creek crossings. It is assumed that creek crossings will be done via open cut construction, although additional research needs to be done to determine installation method. - The segment of pipe running south adjacent to E-470 has limited construction width (see Figure 5.2). The pipeline alignment is within E-470 Authority property, between the highway and an existing fiber line. The surface in this area is sloped and will require a longer construction duration and relatively high liquidated damages to reduce the likelihood that the fiber line is cut. - Approximately 5,400 feet of pipeline within roadways, requiring traffic control.

Table 5.6: Constructability Assigned Scores

Alternative	Assigned Score	Description
Northern Power Alignment	"N" Neutral	The Northern Power Alignment includes: - No geotechnical challenges. Subsurface conditions along this alignment include artificial fill consisting of rip rap, engineered fill, and refuse placed during construction, in addition to alluvial deposits. Bedrock is not expected to be a concern at installation depths of 5-20 feet. - No major dewatering challenges. - Three creek crossings. It is assumed that creek crossings will be done via open cut construction, although additional research needs to be done to determine installation method. - The segment of pipe running west through PSCO property is within a limited construction area. PSCO plans to install a new power line adjacent to the existing power line, restricting the remaining area for utilities. All construction equipment must be a minimum of 20 feet away from the power towers at all time, reducing the allowable construction easement for tall equipment to a maximum of 30 feet (see Figure 5.3). - The segments of pipe running south adjacent to E-470 is within a restricted construction area as described for the Northern alignment. - Approximately 200 feet of pipeline within roadways, requiring traffic control.
Central Alignment	"L" Less Favorable	The Central Alignment includes: - No geotechnical challenges. Subsurface conditions along this alignment include artificial fill consisting of rip rap, engineered fill, and refuse placed during construction, in addition to alluvial deposits. Bedrock is not expected to be a concern at installation depths of 5-20 feet. - No major dewatering challenges. - Four creek crossings. It is assumed that creek crossings will be done via open cut construction, although additional research needs to be done to determine installation method. - The segments of pipe running south adjacent to E-470 is within a restricted construction area as described for the Northern alignment. - If the start of the pipeline construction is after development of the Pomeroy parcel, the segment of pipe running west through this area may be within a limited construction area. - Approximately 200 feet of pipeline within roadways, requiring traffic control.
Southern Alignment	"L" Less Favorable	The Southern Alignment includes: - No geotechnical challenges. Subsurface conditions along this alignment include artificial fill consisting of rip rap, engineered fill, and refuse placed during construction, in addition to alluvial deposits. Bedrock is not expected to be a concern at installation depths of 5-20 feet. - No major dewatering challenges. - Four creek crossings. It is assumed that creek crossings will be done via open cut construction, although additional research needs to be done to determine installation method. - No limited construction areas. - Approximately 600 feet of pipeline within a roadway requiring traffic control.

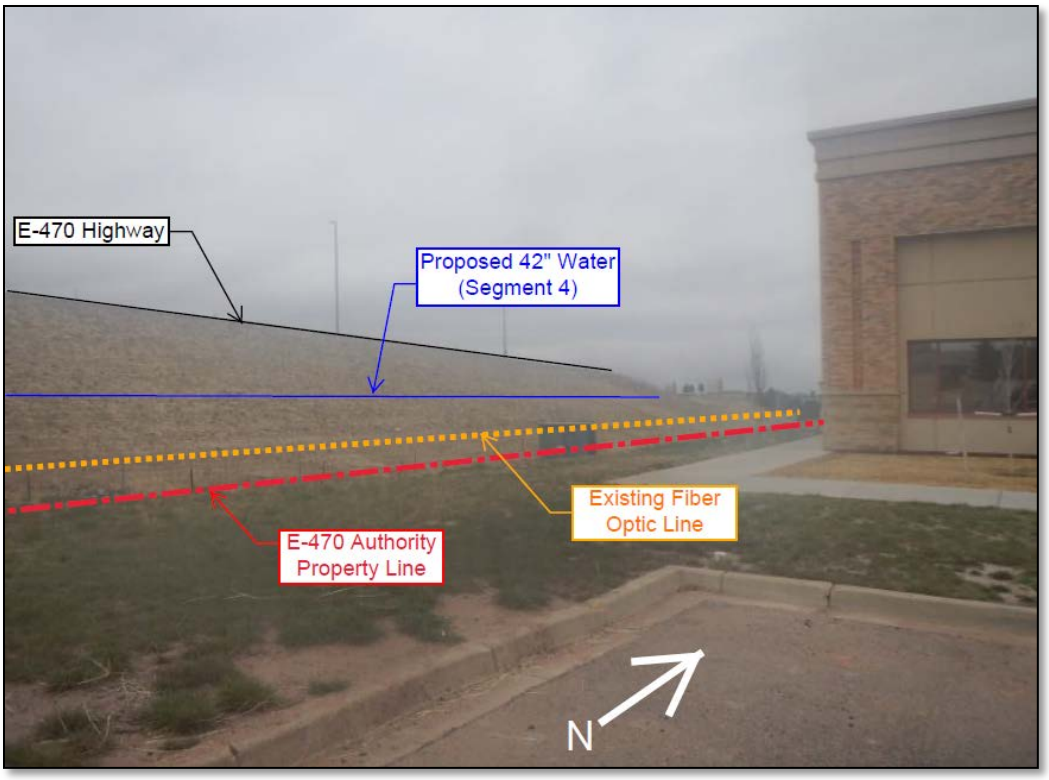


Figure 5.2: Limited Construction Width Adjacent to E-470

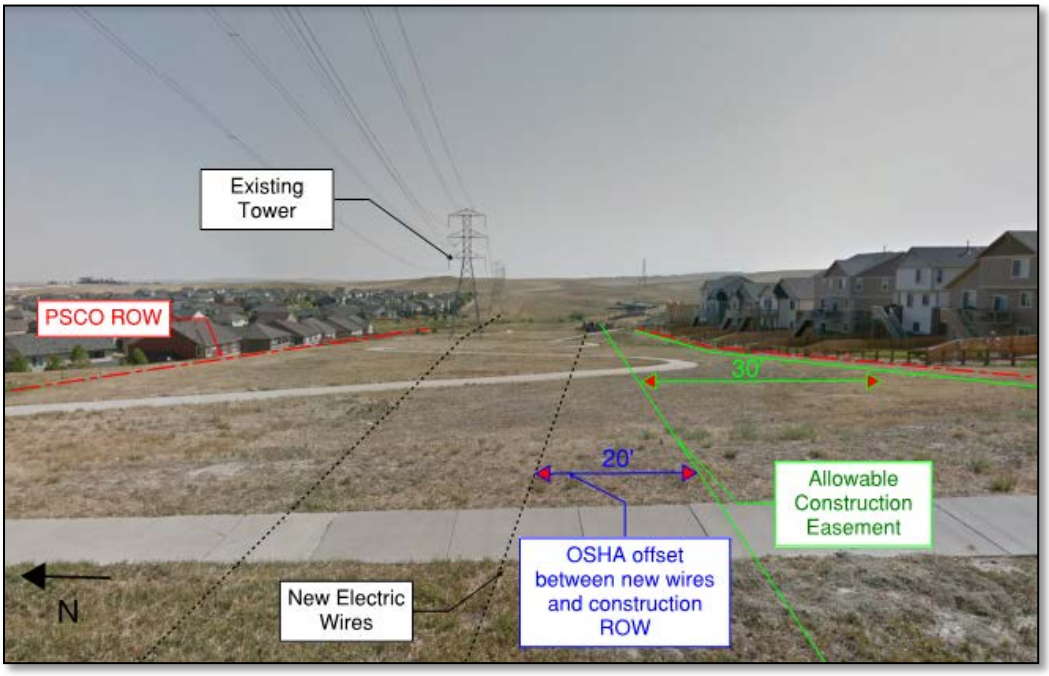


Figure 5.3: Limited Construction Width through PSCO Corridor

5.5 Reliability (Operational Flexibility)

In addition to conveying water from the BWPF to the WISE System, it is possible that SMWA will also need to transfer water from the East Cherry Creek (ECCV) Northern Pipeline to the WISE System. The Operational Flexibility non-cost criterion addresses the reliability of an alternative from an operations

perspective including the future connectivity options to ECCV Northern pipeline (see Figure 5.4). This criterion also categorizes alignments by their ability to flow water backwards from Smoky Hill Tank to the Rangeview Connection.

Table 5.7 Reliability (Operational Flexibility) Assigned Scores

Alternative	Assigned Score	Description
Northern Alignment	"M"	The Northern Alignment includes:
	More Favorable	- A section of this alignment parallels the existing ECCV line. There is some flexibility on where to locate the required low-lift pump station and chemical feed facility that may be required to transfer water from the ECCV Northern Pipeline to the WISE pipeline. - Ability to flow backwards, no major high points along alignment
Northern Power Alignment	"M"	The Northern Power Alignment includes:
	More Favorable	- This alignment has the same benefits as the Northern Alignment. - Ability to flow backwards, no major high points along alignment
Central Alignment	"N"	The Central Alignment includes:
	Neutral	- A section of this alignment comes within relatively close proximity to the existing ECCV line. There is some potential space in that region to locate the low-lift pump station and chemical feed facility that may be required to transfer water from the ECCV Northern Pipeline to the WISE pipeline. - Ability to flow backwards, no major high points along alignment
Southern Alignment	"O"	The Southern Alignment includes:
	Negative	- No sections of this alignment are close to the existing ECCV line. Connection to this pipeline could require greater construction effort. - Intermediate high point in pipeline alignment. Ability to flow backwards requires installing sections of pipeline approximately 40- 60 feet deep.

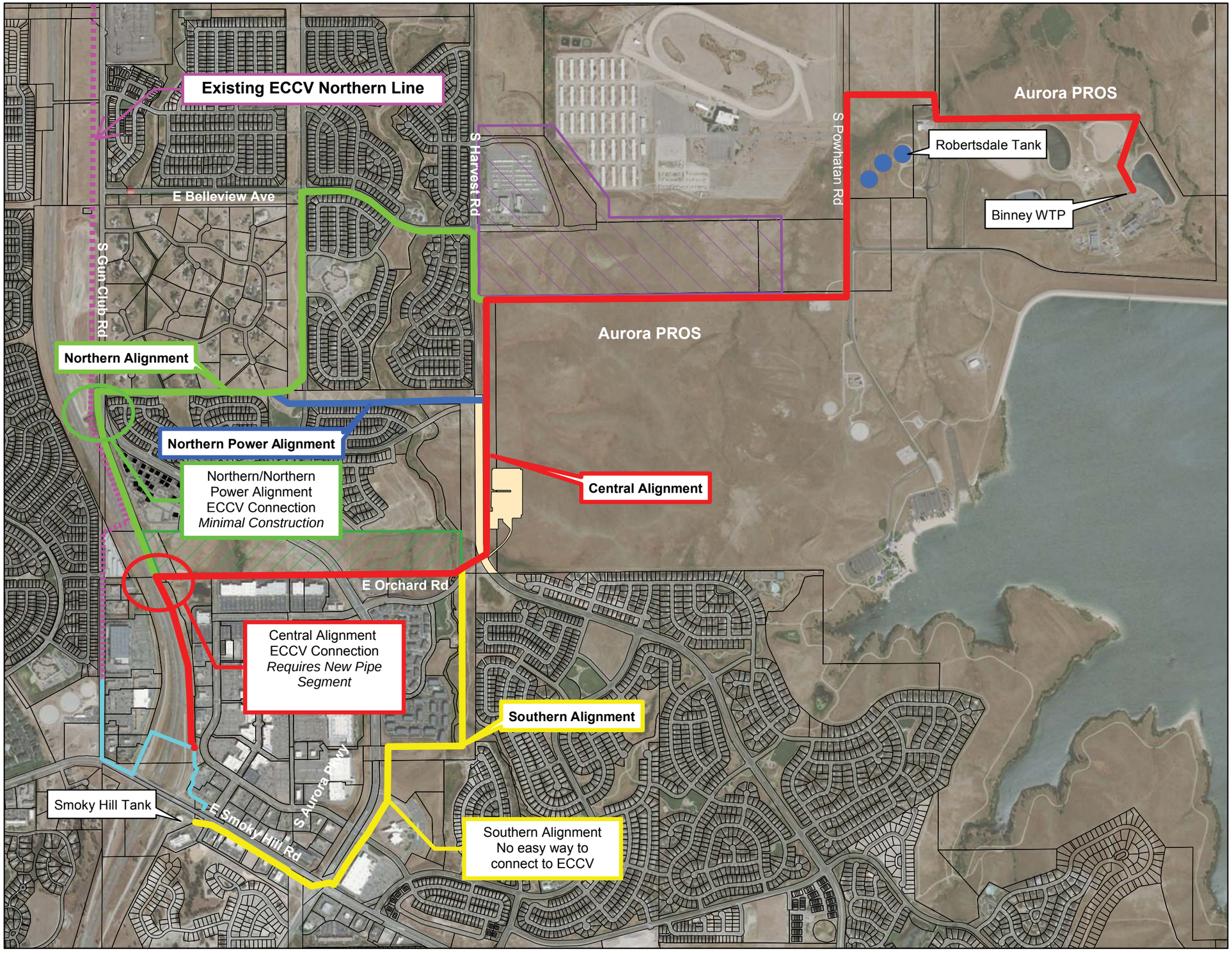


Figure 5.4: ECCV Connections

Binney Connection Alignment Study

5.6 Public Acceptance

The Public Acceptance non-cost criteria covers a range of potential issues that might make a pipeline alignment difficult to implement from a public acceptance perspective.

Table 5.8: Public Acceptance Assigned Scores

Alternative	Assigned Score	Description
Northern Alignment	"L"	The Northern Alignment includes:
	Less Favorable	- Construction through main streets in a relatively dense neighborhood. Lane closure in Belleview which may be viewed negatively by the neighborhood public.
Northern Power Alignment	"N"	The Northern Power Alignment includes:
	Neutral	- Construction in landscaped Sorrel Ranch HOA area that may be viewed negatively by immediate neighbors (see Figure 5.5).
Central Alignment	"N"	The Central Alignment includes:
	Neutral	- Limited road closures or public impacts unless the Pomeroy development is complete prior to construction.
Southern Alignment	"O"	The Southern Alignment includes:
	Negative	- Alignment will require E. Smoky Hill Road lane closures, which is the main access route from E-470 to Southlands Mall and the other businesses as well as for residents in this area of Aurora.

Figure 5.5: Sorrel Ranch HOA Property

6.0 Hydraulic Evaluation

A complete hydraulic evaluation, including a surge analysis, was performed for each pipeline alignment. The results of this evaluation can be found in TM *WISE Binney Connection Pump Station Study, CH2M, 2018.*

7.0 Alternative Ranking and Selection

The alignment alternatives were ranked based on a combination of the cost and non-cost criterion weight and scoring. Each alignment was assigned a relative benefit score based on the sum of the products of the non-cost criteria weight and scoring. The higher the benefit score, the better the benefits of the alternative. A cost per benefit was then calculated by dividing project costs by benefit score. The lower the weighted cost, the more benefit per dollar. The total estimated construction cost, ROW cost, non-cost criteria scoring, weighted non-cost score, and cost per benefit are identified in Table 7.1 and shown graphically in Figure 7.1.

Table 7.1: Alignment Alternative Costs, Scoring, And Ranking

Alternative	Estimated Construction Cost	Estimated ROW Cost	Land Requirements 16%	Operations & Maintenance 26%	Permitting 11%	Constructability 21%	Reliability/Operational Flexibility 21%	Public Acceptance 5%	Total Estimated Project Cost	Benefit	Cost Per Benefit
1 - Northern	$ 18,800,000	$ 3,000,000	L	L	L	O	M	L	$ 21,800,000	0.47	$ 46,714,000
2 - Northern Power	$ 17,000,000	$ 3,400,000	L	L	N	N	M	N	$ 20,400,000	0.64	$ 31,970,000
3 - Central	$ 17,600,000	$ 5,500,000	N	N	N	L	N	N	$ 23,100,000	0.64	$ 36,201,000
4 - Southern	$ 16,800,000	$ 3,600,000	N	O	O	L	O	O	$ 20,400,000	0.26	$ 79,333,000

The alignment alternative with the lowest total weighted cost or highest cost to relative benefit score ration is the Northern Power Alignment and represents the preferred alignment for the WISE Binney Connection Pipeline.

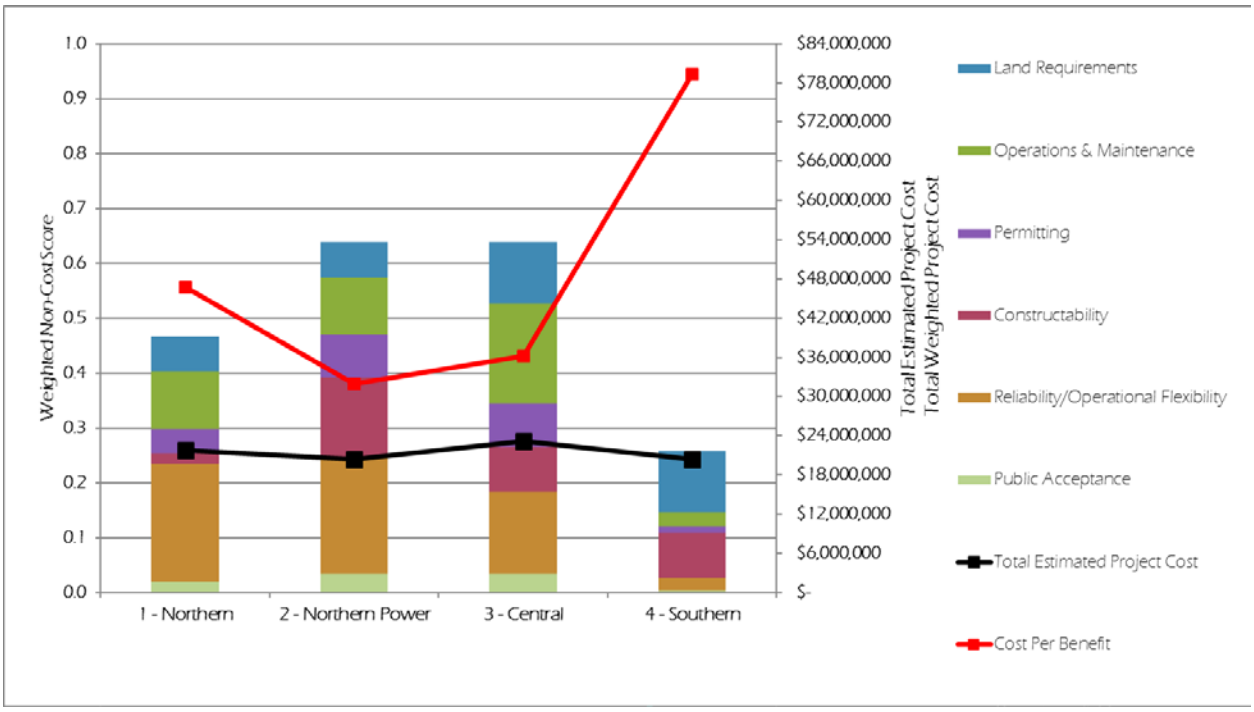


Figure 7.1: Alignment Alternative Costs, Ranking, and Scoring

8.0 Consider Potential Adverse Consequences of Preferred Alignment

While the Northern Power alignment provides the lowest project cost and highest total benefit, additional factors not analyzed in this study present potential risks during design and construction. These risks should be considered in coordination with monitoring the schedule and status of the proposed development along the Central Alignment. If the proposed development along the Central Alignment does not proceed on the schedule currently identified by the property owner, then the Central Alignment may present a viable and possibly a preferred alignment when compared to the Northern Power Alignment.

Key items to consider before advancing the Northern Power Alignment alternative include:

- It is unknown if PSCO will issue an easement on their property and will likely pursue a license agreement to have the pipeline on the property. There is risk with a license agreement that PSCO could require the pipeline to be moved in the future to accommodate powerline expansion on the property.
- Installing the pipeline parallel to high voltage overhead power lines requires careful consideration and design of cathodic protection systems. There is an increased risk of pipeline failure when located parallel to high voltage lines if the cathodic protection system is not functionally maintained and rapid corrosion occurs.
- Risk of existing utility conflicts not identified in this study.
- Risk of construction costs being higher than expected due to limited construction space adjacent to E-470 and within PSCO easement/property.

9.0 Preferred Alignment Class 4 Cost Estimate

Upon selection of the preferred alignment, the Northern Power Alignment cost estimate was refined to be a Class 4 Estimate as defined by the American Association of Cost Engineering (AACE) and as designated in ASTM E2516-06 Standard Classification for Cost Estimate Classification System. Class 4 costs are considered accurate from -30 to +50 percent based on a 1 to 15 percent complete project definition. This range of accuracy is on the final estimate, including any applicable markups for contingency and other project costs.

Unit prices were developed for the following items and the quantities were developed for the Northern Power Alignment. This cost estimate is included as Appendix E of this TM.

- General Items: Dewatering, Erosion Control, and Traffic Control
- Demolition: Sidewalk Demolition, Pavement Demolition, Curb & Gutter Demolition
- Concrete: New Sidewalk, New Pavement, New Curb & Gutter
- Sitework: Steep Sloped Surface Construction (construction E-470 easement), Open Space Construction, and Roadway Construction.
- Pipe Materials: 42-inch ASTM 1018 Structural Steel Grade 2 Pipe, 52-inch Steel Casing (for tunneled installation), Thrust Blocks, Blow Off Valves, Air/Vacuum Valves, Isolation Valves, Cathodic Protection Anodes, Cathodic Protection Test Stations

Table 9.1 displays the updated construction cost and the total project cost for the Northern Power Alignment.

Table 9.1: Preferred Alignment Class 4 Cost

Alternative	Class 4 Construction Cost Estimate (without contingency)	Estimated ROW Cost	Total Project Cost (Construction and ROW)	Total Project Cost -30%	Total Project Cost +50%
Northern Power Alignment	$15,449,000	$3,400,000	$18,849,000	$13,194,300	$28,273,500

Additional costs to be considered during budgeting are listed below. Note that actual costs may vary from these estimates, but they provide a basis for budgeting and funding dedication.

- **Engineering Design and Permitting Estimate**: $1,900,000 (based on approximately 10% of the total construction cost).
- **Engineering Services During Construction Estimate:** $500,000 (based on approximately 2.5% of the total construction cost. This will vary based on the complication of the design).
- **Construction Management and Inspection**: $750,000.

The total recommended budget for design and construction is $21,999,000, not including a contingency. This number can increase or decrease upon further study.

10.0 Construction Schedule and Next Steps

Key next steps are summarized below. Refer to Appendix F for the proposed construction schedule.

- Begin Detailed Design: October 2018
- Bid Project: September 2019
- Begin Construction: January 2020
- Begin Start-up and Testing: March 2021
- Begin Normal Operations: June 2021

Appendix A – Conceptual Level Cost Estimate

Conceptual Level Construction Costs

NORTHERN ALIGNMENT		NORTHERN POWER ALIGNMENT		CENTRAL ALIGNMENT		SOUTHERN ALIGNMENT	
Estimated Construction Cost		Estimated Construction Cost		Estimated Construction Cost		Estimated Construction Cost	
Segment 1	$ 4,604,000	Segment 1	$ 4,604,000	Segment 1	$ 4,604,000	Segment 1	$ 4,604,000
Segment 2A	$ 3,698,500	Segment 2	$ 455,700	Segment 2	$ 455,700	Segment 2	$ 455,700
Segment 2D	$ 1,687,800	Segment 2B	$ 1,420,800	Segment 2C	$ 858,600	Segment 2C	$ 858,600
Segment 4	$ 1,249,200	Segment 2D	$ 1,687,800	Segment 3	$ 2,425,200	Segment 3A	$ 3,537,000
		Segment 4	$ 1,249,200	Segment 4	$ 1,249,200		
Air Release Valves	$ 72,900	Air Release Valves	$ 656,100	Air Release Valves	$ 729,000	Air Release Valves	$ 583,200
Blowoff Valves	$ 48,600	Blowoff Valves	$ 388,800	Blowoff Valves	$ 437,400	Blowoff Valves	$ 340,200
Isolation Valves	$ 38,400	Isolation Valves	$ 230,400	Isolation Valves	$ 307,200	Isolation Valves	$ 230,400
Sub-Total	$ 11,399,400	Sub-Total	$ 10,692,800	Sub-Total	$ 11,066,300	Sub-Total	$ 10,609,100
Overhead -12%	$ 1,501,800	*Overhead -12%*	$ 1,283,100	*Overhead -12%*	$ 1,328,000	*Overhead -12%*	$ 1,273,100
Profit - 5%	$ 625,700	*Profit - 5%*	$ 534,600	*Profit - 5%*	$ 553,300	*Profit - 5%*	$ 530,500
Mobs/Bonds/Insurance - 30%	$ 625,700	*Mobs/Bonds/Insurance - 30%*	$ 534,600	*Mobs/Bonds/Insurance - 30%*	$ 553,300	*Mobs/Bonds/Insurance - 30%*	$ 530,500
Contingency - 30%	$ 4,580,400	*Contingency - 30%*	$ 3,913,500	*Contingency - 30%*	$ 4,050,300	*Contingency - 30%*	$ 3,883,000
Total Estimated Construction Cost	**$18,733,000**	*Total Estimated Construction Cost*	**$16,958,600**	*Total Estimated Construction Cost*	**$17,551,200**	*Total Estimated Construction Cost*	**$16,826,200**

Appendix B – Right of Way Non-Cost Evaluation

ROW Non-Cost Evaluation

Alignment	Total Number of Parcels Impacted	Total Number of Property Owners Impacted	Total ROW Cost*
Northern	21	7	$ 2,958,000
Northern Power	21	8	$ 3,425,500
Central	15	9	$ 5,524,000
Southern	14	9	$ 3,600,500

*Assume 50-ft wide permanent easement (25ft. +/- pipe centerline)

Surface Type	Cost Per SF		
	Purchase Price	Permanent Easement	Temporary Easement
Roadway	$ -	$ -	$ -
Aurora Open Space	$ 2.00	$ 1.00	$ 0.20
Aurora Non-Open Space	$ 10.00	$ 5.00	$ 1.00
E-470 Authority	$ 1.72	$ 1.72	$ 1.72
Public Service Company of CO* (PSCO)	$ 500.00	$ 500.00	$ 500.00
Sorrel Ranch HOA Open Space	$ 2.00	$ 1.00	$ 0.20
Pomeroy/Gun Club	$ 15.00	$ 7.50	$ 1.50
Private Property Retail	$ 28.00	$ 14.00	$ 2.80

*The $500 is a one time license application fee, not per SF.

Segment 1

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-09-3-01-001	4181	209056	AURORA CITY OF & STATE OF COLORADO	Aurora Non-Open Space	$ 1,255,000
2071-09-2-01-001	1345	67273	AURORA CITY OF	Aurora Non-Open Space	$ 404,000
ROW	1506	75287	-	Roadway	-
2071-00-0-00-142	1315	65767	AURORA CITY OF	Aurora Open Space	$ 79,000
2071-21-2-09-006	5065	253258	AURORA CITY OF	Aurora Open Space	$ 304,000
2071-00-0-00-211	127	6362	AURORA CITY OF	Aurora Non-Open Space	$ 39,000

Segment 2

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-00-0-00-211	1424	71201	AURORA CITY OF	Aurora Non-Open Space	$ 428,000

Segment 2A

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-00-0-00-211	188	9385	AURORA CITY OF	Aurora Open Space	$ 12,000
ROW	6166	308316	-	Roadway	-
2071-00-0-00-006	247	12328	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
2071-18-4-00-008	20	981	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
2071-18-3-09-027	226	11314	AURORA CITY OF	Aurora Open Space	$ 14,000

Segment 2B

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-00-0-00-211	166	8293	AURORA CITY OF	Aurora Non-Open Space	$ 50,000
2071-18-4-00-008	2659	132955	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
2071-18-3-09-027	266	13310	AURORA CITY OF	Aurora Open Space	$ 16,000

Segment 2C

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-00-0-00-211	2341	117059	AURORA CITY OF	Aurora Non-Open Space	$ 703,000
2071-18-4-00-008	242	12114	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500

Segment 2D

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-18-3-09-027	54	2706	AURORA CITY OF	Aurora Open Space	$ 4,000
2071-18-3-09-028	1110	55485	SORREL RANCH HOMEOWNERS ASSOC INC	Sorrel Ranch HOA	$ 2,000
2071-18-3-01-021	460	22978	AURORA CITY OF	Aurora Open Space	$ 28,000
2071-18-3-02-014	723	36130	SORREL RANCH HOMEOWNERS ASSOC INC	Sorrel Ranch HOA	$ 1,000
2071-18-3-03-016	9	468	SORREL RANCH HOMEOWNERS ASSOC INC	Sorrel Ranch HOA	$ 1,000
2073-13-4-00-005	398	19889	AURORA CITY OF	Aurora Open Space	$ 24,000
ROW	438	21903	-	Roadway	-
2073-13-1-00-010	31	1562	E-470 PUBLIC HIGHWAY AUTHORITY	E-470 Authority	$ 6,000
2071-18-3-00-273	1321	66035	E-470 PUBLIC HIGHWAY AUTHORITY	E-470 Authority	$ 228,000
2071-00-0-00-271	688	34408	E-470 PUBLIC HIGHWAY AUTHORITY	E-470 Authority	$ 119,000

Segment 3

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-18-4-00-008	18	891	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
2071-18-4-00-293	1678	83888	GUN CLUB GROUP PARTNERS, JACOBSON LAWRENCE, BARNARD GLEN, STUTZ ARI	Pomeroy/Gun Club	$ 755,000
ROW	168	8379	-	Roadway	-
2071-18-4-00-292	2202	110108	GUN CLUB GROUP PARTNERS	Pomeroy/Gun Club	$ 991,000
2071-18-3-00-272	267	13354	GUN CLUB GROUP PARTNERS	Pomeroy/Gun Club	$ 121,000
2071-00-0-00-271	40	2012	E-470 PUBLIC HIGHWAY AUTHORITY	E-470 Authority	$ 7,000

Segment 3A

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-18-4-00-008	77	3827	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
2071-19-1-00-009	3698	184925	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
2071-19-4-02-001	2092	104597	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
2071-19-4-00-001	245	12270	SOUTHLANDS COLORADO LLC	Private Property Development	$ 207,000
2071-19-4-00-006	251	12535	PUBLIC SERVICE CO OF COLORADO	PSCO	$ 500
ROW	1412	70592	-	Roadway	-
2071-19-3-05-007	65	3227	FOREST TRACE METROPOLITAN DISTRICT 2	Private Property Development	$ 55,000
2071-19-3-05-008	79	3966	FOREST TRACE DEVELOPMENT INC	Private Property Development	$ 67,000
2071-19-3-05-001	68	3375	HTA-AURORA HOSPITAL LLC	Private Property Development	$ 57,000

Segment 4

Parcel No.	Length	Easement Area (SF)*	Parcel Owner	Surface Type	Cost
2071-00-0-00-271	14	696	E-470 PUBLIC HIGHWAY AUTHORITY	E-470 Authority	$ 3,000
2071-19-2-00-269	2497	124868	E-470 PUBLIC HIGHWAY AUTHORITY	E-470 Authority	$ 430,000
2071-19-2-00-008	21	1045	E-470 PUBLIC HIGHWAY AUTHORITY	E-470 Authority	$ 4,000

Appendix C – WISE Infrastructure Project Regulatory Analysis

1.0 Overview

The proposed WISE Binney Connection Pipeline will convey flows from the Robertsdale Tank near Binney Water Purification Facility (BWPF) to the existing Smoky Hill Tank. The pipeline alignments range from approximately 4.6 miles to 5.3 miles of 42-inch pressurized steel pipeline. The focus of the WISE Binney Connection Pump Station Study is to evaluate alternatives for siting disinfection, blending, and pumping facilities that would transfer water from the BWPF to the WISE conveyance system.

This project will likely require federal, state, and local regulatory agency reviews, which will impact the project from both a cost and schedule perspective. The permitting requirements for both the pipeline and pump station projects are summarized in Table C.1. It is anticipated the project will require permitting approval from the following agencies:

- U.S. Army Corps of Engineers (USACE)
- U.S. Fish and Wildlife Service (USFWS)
- Colorado State Office of Archaeology and Historic Preservation (SHPO)
- Colorado Parks and Wildlife Division (CPW)
- Colorado Department of Public Health and Environment (CDPHE)
- City of Aurora
- E-470 Public Highway Authority

TABLE C.1

Binney WISE Connection Pump Station and Pipeline Permit Requirements

Section Reference	Agency	Permit	Applicability	Permittee	Responsibility for Preparing Permit Application	Estimated Time to Submit Application	Total Estimate Time to Obtain Approval	Design	Construction	Notes
Federal										
2.1	United States Army Corps of Engineers (USACE)	404 Nationwide Permit 12 Authorization (Utility crossing)	Required - Pipeline	SMWA	SMWA/Designer	10 days	45 days	X		A nationwide 404 permit is a straightforward permit for crossing waters of the United States as compared to an Individual 404 permit. It is highly likely that a nationwide permit can be acquired for this project if waters of the U.S. are tunneled, wetlands are avoided, and a reasonable effort is made to minimize impacts to cultural resources. Specifically, this project will apply for a NWP 12 – Utility Line Activities. This permit applies for activities that do not result in the loss of greater than ½ acre of waters of the United States. The requirement to tunnel Waters of the US will require further investigation to determine if there is a federal nexus for this project that would not allow open-cut under a nationwide permit. That nexus could reside in agreement related to WISE specifically. A Pre-Construction Notice (PCN) and a delineation is required if this project uses mechanized land clearing in wetlands (likely), pipeline exceeds 500 linear feet in the waters of the U.S. (unlikely), or runs parallel to a stream bed within the jurisdictional area (unlikely). The designer will provide exhibits once utility crossing design is completed. PCN exhibits include location map, plan view sketch, and cross-section sketch of the utility crossing.
2.2	U.S. Department of the Interior – U.S. Fish and Wildlife Service (USFWS)	Section 7 Consultation	Required - Pipeline	SMWA	Designer	10 days	40 days	X		As part of the 404 nationwide permit process and/or as part of City of Aurora Permitting Process, a consultation with the U.S. Fish and Wildlife Service is required if it is found that the project has adverse effects on any federally listed species or its habitat. The designer will need to provide a natural resources assessment identifying potential wetlands, potential federally threatened and endangered species habitat, and natural resources that may affect the project's alignment. A biological assessment may identify the following, but not limited to, federally-endangered species: Preble's Meadow Jumping Mouse Habitat, Raptor Nesting Corridors, Songbird Nesting Corridors, Burrowing Owls Habitat. If any of these areas are identified, it can impact the season that construction is required and my required some habitat mitigation.
2.3	Federal Emergency Management Agency (FEMA)	Conditional Letter of Map Revision (CLOMR) / Letter of Map Revision (LOMR)	Not Likely - Pipeline	SMWA	SMWA/Designer	2 months	CLOMR: 3-5 months LOMR: 6 months	X		FEMA permitting would only be required if the pipeline results in modifications to the 100-year floodplain. It is expected that the design can avoid impacts to the 100-year floodplain and this permit is not likely.
State										
3.1	Colorado Office of Archaeology and Historic Preservation	Class I/III Cultural Resource Survey (Section 106 of the National Historic Preservation Act (NHPA) Review	Likely Required - Pipeline, Pump Station	SMWA	SMWA	2 months	2 months	X		As part of the 404 nationwide permit process and/or as part of City of Aurora Permitting Process, a Class I cultural survey may be required. A class I survey can take about 2 months. If a Class I survey identifies construction is proposed in an area with cultural interests, a Class III survey may be required. A Class III survey can take at least 3 months and possibly as long as 8 months. The Class III survey can identify areas where monitoring is required during construction and possibly a revised alignment could be required to avoid cultural or historic resources.
3.2	Colorado Department of Public Health and Environment (CDPHE)	Site Location & Design Approval	Required – Pump Station/Disinfection	SMWA	Designer	1 month	3 months	X		Required for new or expanding lift/pump stations. Section 22.7 Site Location Application along with an engineering report is required.
3.3	CDPHE	Drinking Water Design Submittal	Required – Pump Station/Disinfection	SMWA	Designer	1 month	3 months	X		Required for in-plant improvements of the Binney Water Purification Facility (BWPF) or any drinking water facility, which include siting new disinfection, blending, and pumping facilities. A Drinking Water Construction Completion Certification Form will need to be submitted upon the completion of construction and prior to commencing operations.
3.4	CDPHE	APEN and Construction Permit	Required – Pipeline, Pump Station	Contractor	Contractor	2 weeks	90 days		X	Required as authorization for air emissions associated with construction activities for projects that are greater than 25 acres of earthmoving operations AND lasting longer than 6 months in duration. This will be required for all pipeline alternative alignments and likely not required for the pump station since disturbance is less than 25 acres.
3.5	CDPHE	Construction Stormwater Discharge Permit	Required - Pipeline	Contractor	Contractor	1 month	30 days		X	Required to obtain permit certification authorizing the discharge of stormwater runoff from construction sites greater than 1 acre. The development and implementation of a Stormwater Management Plan (SWMP) is required prior to submission of the application. The SWMP should be developed along with the Grading Permits as the same information is required. This permit is required for the pipeline project and likely the pump station project too.
3.6	CDPHE	Construction Dewatering Discharge Permit	Required – Pipeline, Pump Station	Contractor	Contractor	2 weeks	30 days		X	Required for authorization of groundwater discharge and stormwater from excavation sites into state waters. Timeframe assumes that water quality samples have already been obtained.

TABLE C.1

Binney WISE Connection Pump Station and Pipeline Permit Requirements

Section Reference	Agency	Permit	Applicability	Permittee	Responsibility for Preparing Permit Application	Estimated Time to Submit Application	Total Estimate Time to Obtain Approval	Design	Construction	Notes
3.7	CDPHE	Hydrostatic Testing of Pipelines, Tanks, and Similar Vessels Discharge Permit	Required – Pipeline, Pump Station	Contractor	Contractor	2 weeks	30 days		X	Required for authorization of the discharge of hydrostatic testing process generated wastewater effluent to ground and/or surface waters of the State of Colorado.
3.8	Colorado Division of Water Resources	Dewatering Well – Notice of Intent	Required – Pipeline, Pump Station	Contractor	Contractor	1 day	3 days		X	As defined in Section 37-91-102(4.5), C.R.S., a Dewatering Well is any excavation or other ground penetration for dewatering purposes exclusively related to construction projects. Dewatering Wells may be constructed only after proper Notice of Intent and must be plugged and abandoned within one year of being constructed. Upon written request for variance and as warranted by project considerations, the one-year abandonment requirement may be extended.
3.9	Colorado Department of Local Affairs (CDLA)	1041 Regulation	Unlikely – Pipeline	N/A	N/A					May be required if the pipeline crosses the City of Aurora boundaries into Arapahoe County, that has 1041 in effect for large water supply projects. 1041 powers allow local governments to identify, designate, and regulate areas and activities of state interest through a local permitting process. The general intention of these powers is to allow for local governments to maintain their control over particular development projects even where the development project has statewide impacts.
City – Aurora										
4.1	Aurora	Planning – Development Application (Use by Special Review, Location and Extent)	Required – Pipeline, Pump Station	SMWA	Designer	1 week	3 to 4 months	X		If siting is in municipal city limits, then comply with applicable zoning and subdivision requirements.
4.2	Aurora	Civil Construction Plan	Required – Pipeline, Pump Station	SMWA	Designer	1 week	2 months	X		Required to obtain Public Improvement Permit and Stormwater Management Permit.
4.3	Aurora	Public Improvement Permit: Include Right-of-Way Use	Required – Pipeline, Tentative - Pump Station	Contractor	Contractor	1 week	2 weeks		X	These permits are issued for any work performed within the City's right of way related to street cuts for water, sanitary, and storm sewer tie-ins. Permits are also required for paving, curb and gutter, and sidewalk construction, etc. Permits are required for retaining wall installations as well. Construction within the right of way (curb/gutter/sidewalks) and on city-owned and maintained facilities require special licensing and bonding for contractors. Required for the construction of the pipeline within public right-of-way. Any work in the right of way restricting access to ROW will require an approved traffic control plan prior to permit issuance.
4.4	Aurora	Temporary Use Permit	Required – Pipeline, Pump Station	Contractor	Contractor	1 week	2 weeks		X	Required for construction access and staging.
4.5	Aurora	COA Stormwater Quality Discharge Permit for Construction Activities	Required – Pipeline, Tentative - Pump Station	SMWA	Designer	1 week	2 weeks	X		Covers stormwater discharges associated with small and large construction sites. Required for projects greater than 1 acre. The Permittee is responsible for and is subject to any liability for drainage, erosion, and sediment control for the permitted site.
4.6	Aurora	Grading, Erosion and Sediment Control Permit (GESC)	Required – Pipeline, Pump Station	SMWA	Designer	1 week	2 weeks	X		GESC report and plans are required for sediment and erosion control measures. The pipeline will have less stringent GESC requirements compared to plant development. GESC report and drawings will be encompassed in the City of Aurora SWMP plan.
4.7	Aurora	Floodplain Development Permit	Required – Pipeline, Tentative - Pump Station	SMWA	Designer	1 month	1 month	X		Required if pipeline crosses a drainage or if pump station development occurs within a designated floodplain. Regulates new development, minor improvements, or substantial improvements that occur within a designated floodplain.
4.8	Aurora	Building Permit	Required – Pipeline, Pump Station	Contractor	Contractor	1 week	2 months		X	Building permit may be required for disinfection, blending, and pumping facilities based on alternative selected. This permit demonstrates that a building project is being constructed under processes for insuring code compliance and public safety. City of Aurora Building permits cannot be issued until all other Development Review processes have been completed.
4.9	Aurora	Certificate of Occupancy or Temporary Certificate of Occupancy	Required – Pipeline, Pump Station	Contractor	Contractor	1 day	24-hour notice prior to occupancy		X	The Certificate of Occupancy (CO), either temporary or final, is issued prior to occupancy of any structure. No CO may be issued until the requirements of all inspection agencies involved are satisfied, which include stormwater management plan inspections, building inspections, and public improvement inspections.
Other										
3.10	E-470 Public Highway Authority	Construction Permit/Permit to Occupy	Required (Pending Design) - Pipeline	SMWA	Contractor (Designer to start, Contractor to complete)	1 month	2 months	X	X	Required to allow shoulder survey work, construction, operation, and maintenance of the trenchless crossing through E-470 right-of-way.

2.0 Federal Agencies

USACE typically requires a month to initiate its review process before notifying the USFWS for biological assessment review. After the USFWS review and approval is complete, the USACE typically issues a permit within one month, though the process could require up to 45 days to finalize. The USFWS is given 135 days (4.5 months) to review and issue an opinion, however the current backlog is stretching the process to nearly six months. It is recommended that the project schedule include one year to clear federal review and approval.

2.1 Section 404 Permit – United States Army Corp of Engineers

Under Section 404 of the Clean Water Act, the USACE regulates the discharge of dredge and fill material in jurisdictional waters and associated wetlands of the United States. Pipelines fall under NWP 12, which applies to the construction, repair, maintenance and removal of utility lines, provided the area impacted by the project does not result in the loss of greater than 0.5 acres of waters of the United States. For this project, most of the impacts to jurisdictional waters will be temporary during construction and the affected area will be restored to pre-construction grade and conditions. Based on the selected alignment, around 0.046 to 0.172 acres of jurisdictional waters (stream crossings) will be temporarily impacted via open cut. If the project surpasses the half-acre disturbance requirement, trenchless technology will be used instead of open cut to avoid the need for an individual 404 permit. Trenchless technology will not disturb any wetlands or its ordinary floodway compared to open cut.

It will also be important to review any jurisdictional related documentation associated with this project to confirm if previous direction was provided by a Federal Agency that would restrict the options for open-cut of a Waters of the U.S. If those provisions are in place, then the waters of the US will be crossing with trenchless construction to mitigate potential impacts.

If the pipeline alignment encounters wetlands, a Pre-Construction Notification (PCN) and a wetlands delineation will be required to the District Engineer before commencing construction, since there will be mechanized land clearing for the right-of-way. Additionally, if it is determined that the site will adversely impact an endangered species, habitat or wetlands, it is recommended that the PCN mentions mitigation strategies indicating that the pipeline will avoid impacting this area to the maximum extent practicable.

2.2 Section 7 Consultation - U.S. Department of the Interior – U.S. Fish and Wildlife Service (USFWS)

Section 7 of the Endangered Species Act requires federal agencies to coordinate with the USFWS whenever a project has the potential to adversely impact any federally listed species or its habitat. To determine if the alignment disturbs any of these areas, a biological assessment is required to identify potential wetlands, potential federally threatened and endangered species habitat, and natural resources that may affect the selected project's alignment. If the assessment determines the alignment impacts wetlands, species or habitat, coordination with Colorado Fish and Wildlife Conservation Office is recommended.

Common federally-listed species that may be near the project site include:

- Preble's Meadow Jumping Mouse
- Raptor Nesting Corridors – require a concurrent Colorado Parks and Wildlife review and a Letter of Conformance if the project is anticipated to impact raptor habitat during the breeding season.
- Songbird Nesting Corridors
- Burrowing Owls
- Additional species of concern may be identified at project site.

The USFWS is then notified by the USACE through consultation to review the potential impacts on critical habitat in the project location.

2.3 Conditional Letter of Map Revision (CLOMR) / Letter of Map Revision (LOMR) - Federal Emergency Management Agency (FEMA)

FEMA permitting would only be required if the pipeline or pump station results in modifications to the 100-year floodplain. It is expected that the design can avoid impacts to the 100-year floodplain and this permit is not likely to be required.

If required this permit may impact the project schedule and cost. FEMA requires a Conditional Letter of Map Revision (CLOMR) review prior to construction and a Letter of Map Revision (LOMR) at project completion with demonstration the action will not cause a rise in the 100-year water surface elevation. This process can be executed while other permitting processes are underway. LOMR and CLOMR requirements are moderately complex.

To avoid FEMA permitting, the designer will need to avoid impacting the floodway in the design of the pipeline.

3.0 State Agencies

3.1 Class I Cultural Resource Survey (Section 106 of the National Historic Preservation Act (NHPA) Review – Colorado Office of Archaeology and Historic Preservation (SHPO)

Section 106 of the National Historic Preservation Act requires federal permitting agencies to ensure cultural and archaeological resources are identified and protected as part of their application review. In Colorado, the SHPO agency is responsible for review of a cultural survey if USACE identifies there is a potential for cultural resources to be found in the project area. It is unclear at this stage whether USACE will require SHPO consultation. However, it is important to consider SHPO review has the potential to significantly impact schedule, if required. Cultural survey reviews could take at least six months and possibly as much as one year to complete.

Based on the available cultural resource mapping provided for this project by SHPO, the only pipeline alignment that has cultural resource impacts except is the Southern Alignment. This alignment passes the Smoky Hill Trail, which is classified as cultural land.

Compliance during Construction:

If a cultural sensitive artifact is discovered at the project site during construction, the contractor must stop work in that area and report the findings to the owner, who will make the necessary notifications and determine follow up action. The Contractor will not be allowed to work in the area until it has been cleared by SHPO.

3.2 Site Location Approval – CDPHE

New and expanding pump stations require CDPHE Site Location Approval under Regulation 22.7 before construction can begin. This section requires a basis of design report, an engineering report and signage (public notification) for all new pump stations. Signs are to be posted for 15 continuous days prior to the time the site application is submitted to the Division. A photograph of the sign or other documentation certifying that this posting requirement has been met must be included in the application. CDPHE is experiencing significant application backlog now with review and approvals requiring up to four months to complete. For planning purposes, even though the process could potentially take longer, eight to ten months should be assumed for Site Location Approval document preparation, agency review and approval.

3.3 Drinking Water Design Submittal – CDPHE

Drinking Water Design Submittal application is required for in-facility modifications to the BWPF. This application requires a site plan, design report of modifications, stamped drawings and specifications. It is estimated that CDPHE review and approval will take up to four months to complete. Future backlogs and review and approval schedules are difficult to predict.

3.4 APEN and Construction Permit – CDPHE

For all alignments, the pipeline will likely require APEN authorization if construction of the pipeline is over 25 contiguous acres and exceeds six months in duration. It is expected that the pump station will be APEN-exempt since the disturbance will be less than 25 acres.

If APEN permit is required, it is anticipated that the selected construction contractor could request coverage under the Land Development General Permit (GP03).

3.5 Construction Stormwater Discharge Permit – CDPHE

The pipeline will require certification under CDPHE's Colorado Discharge Permit System Stormwater Discharge Permit since this project will disturb greater than one acre of land. This permit requires the development of a Stormwater Management Plan (SWMP). The SWMP developed must include the required elements of the Grading, Erosion and Sediment Control Permit (GESC Grading permits) developed for the City of Aurora. The Construction Contractor, while not obtaining these permits, will be expected to comply with the requirements.

The pump station project is expected to disturb about 0.8 acres and will not require this permit unless the area of disturbance is increased during the design process.

3.6 Construction Dewatering Discharge Permit – CDPHE

It is anticipated that the construction of both projects could require dewatering. Consequently, the contractor is required to obtain permit coverage under the Construction Dewatering General Permit. Given the nature of the surrounding development in the area, it is unlikely for CDPHE to require a Groundwater Remediation Discharge Permit. To minimize risks associated with unknown regulatory requirements with the construction dewatering, the client could apply for the Construction Dewatering Discharge Permit prior to selecting a construction contractor and providing a Notice to Proceed.

3.7 Hydrostatic Testing of Pipelines, Tanks, and Similar Vessels Discharge Permit – CDPHE

The construction of both projects will require the contractor to obtain a Hydrostatic Testing of Pipelines, Tanks and Similar Vessels Discharge Permit. This applies to hydrostatic testing of equipment and discharge of water after testing.

3.8 Dewatering Well – Notice of Intent – Colorado Division of Water Resources

If dewatering is required for pipeline or pump station construction, then the selected construction contractor will need to submit a Notice of Intent to the Colorado Division of Water Resources prior to exposing groundwater.

For the purposes of determining well permitting and notification requirements, the Colorado Division of Water Resources provides the following information on their website, "As defined in Section 37-91-102(4.5), C.R.S., a Dewatering Well is any excavation or other ground penetration for dewatering purposes exclusively related to construction projects. Dewatering Wells may be constructed only after proper Notice of Intent and must be plugged and abandoned within one year of being constructed. Upon written request for variance and as warranted by project considerations, the one-year abandonment requirement may be extended."

In accordance with Rule 6.3 of the Water Well Construction Rules (2 CCR 402-2) (Rules) and the requirement of the State Engineer, Notice of Intent (Notice) must be provided before drilling any Test Hole that penetrates a confining layer and any Monitoring and Observation Hole or Dewatering Well. Notice is accomplished by submitting Form GWS-51(Monitoring and Observation Holes), or Form GWS-62 (Dewatering Wells), to the Division of Water Resources at least three (3) days and no more than ninety (90) days prior to construction. Faxed notices are acceptable.

All Monitoring and Observation Holes and Dewatering Wells must be constructed within 90 days of the receipt of the Notice by the State Engineer's office. Multiple Notices may be filed for projects that require the installation of wells over more than one 90-day period.

3.9 1041 Regulations – Colorado Department of Local Affairs (CDLA)

The Colorado General Assembly empowers local agencies with permit review authority over projects of statewide interest through 1041 regulations. Arapahoe County has 1041 regulations in effect for large water supply projects. The 1041 process can be used as a method to control development by local agencies. The regulations have the potential to adversely impact projects with costly remediation requirements or long public and agency review schedules. To avoid lengthy and costly 1041 processes, a proactive approach is recommended that includes project proponents conducting outreach to county and local agencies prior to project site selection. This allows project owners to explore how their project would be perceived in each county, to help county leaders understand the benefits of locating the project in their jurisdiction, and to define the project to meet the least local resistance. The 1041 process can be highly complex because of the extended length of time required and potentially challenging political atmosphere.

This project is not expected to require the 1041 process as the entire limits are within the City of Aurora limits. If during the design process the construction limits are extending into unincorporated Arapahoe County, then this permit process could be required.

3.10 Construction Permit/Permit to Occupy – E-470 Public Highway Authority

E-470 Public Highway Authority will become involved if the pipeline alignment is within E-470 Authority Property. The E-470 Public Highway Authority requires construction permits for occupancy, access, and construction. E-470 may be willing to enter into a Common Use Agreement with negotiated fees associated with permits. Occupancy and access permits will be pursued early in the design phase, but construction permit applications cannot be submitted until after the Common Use Agreement is finalized.

4.0 City of Aurora

City of Aurora land use laws apply to sites located within their boundaries. Potential permitting submittals include the Development Application (DA), Civil Construction Documents (Civil CDs), and Building Construction Documents (Building CDs). Checklists of the minimum information needed in the plan submittals can be found on City of Aurora's website.

A pre-application meeting is recommended to determine the exact permits required for and issues that may affect the pipeline and pump station project. Additionally, the City of Aurora's development process includes pre-submittal meetings with the planning, engineering, and building departments. At the pre-submittal meeting, all plan sets will be reviewed prior to submittal to ensure the plans are complete and ready for the City of Aurora's review.

4.1 Planning – Development Application (Use by Special Review, Location and Extent)

This application will be submitted to the Planning and Development Services Department. The typical submittal includes a site plan, preliminary drainage study, landscape plan, and building elevations. A typical review time is a 12.5-week schedule.

4.2 Engineering - Civil Construction Documents

These documents will be submitted to the Public Works Department's Engineering Services Division. The typical submittal includes erosion control plans, grading plan, street construction plans and utility plans. The review timeframe varies based on the number of sheets in the plan set submitted, but is typically an 8-week schedule.

4.3 Public Improvement Permit: Right-of-Way Use

These permits are issued for any work performed within the City's right of way related to utility tie-ins. This permit also covers wall installation as well as paving, curb and gutter, and sidewalk construction. Note, the construction within the right of way and on city-owned and maintained facilities require special licensing and bonding for contractors.

4.4 Temporary Use Permit

The Temporary Use permit process is intended to allow uses of a temporary nature to exist for a specified length of time in a manner which will not adversely impact the general welfare of persons residing in the community. The pipeline will require this permit, since construction will interfere with pedestrian or vehicular traffic occurring on city streets or right of ways. Depending on the alignment selected and advanced through final design, approximately 200 to 5,400 feet of pipeline is within the roadway.

Additionally, this permit is required for construction staging.

4.5 Stormwater Quality Discharge Permit for Construction Activities

This permit is required for the pipeline and is issued prior to grading or other earth disturbance activities and allows the discharge of stormwater from a construction site within City of Aurora limits. According to the "*Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities*" handbook, any of the following conditions for utility construction trigger the need for this permit:

- Disturb one acre or more
- Utility installation site is less than one acre, but is part of a larger project
- Installing underground utilities in excess of 1000 linear feet using open cut installation
- Utilizing trenchless technology for utility boring that has one acre or more of attributable construction disturbance area. BMPs are required to limit discharge into the public right of wat at bore pit locations.
- Installing utilities for a development, prior to the start of overlot clearing and grading.
- Within 100 feet of a watercourse

Projects within the Cherry Creek Watershed must also comply with Cherry Creek Reservoir Control Regulation No. 72, which identifies specific requirements for erosion and sediment control (GESC) best management practices (BMPs) on construction sites and limits the area of land that can be disturbed at a time.

Before the permit can be issued a Stormwater Management Plan (SWMP) must be developed by the applicant and approved by the City of Aurora. During the construction phase, routine inspections by the City of Aurora Water Department Erosion Control Program Staff will be conducted to ensure that the site complies with the permit.

4.6 Grading and Erosion Control Plans

A Stormwater Management Plan (SWMP) detailed drawings and report, which include the grading and erosion control plans, must be submitted and approved to receive the Stormwater Quality Discharge

Permit. The design of this report and drawing criteria can be referred in the City of Aurora's "*Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities*" handbook.

Compliance during Construction:

The Designer will identify this permit requirement in the design documents. SWMP must be approved prior to the issuance of the Stormwater Quality Discharge Permit for construction activities. The erosion control BMPs identified in the SWMP report and plans are the minimum required. The contractor is required to comply with the permit. The permit requirements should be included as elements in the Contractors SWMP for coverage under the CDPHE General Permit for Stormwater at Construction Sites.

4.7 Floodplain Development Permit

The Floodplain Development Permit is required for the pipeline since portions of the alignment will be constructed within the floodplain and will require temporary modifications (typically fill) to the floodplain itself. The process requires demonstration of no impact on the water surface level. This permit will be applicable to the pump station project if any construction occurs within the floodplain.

Compliance during Construction:

The contractor is responsible for verifying that there is zero net fill or cut within the floodplain and that no materials will be stockpiled within the floodplain.

4.8 Building Construction Documents

These documents will be submitted to the Public Works Department's Building Division. The typical submittal contains plans and calculations for structural, electrical, plumbing, mechanical, fire and life safety items. The review process can take up to 8 weeks.

4.9 Certificate of Occupancy (CO) or Temporary Certificate of Occupancy

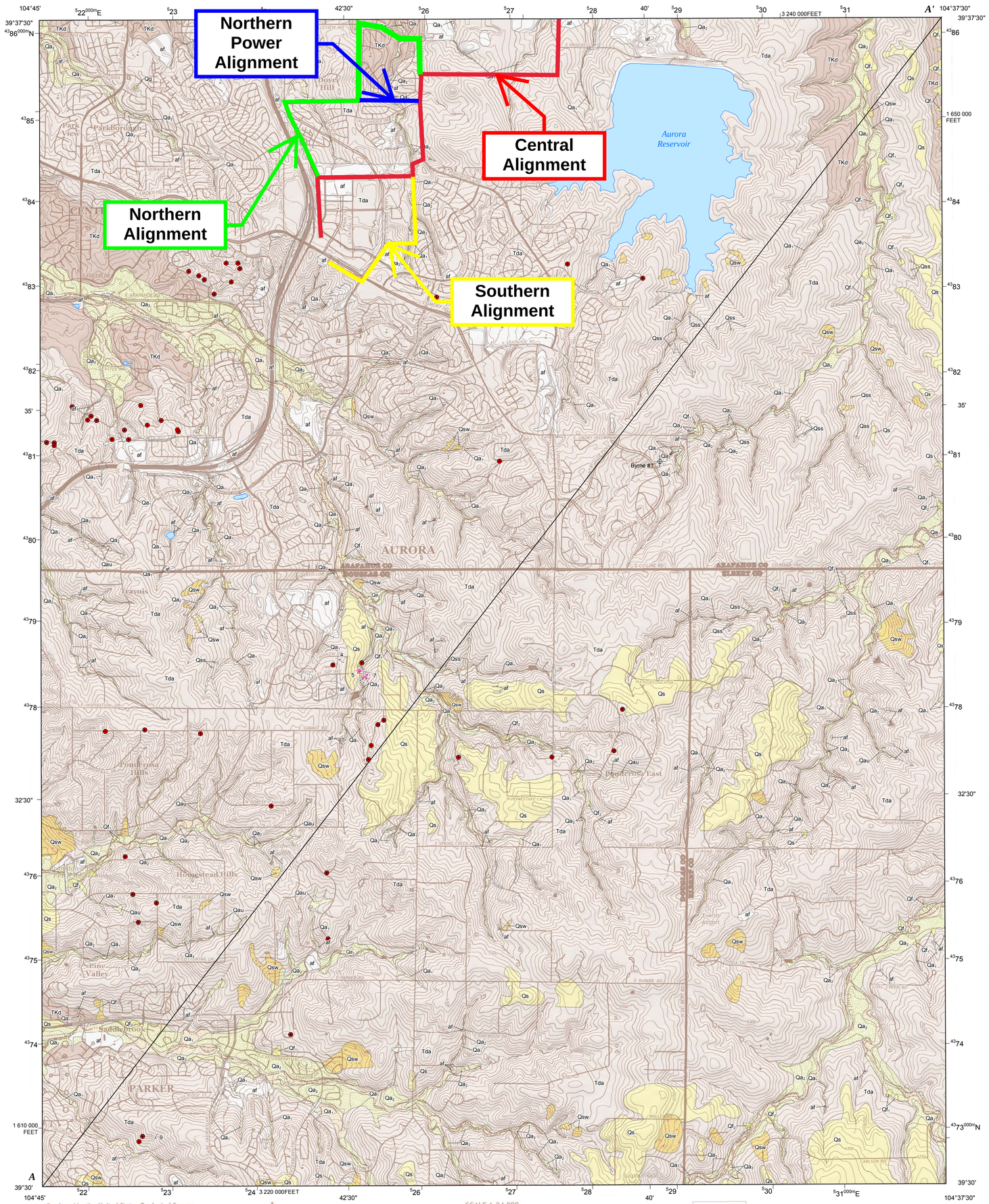
All temporary or final buildings and facilities require to have a Certificate of Occupancy that describes the approved uses for the building. Before receiving this Certificate of Occupancy (CO), inspections that include Storm Water Management Plan Inspections, Building Inspections, Public Improvement Inspections, and Zoning Inspections must be completed and passed to proceed. Prior to the start of construction, a pre-construction meeting is recommended to provide additional information on how the City of Aurora will interact with the contractors working on the projects.

5.0 Permit Acquisition Strategy

The schedule displaying permitting activities and durations will be developed when a project timeline is set. This schedule will include the acquisition of permits that will be obtained by the Designer, responsible parties for each step in the permitting process, and key milestones associated with the design and construction procurement processes.

Appendix D – Geological Map of the Piney Creek Quadrangle

COLORADO GEOLOGICAL SURVEY
COLORADO SCHOOL OF MINES
GOLDEN, COLORADO



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

HUMAN-MADE DEPOSITS

af — **Artificial fill (latest Holocene)** — Rip rap, engineered fill, and refuse placed during construction of roads, railroads, buildings, dams, and landfills. Generally consists of unsorted silt, sand, clay, and rock fragments. The average thickness of the unit is less than 20 feet. Artificial fill may be subject to settlement, slumping, and erosion if not adequately compacted. Extensive areas of artificial fill exist in the urbanized eastern half of the quadrangle. Accurate mapping of the actual extent of fill in these heavily developed areas was problematic and the mapped extents represent a conservative estimation.

ALLUVIAL DEPOSITS

Qa_1 — **Alluvium one (late Holocene)** — Tan to pale-brown, poorly to moderately sorted, poorly to moderately consolidated, sand, gravel, silt, and minor clay and sparse boulders in the currently active stream channels or in low stream-terrace deposits less than 5 feet higher than the current stream channel. Clasts are subrounded to well rounded and the dominant sediment is sandy gravel with a sandy silt matrix. The unit correlates with the post-Piney Creek alluvium described by Hunt (1954) in the Denver area and of Maberry and Lindvall (1972). Mapped extents of Qa_1 may include Qa_2 deposits of limited extent. The unit is subject to frequent flooding and is a source of sand and gravel. Maximum exposed thickness of the unit locally exceeds 5 feet.

Qa_2 — **Alluvium two (late Holocene) —** Dark-gray to brown, poorly to well-sorted, moderately to well-consolidated, silt, sand, gravel, and minor clay and sparse boulders in stream-terrace deposits approximately 6-12 feet higher than the modern flood plain or as non-terrace forming alluvium in valley headwaters. Clasts are subrounded to well rounded and the dominant sediment is sandy gravel with a silty sand matrix. Thinly-bedded (1-4 inches thick) clay seams are present in the lower parts of the unit. The unit is generally correlative, by virtue of height and soil characteristics, with the Piney Creek alluvium described by Hunt (1954) in the Denver area and of Maberry and Lindvall (1972). The unit is subject to occasional flooding and is a potential source of sand and gravel. Maximum exposed thickness of the unit locally exceeds 20 feet.

Qau — **Alluvial deposits, undivided (Holocene to late Pleistocene)** — Gray-brown to tan-brown, poorly sorted sand and fine gravel in valley heads in the upper parts of drainages and in main trunk streams where differentiation of specific alluvial units was not possible due to poor exposure. The unit includes sheetwash and stream-deposited alluvium that are undivided. The unit may be overlain by thin laminae of eolian sand. Maximum exposed thickness of the unit locally exceeds 15 feet.

Qf_1 — **Alluvial fan deposit one (late Holocene)** — Tan to pale-brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, and gravel deposited as alluvial fans at the mouths of perennial streams. Deposits have a fan-like shape and consist of subangular to well-rounded clasts of varied lithology that are derived from local surficial deposits; however, sand and gravel derived from the Dawson Arkose and Denver Formation are major constituents. These deposits are similar to and depositionally related to unit Qa_1. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. Deposits locally exceed 10 feet in thickness. Areas mapped as alluvial fans are subject to future flash floods and debris flow events. Deposits may be prone to collapse, hydrocompaction, or slope failure when wetted or loaded. Deposit is a potential source of sand and gravel.

Qf_2 — **Alluvial fan deposit two (late Holocene)** — Dark-gray to brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, and gravel deposited as alluvial fans at the mouths of perennial streams. Deposits consist of subangular to well-rounded clasts of varied lithology that are derived from local surficial deposits; however, sand and gravel derived from the Dawson Arkose and Denver Formation are major constituents. These deposits are similar to and depositionally related to unit Qa_2. They have a fan-like shape, but are more dissected than younger Qf_1 deposits. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. The apex of the fan is as much as 15 feet higher than modern streams. Deposit locally exceeds 15 feet in thickness. Areas mapped as alluvial fans are subject to future flash floods and debris flow events. Deposits may be prone to collapse, hydrocompaction, or slope failure when wetted or loaded. Deposit is a potential source of sand and gravel.

Qg — **Gravel deposits (Pleistocene)** — Yellowish-brown to grayish-brown, poorly sorted, pebble, cobble, and boulder gravel with a fine to coarse sand matrix. Clasts are subrounded to well rounded. Matrix typically consists of feldspar and quartz sand likely derived from the local bedrock. Clast types within the gravel are predominantly pink granite, white vein quartz, quartzite, and granitic gneiss, with lesser amounts of red sandstone, intermediate volcanic rocks, chert, and limestone. Top of the unit is 60 to 70 feet higher than main stem creeks. The unit is 10 to 15 feet in thickness. The deposit forms a stable building surface, but excavations may be prone to slumping. The unit is a potential source of sand and gravel.

Qsw — **Sheetwash alluvium (Holocene to late Pleistocene)** — Light-grayish-brown, pale-brown to brown, poorly sorted sand, silty and clayey sand, and minor amounts of gravel including some cobbles. Unit consists chiefly of local materials transported on moderate slopes (~10 percent grade) by sheet flow but also includes some sediment delivered by runoff in rills and minor gullies. Maximum exposed thickness is 20 feet.

EOLIAN DEPOSITS

Qs — **Eolian sand deposits (Holocene to late Pleistocene)** — Yellowish-brown to tan, fine- to coarse-grained, frosted sand and silt deposited by wind or sheetflow. Typically this unit is faintly stratified and non-cohesive; dune forms are not present. The lower, older parts of the unit are weakly cemented by calcium carbonate and can hold a face where recently excavated. The unit is likely deposited as a sand sheet by winds capable of moving granules and very small pebbles. These sand deposits are moderately compacted, easily excavated; however, they can hold surface water. This unit may be prone to hydrocompaction. Unit locally may exceed 10 feet in thickness.

MASS-WASTING DEPOSITS

Qss — **Soil slip deposits (Holocene)** — Areas where the surface soil has detached and migrated downhill, exposing bedrock within the detachment zone. The slip surfaces are typically parallel to the slope and less than 3 feet below the surface. These features commonly form where water seeps are exiting the slope causing the soil to become saturated and to flow under gravity. Areas mapped as soil slips are prone to future movement if saturated by runoff or precipitation. Thickness of soil slip deposits is typically less than 5 feet.

BEDROCK

Denver Basin Group

Tda — **Dawson Arkose (Paleocene to Eocene)** — White and tan, thick to massive, cross-bedded arkoses, pebbly arkoses, and arkosic pebble-cobble conglomerates. Contains beds of white and tan fine- to medium-grained feldspathic cross-bedded friable sandstone that is poorly sorted, has high clay contents, and is commonly thin or medium bedded. The unit also contains sparse interbeds of thin-bedded gray claystone and sandy claystone or dark-brown, organic-rich siltstone to coarse sandstone. The interbeds contain fossilized plant fragments. Two- to five-foot thick zones of pebble-cobble conglomerate consist of rounded to subrounded clasts of granite and milky quartz with lesser amounts of gneiss, red sandstone, grayish-blue quartzite, and intermediate volcanic rocks. Thickness of the Dawson Arkose may reach 1000 feet in the Monument area; however, the exposed thickness in the Piney Creek quadrangle is approximately 530 feet. The unit is prone to swelling when wet. Residuum is commonly developed on the surface of the Dawson Arkose; residuum was not mapped due to poor exposures and variations in thickness. The Dawson Arkose is described in detail by Thorson (2011).

Within the Piney Creek quadrangle, the Dawson Arkose is separated from the underlying Denver Formation by a distinct zone of gray to pink to dark red clays up to 40 feet thick, interpreted to represent a paleosurface of soil formation which also approximates the Paleocene—Eocene boundary (Raynolds, 2002; Thorson and Madole, 2002; Thorson, 2003). The distinctly different weathered colors and clay-rich content between the coarser grained Dawson Arkose and the finer grained Denver Formation make this zone recognizable. This zone also contains abundant root casts, has a distinct mottled and banded character, and has economic use as brick-making clay. A pollen sample identified as *Momipites wyomingensis* (Brosipollis sp.) (J. O'Keefe, Morehead State Univ., personal commun., 2015) was collected near the base of the paleosol at UTM location N525,908.80 E4,385,158.92 and is likely indicative of pollen zone P6 (uppermost Paleocene).

Bryant and others (1981) described two crystal tuff locations within the northeastern and northwestern parts of the mapped area; the most reliable age date as determined from biotite yielded a late Paleocene-early Eocene age of 56.5 +/- 1.9 Ma.

TKd — **Denver Formation (Upper Cretaceous to Paleocene)** — The Denver Formation consists of tan, brown, and gray cross-bedded arkosic sandstone and greenish-gray sandy claystone. The sandstones are poorly sorted and contain abundant clay. They can be thin or medium bedded with ripple cross laminations. Some zones below the paleosol contain discontinuous pebbly conglomerate lenses of pink granite and vein quartz that are commonly less than 1 foot thick and typically weather out of deteriorated outcrops. Exposed thickness in the mapped area is less than 130 feet.

Kl — **Laramie Formation (Upper Cretaceous)** — Shown on cross section only

Kfh — **Fox Hills Sandstone (Upper Cretaceous)** — Shown on cross section only

Kp — **Pierre Shale (Upper Cretaceous)** — Shown on cross section only

Contact—Approximately located

5 — **Strike and dip of inclined bedding**—Showing direction and angle of dip

Conglomeratic sandstone lenses—Zones of coarse gravel and cobbles within the Dawson Arkose that represent high-discharge flooding events

Well—Plugged and abandoned

Anticlinal fold axis—Approximately located and queried

A ——A′ — **Alignment of cross section**

References

Bryant, Bruce, McGrew, L.W., and Wobus, R.A., 1981, Geologic map of the Denver 1° x 2° quadrangle, north-central Colorado: U.S. Geological Survey Miscellaneous Investigations Series Map I-1163.

Hunt, C.B., 1954, Pleistocene and recent deposits in the Denver area, Colorado: U.S. Geological Survey Bulletin 996-G, p. 91-140.

Maberry, J.O., and Lindvall, R.M., 1972, Geologic map of the Parker quadrangle, Arapahoe and Douglas Counties, Colorado: U.S. Geological Survey Miscellaneous Investigation Series Map I-770-A, scale 1:24,000.

Raynolds, R.G., 2002, Upper Cretaceous and Tertiary stratigraphy of the Denver Basin, Colorado: Rocky Mountain Geology, v. 37, p. 111–134.

Thorson, J.P. and Madole, R.F., 2002, Geologic map of the Monument quadrangle, El Paso County, Colorado: Colorado Geological Survey Open-File Report 02-04, scale 1:24,000.

Thorson, J.P., 2003, Geologic map of the Black Forest quadrangle, El Paso County, Colorado, Colorado Geological Survey Open-File Report 03-06, scale 1:24,000.

Thorson, J.P., 2011, Geology of Upper Cretaceous, Paleocene, and Eocene strata in the southwestern Denver Basin, Colorado: Colorado Geological Survey, 3 plates, scale 1:50,000.

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COLORADO GEOLOGICAL SURVEY
COLORADO SCHOOL OF MINES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 13S
10 000-foot ticks: Colorado Coordinate System of 1983 (central zone)

Imagery.....NAIP, July 2011
Roads.....©2006-2012 TomTom
Names.....GNIS, 2013
Hydrography.....National Hydrography Dataset, 2011
Contours.....National Elevation Dataset, 2009
Boundaries.....Census, IBWC, IBC, USGS, 1972 - 2012
Public Land Survey System.....BLM, 2011

UTM GRID AND 2013 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
ED
Grid Zone Designation
13S

SCALE 1:24 000

1 KILOMETERS 0.5 0 1 2
1000 500 0 METERS 1000 2000
1 MILES 0.5 0 1
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

QUADRANGLE LOCATION
COLORADO

ADJOINING 7.5' QUADRANGLES
Fitzsimons | Coal Creek | Watkins
Parker | Piney Creek | Watkins SE
Castle Rock North | Ponderosa Park | Cabins Gulch

This mapping project was funded jointly by the Colorado Geological Survey and the U.S. Geological Survey through the National Cooperative Geologic Mapping Program under STATEMAP agreement number G14AC00220

GEOLOGIC MAP OF THE PINEY CREEK QUADRANGLE, ARAPAHOE, DOUGLAS, AND ELBERT COUNTIES, COLORADO

By Matthew L. Morgan

2015

Appendix E – Northern Power Alignment Class 4 Cost Estimate

Northern Power Class 4 Cost Estimate

Assumptions and Clarifications

No Dewatering
Pipe pricing per NWPipe budget quote received 6/26/2018
CARV, Blow off and Isolation valve and vault quantification provided by engineer. Pricing taken from averages across Ridgegate bid received
Estimate is based on assumed alignment based on rough aerial image. No drawings or specs provided for this estimate.
Estimate is considered a Class 4 -30% to +50%
No Hazardous material
No permit costs included.
No Contingency has been applied to the estimate.
No design for cathodic protection. Costs carried in estimate are database driven. Quantification discussed with engineer.
Asphalt depths assummed to be 4" thick over 6" aggregate base material.

Estimate Summary

Description	Amount	Totals	Hours	Rate
Labor	1,383,386		27,523.305 hrs	
Material	7,857,216			
Subcontract	1,915,749			
Equipment	1,303,318		20,686.575 hrs	
Other	324,000			
Total Before Markups	**12,783,669**	**12,783,669**		
Existing Conditions OH&P	606			10.000 %
Concrete Work OH&P				10.000 %
Masonry Work OH&P				10.000 %
Metals Work OH&P				10.000 %
Architectural (Div 6-12) OH&P				10.000 %
Mechanical Work OH&P				10.000 %
Electrical Work OH&P				10.000 %
Site/Civil OH&P	149,212			10.000 %
Buried Piping OH&P	1,128,549			10.000 %
Process Piping OH&P				10.000 %
Instruments & Controls OH&P				10.000 %
Material Handling OH&P				10.000 %
Process Equipment OH&P				10.000 %
Total Subcontractor OH&P	**1,278,367**	**14,062,036**		
Concrete GC's				
Architectural GC's				
Mech_Plumbing GCs				
Electrical GC's				
Site/Civil GC's				
Buried Piping GC's				
I&C GC's				
Process Piping GC's				
Process Equipment GC's				
Total Subcontracto GC's		**14,062,036**		
Blder's Risk & Gen Liab Ins -%	154,489			1.000 %
CCI Payment & Performance Bond	150,936			0.977 %
Total Bonds and Insurances	**305,425**	**14,367,461**		
Escalation				
Total Escalation		**14,367,461**		
Contingency - %	$ -			

Description	Amount	Totals	Hours	Rate
Total Contingency		**14,367,461**		
Markup	1,081,422			7.000 %
Total	**1,081,422**	**15,448,883**		
Preliminary Engineering				
Final Engineering and Precon				
SDC - Construction Management				
Total Design		**15,448,883**		
Total		***15,448,883***		

Bid Item	WorkActiv	Description	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount	Grand Total Unit Price	Grand Total
1		**Mobilization and General Conditions**										
	Mobilization	Mobilization and General Conditions										
		Mobilization: Excavator, Large	2.00 ea	$ 1,015.00			$ 1,834.00		$ 1,424.66 /ea	$ 2,849.00	$ 1,721.68 /ea	$ 3,443.00
		Mobilization: Excavator, Small	1.00 ea	$ 304.00			$ 550.00		$ 854.79 /ea	$ 855.00	$ 1,033.00 /ea	$ 1,033.00
		Mobilization: Loader, Large	1.00 ea	$ 507.00			$ 917.00		$ 1,424.66 /ea	$ 1,425.00	$ 1,721.68 /ea	$ 1,722.00
		Mobilization: Loader, Medium	1.00 ea	$ 406.00			$ 734.00		$ 1,139.73 /ea	$ 1,140.00	$ 1,377.35 /ea	$ 1,377.00
		Mobilization: Dozer, Medium	1.00 ea	$ 406.00			$ 734.00		$ 1,139.73 /ea	$ 1,140.00	$ 1,377.35 /ea	$ 1,377.00
		Mobilization: Dozer, Small	1.00 ea	$ 304.00			$ 550.00		$ 854.79 /ea	$ 855.00	$ 1,033.00 /ea	$ 1,033.00
		Mobilization: Blade, Medium	1.00 ea	$ 304.00			$ 550.00		$ 854.79 /ea	$ 855.00	$ 1,033.00 /ea	$ 1,033.00
		Mobilization: Compactor, Medium	1.00 ea	$ 304.00			$ 550.00		$ 854.79 /ea	$ 855.00	$ 1,033.01 /ea	$ 1,033.00
		Mobilization: Water Truck	1.00 ea	$ 304.00			$ 550.00		$ 854.79 /ea	$ 855.00	$ 1,033.00 /ea	$ 1,033.00
		Mobilization: Water Tank	1.00 ea	$ 304.00			$ 550.00		$ 854.79 /ea	$ 855.00	$ 1,033.00 /ea	$ 1,033.00
		Misc. Supplies	12.00 mo		$ 1,800.00				$ 150.00 /mo	$ 1,800.00	$ 181.27 /mo	$ 2,175.00
		Conex Containers	24.00 mo				$ 4,800.00		$ 200.00 /mo	$ 4,800.00	$ 241.70 /mo	$ 5,801.00
		Mobile Phone	12.00 mo		$ 1,800.00				$ 150.00 /mo	$ 1,800.00	$ 181.27 /mo	$ 2,175.00
		Portable Toilets	12.00 mo			$ 1,500.00			$ 125.00 /mo	$ 1,500.00	$ 151.06 /mo	$ 1,813.00
		Pipeline Superintendent	12.00 mo	$ 135,197.00					$ 11,266.45 /mo	$ 135,197.00	$ 13,615.34 /mo	$ 163,384.00
		Drug Tests	5.00 ea			$ 375.00			$ 75.00 /ea	$ 375.00	$ 90.64 /ea	$ 453.00
		Safety Equipment - Project	1.00 ls		$ 6,382.00				$ 6,381.50 /ls	$ 6,382.00	$ 7,711.95 /ls	$ 7,712.00
		Safety Equipment - Per Worker	25.00 ea		$ 3,750.00				$ 150.00 /ea	$ 3,750.00	$ 181.27 /ea	$ 4,532.00
		First Aid Consumables	12.00 mo		$ 3,000.00				$ 250.00 /mo	$ 3,000.00	$ 302.12 /mo	$ 3,625.00
		Safety Supervisor	4.00 wk	$ 754.00			$ 349.00		$ 275.60 /wk	$ 1,102.00	$ 333.06 /wk	$ 1,332.00
		Dumpster Rental	12.00 mo		$ 2,400.00				$ 200.00 /mo	$ 2,400.00	$ 241.70 /mo	$ 2,900.00
		Dumpster Pulls	24.00 ea		$ 7,200.00				$ 300.00 /ea	$ 7,200.00	$ 362.55 /ea	$ 8,701.00
		Final Clean-up	1.00 ea	$ 9,900.00	$ 1,000.00				$ 10,900.00 /ea	$ 10,900.00	$ 13,172.50 /ea	$ 13,173.00
		Mobilization Mobilization and General Conditions		**$ 150,012.00**	**$ 27,332.00**	**$ 1,875.00**	**$ 12,670.00**		**/LS**	**$ 191,888.00**	**/LS**	**$ 231,895.00**
		1 Mobilization and General Conditions	**1.00 LS**	**$ 150,012.00**	**$ 27,332.00**	**$ 1,875.00**	**$ 12,670.00**		**$ 191,888.48 /LS**	**$ 191,888.00**	**$ 231,894.50 /LS**	**$ 231,895.00**
2		**Erosion Control**										
	42'- Sloped	Install in sloped area of E-470										
		Silt Fence, Heavy-Duty, Subcontracted	5,700.00 lf			$ 17,100.00			$ 3.00 /lf	$ 17,100.00	$ 3.63 /lf	$ 20,665.00
		Stabilized Construction Entrance, Clean Rock, 1-1/2" thru 3"	633.33 tn	$ 4,421.00	$ 15,833.00		$ 6,260.00		$ 41.87 /tn	$ 26,515.00	$ 50.59 /tn	$ 32,043.00
		Filter Fabric under Stabilized Construction Entrance	791.67 sy		$ 1,465.00				$ 1.85 /sy	$ 1,465.00	$ 2.24 /sy	$ 1,770.00
		42'- Sloped Install in sloped area of E-470		**$ 4,421.00**	**$ 17,298.00**	**$ 17,100.00**	**$ 6,260.00**		**/LS**	**$ 45,079.00**	**/LS**	**$ 54,478.00**
	42'-Open	Install in open easement										
		Silt Fence, Heavy-Duty, Subcontracted	20,080.00 lf			$ 60,240.00			$ 3.00 /lf	$ 60,240.00	$ 3.63 /lf	$ 72,799.00
		Stabilized Construction Entrance, Clean Rock, 1-1/2" thru 3"	2,231.11 tn	$ 15,576.00	$ 55,778.00		$ 22,053.00		$ 41.87 /tn	$ 93,406.00	$ 50.59 /tn	$ 112,880.00
		Filter Fabric under Stabilized Construction Entrance	2,788.89 sy		$ 5,159.00				$ 1.85 /sy	$ 5,159.00	$ 2.24 /sy	$ 6,235.00
		42'-Open Install in open easement		**$ 15,576.00**	**$ 60,937.00**	**$ 60,240.00**	**$ 22,053.00**		**/LF**	**$ 158,805.00**	**/LF**	**$ 191,914.00**
		2 Erosion Control	**1.00 LS**	**$ 19,997.00**	**$ 78,235.00**	**$ 77,340.00**	**$ 28,313.00**		**$ 203,884.48 /LS**	**$ 203,884.00**	**$ 246,391.49 /LS**	**$ 246,391.00**
3		**Site Preparation and Grading**										
	42'- Sloped	Install in sloped area of E-470										
		Strip and Haul Topsoil, Dozer and Traxcavator, Small Crew	3,483.33 cy	$ 1,853.00			$ 1,664.00		$ 1.01 /cy	$ 3,517.00	$ 1.22 /cy	$ 4,250.00
		Regrade slope following pipe installation	3,800.00 cy	$ 9,310.00			$ 7,863.00		$ 4.52 /cy	$ 17,173.00	$ 5.46 /cy	$ 20,753.00
		Excavation to establish bench	3,800.00 cy	$ 2,022.00			$ 1,815.00		$ 1.01 /cy	$ 3,836.00	$ 1.22 /cy	$ 4,636.00
		42'- Sloped Install in sloped area of E-470		**$ 13,184.00**			**$ 11,342.00**		**/LS**	**$ 24,526.00**	**/LS**	**$ 29,640.00**
	42'-Open	Install in open easement										
		Strip and Haul Topsoil, Dozer and Traxcavator, Small Crew	12,271.11 cy	$ 6,528.00			$ 5,861.00		$ 1.01 /cy	$ 12,389.00	$ 1.22 /cy	$ 14,972.00
		42'-Open Install in open easement		**$ 6,528.00**			**$ 5,861.00**		**/LF**	**$ 12,389.00**	**/LF**	**$ 14,972.00**
	Demo	Demolition										
		Saw Cutting, Ashpalt, 4" Depth	588.00 lf			$ 1,029.00			$ 1.75 /lf	$ 1,029.00	$ 2.11 /lf	$ 1,244.00
		Saw Cutting, Concrete Curb / Paving , 6" Depth	10.00 lf			$ 35.00			$ 3.50 /lf	$ 35.00	$ 4.23 /lf	$ 42.00
		Asphalt Demolition and Loading	100.00 cy	$ 119.00			$ 115.00		$ 2.34 /cy	$ 234.00	$ 2.82 /cy	$ 282.00
		Concrete Curb Demolition and Loading	198.00 lf	$ 368.00			$ 355.00		$ 3.65 /lf	$ 723.00	$ 4.41 /lf	$ 874.00
		Concrete Sidewalk Demolition and Loading	100.00 cy	$ 119.00			$ 115.00		$ 2.34 /cy	$ 234.00	$ 2.82 /cy	$ 282.00
		Haul Site Demolition Spoils, 12 yd capacity, 20 miles RT, priced per cy	200.00 cy	$ 405.00			$ 898.00		$ 6.51 /cy	$ 1,303.00	$ 7.87 /cy	$ 1,574.00
		Dump Charges for Site Demolition Spoils, 12 yd tandem, priced per cy	200.00 cy		$ 2,500.00				$ 12.50 /cy	$ 2,500.00	$ 15.11 /cy	$ 3,021.00
		Demo Demolition		**$ 1,011.00**	**$ 2,500.00**	**$ 1,064.00**	**$ 1,482.00**			**$ 6,057.00**		**$ 7,320.00**
		3 Site Preparation and Grading	**1.00 LS**	**$ 20,723.00**	**$ 2,500.00**	**$ 1,064.00**	**$ 18,685.00**		**$ 42,972.02 /LS**	**$ 42,972.00**	**$ 51,931.07 /LS**	**$ 51,931.00**
4		**Traffic Control**										
	42'- Sloped	Install in sloped area of E-470										
		Traffic Control Supervisor	79.80 day	$ 30,643.00					$ 384.00 /day	$ 30,643.00	$ 464.06 /day	$ 37,032.00
		Road Work Ahead, 48x48 (Total Sign Days)	319.20 ea		$ 798.00				$ 2.50 /ea	$ 798.00	$ 3.02 /ea	$ 964.00
		Flashing Lite Boxes (Total Lite Days)	1,596.00 ea		$ 559.00				$ 0.35 /ea	$ 559.00	$ 0.42 /ea	$ 675.00
		Jersey Barriers (Rental and Install)	5,700.00 lf	$ 42,750.00			$ 158,061.00		$ 35.23 /lf	$ 200,811.00	$ 42.57 /lf	$ 242,677.00
		Jersey Barriers (Removal)	5,700.00 lf	$ 42,750.00					$ 7.50 /lf	$ 42,750.00	$ 9.06 /lf	$ 51,663.00

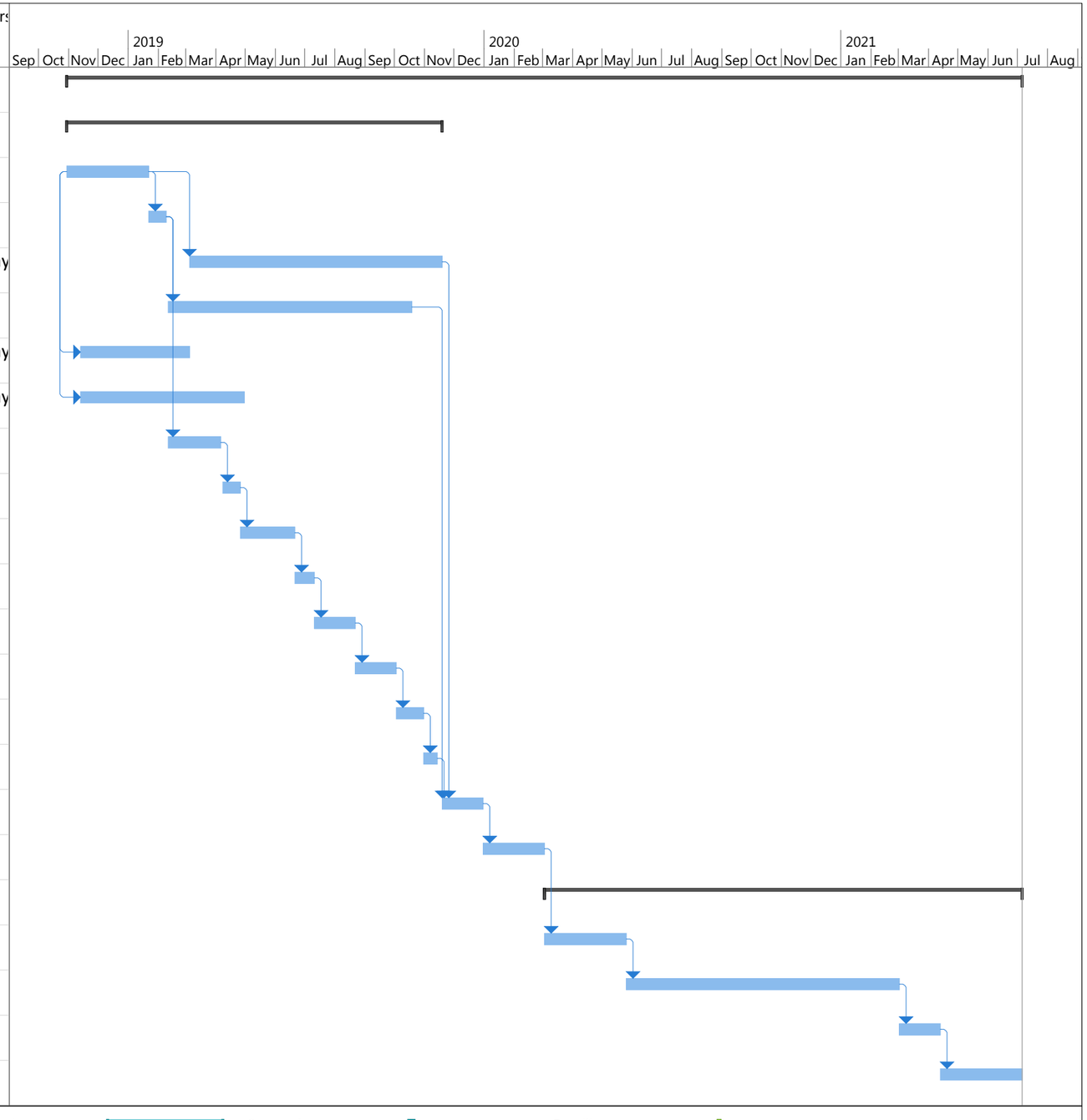
Bid Item	WorkActiv	Description	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount	Grand Total Unit Price	Grand Total
		42'- Sloped Install in sloped area of E-470	1.00 LS	$ 116,143.00	$ 1,357.00		$ 158,061.00		$ 275,560.80 /LS	$ 275,561.00	$ 333,011.31 /LS	$ 333,011.00
	42'-Open Rd Xings	Install in Road Crossings - CLSM Backfill										
		Flagger	30.00 day	$ 5,472.00					$ 182.40 /day	$ 5,472.00	$ 220.43 /day	$ 6,613.00
		Traffic Control Supervisor	15.00 day	$ 5,760.00					$ 384.00 /day	$ 5,760.00	$ 464.06 /day	$ 6,961.00
		Keep Right w/stand, 18x24 (Total Sign Days)	30.00 ea		$ 45.00				$ 1.50 /ea	$ 45.00	$ 1.81 /ea	$ 54.00
		Road Work Ahead, 48x48 (Total Sign Days)	60.00 ea		$ 150.00				$ 2.50 /ea	$ 150.00	$ 3.02 /ea	$ 181.00
		Rt/Lt Lane Closed ahead, 48x49 (Total Sign Days)	30.00 ea		$ 75.00				$ 2.50 /ea	$ 75.00	$ 3.02 /ea	$ 91.00
		Rt/Lt Lane Transition / Merge / Turkey track, 48x50 (Total Sign Days)	30.00 ea		$ 75.00				$ 2.50 /ea	$ 75.00	$ 3.02 /ea	$ 91.00
		Flagger Symbol, 48x51 (Total Sign Days)	30.00 ea		$ 75.00				$ 2.50 /ea	$ 75.00	$ 3.02 /ea	$ 91.00
		Type 3 Barricade (Total Sign Days)	60.00 ea		$ 150.00				$ 2.50 /ea	$ 150.00	$ 3.02 /ea	$ 181.00
		42'-Open Rd Xings Install in Road Crossings - CLSM Backfill	1.00 LS	$ 11,232.00	$ 570.00				$ 11,802.00 /LS	$ 11,802.00	$ 14,262.55 /LS	$ 14,263.00
		4 Traffic Control	**1.00 LS**	**$ 127,375.00**	**$ 1,927.00**		**$ 158,061.00**		**$ 287,362.80 /LS**	**$ 287,363.00**	**$ 347,273.86 /LS**	**$ 347,274.00**
5		**Restoration Items**										
	42'- Sloped	Install in sloped area of E-470										
		Topsoil replacement including fine grade Topsoil replacement including fine grac	3,483.33 cy	$ 7,460.00			$ 6,169.00		$ 3.91 /cy	$ 13,629.00	$ 4.73 /cy	$ 16,470.00
		Permanent Seed and Mulch	6.54 acre			$ 16,360.00			$ 2,500.00 /acre	$ 16,360.00	$ 3,021.21 /acre	$ 19,771.00
		Permanent Erosion and Retention Blanket	31,666.67 sy			$ 63,333.00			$ 2.00 /sy	$ 63,333.00	$ 2.42 /sy	$ 76,537.00
		42'- Sloped Install in sloped area of E-470		$ 7,460.00		$ 79,693.00	$ 6,169.00		/LS	$ 93,322.00	/LS	$ 112,778.00
	42'-Open	Install in open easement										
		Topsoil replacement including fine grade Topsoil replacement including fine grac	12,271.09 cy	$ 26,280.00			$ 21,731.00		$ 3.91 /cy	$ 48,011.00	$ 4.73 /cy	$ 58,020.00
		Permanent Seed and Mulch	23.05 acre			$ 57,630.00			$ 2,500.00 /acre	$ 57,630.00	$ 3,021.21 /acre	$ 69,645.00
		42'-Open Install in open easement		$ 26,280.00		$ 57,630.00	$ 21,731.00		/LF	$ 105,641.00	/LF	$ 127,665.00
	Surf Imp	Surface Improvement Restoration										
		Roadway base course, crushed 1-1/2" stone, compacted to 6" deep	105.00 tn	$ 139.00	$ 2,684.00		$ 431.00		$ 31.00 /tn	$ 3,255.00	$ 37.46 /tn	$ 3,934.00
		Bituminous Pavement Subgrade Prep	350.00 sy			$ 700.00			$ 2.00 /sy	$ 700.00	$ 2.42 /sy	$ 846.00
		Bituminous Asphalt (sy - 4")	350.00 sy			$ 9,800.00			$ 28.00 /sy	$ 9,800.00	$ 33.84 /sy	$ 11,843.00
		Concrete Curbs	200.00 lf			$ 3,600.00			$ 18.00 /lf	$ 3,600.00	$ 21.75 /lf	$ 4,351.00
		Concrete Sidewalk Subgrade Prep	3,112.00 tn			$ 6,224.00			$ 2.00 /tn	$ 6,224.00	$ 2.42 /tn	$ 7,522.00
		Concrete Sidewalk Import Aggregate Base	933.60 tn			$ 28,942.00			$ 31.00 /tn	$ 28,942.00	$ 37.46 /tn	$ 34,976.00
		Concrete Sidewalk (5")	3,112.00 sf			$ 18,672.00			$ 6.00 /sf	$ 18,672.00	$ 7.25 /sf	$ 22,565.00
		Surf Imp Surface Improvement Restoration		$ 139.00	$ 2,684.00	$ 67,938.00	$ 431.00			$ 71,193.00		$ 86,035.00
		5 Restoration Items	**1.00 LS**	**$ 33,879.00**	**$ 2,684.00**	**$ 205,261.00**	**$ 28,331.00**		**$ 270,155.05 /LS**	**$ 270,155.00**	**$ 326,478.52 /LS**	**$ 326,479.00**
6		**42" Welded Steel Pipe**										
	42'- Deep 15'	Install Deep Due to Utility Conflicts At Pump House Location										
		Utility Pot Hole	10.00 ea	$ 1,805.00			$ 917.00		$ 272.16 /ea	$ 2,722.00	$ 328.91 /ea	$ 3,289.00
		Bedding Stone, Material Only	852.47 tn		$ 21,312.00				$ 25.00 /tn	$ 21,312.00	$ 30.21 /tn	$ 25,755.00
		Load Excess Spoils for Off-Site Hauling, Excavator, Cat 330	791.00 cy	$ 161.00			$ 468.00		$ 0.80 /cy	$ 630.00	$ 0.96 /cy	$ 761.00
		Haul Excess Spoils Off-Site, 17 yd capacity, 10 miles RT	791.00 cy	$ 740.00			$ 2,077.00		$ 3.56 /cy	$ 2,817.00	$ 4.30 /cy	$ 3,404.00
		Excess Spoils Dump Charges for 17 yd end dumps, per cy	791.00 cy		$ 8,147.00				$ 10.30 /cy	$ 8,147.00	$ 12.45 /cy	$ 9,846.00
		42" CS pipe Class 300 - NWP Quote - CML - Single lap after backfill	653.00 LF	$ 17,031.00	$ 157,373.00		$ 32,134.00		$ 316.29 /LF	$ 206,538.00	$ 382.23 /LF	$ 249,598.00
		42" CS Ell, 45	1.00 ea	$ 326.00	$ 3,900.00		$ 615.00		$ 4,841.14 /ea	$ 4,841.00	$ 5,850.44 /ea	$ 5,850.00
		42" CS bell & spigot weld	34.65 ea			$ 30,631.00			$ 884.00 /ea	$ 30,631.00	$ 1,068.30 /ea	$ 37,017.00
		Tape wrap joint, 42" pipe	25.00 ea	$ 1,944.00					$ 77.75 /ea	$ 1,944.00	$ 93.96 /ea	$ 2,349.00
		Grout joint, I.D., 42" pipe	40.00 ea	$ 9,256.00	$ 880.00				$ 253.40 /ea	$ 10,136.00	$ 306.24 /ea	$ 12,249.00
		42" CS Magnetic Particle Testing	34.65 ea			$ 18,279.00			$ 527.52 /ea	$ 18,279.00	$ 637.50 /ea	$ 22,089.00
		Unload and Spread Pipe	653.00 lf	$ 283.00			$ 411.00		$ 1.06 /lf	$ 694.00	$ 1.28 /lf	$ 839.00
		Add for Obstructions	10.00 ea	$ 815.00	$ 7,500.00		$ 1,538.00		$ 985.29 /ea	$ 9,853.00	$ 1,190.70 /ea	$ 11,907.00
		Add for tie-in to existing (Adjust productivity)	1.00 ea	$ 2,608.00	$ 50,000.00		$ 4,921.00		$ 57,529.11 /ea	$ 57,529.00	69,523.12 /ea	$ 69,523.00
		Pipe Marking, ID Tape	653.00 lf	$ 378.00	$ 85.00				$ 0.71 /lf	$ 463.00	$ 0.86 /lf	$ 559.00
		42'- Deep 15' Install Deep Due to Utility Conflicts At Pump House I	653.00 LF	$ 35,347.00	$ 249,197.00	$ 48,909.00	$ 43,082.00		$ 576.62 /LF	$ 376,534.00	$ 696.84 /LF	$ 455,036.00
	42'- Sloped	Install in sloped area of E-470										
		Utility Pot Hole	17.10 ea	$ 3,086.00			$ 1,568.00		$ 272.16 /ea	$ 4,654.00	$ 328.90 /ea	$ 5,624.00
		Bedding Stone, Material Only	7,441.17 tn		$ 186,029.00				$ 25.00 /tn	$ 186,029.00	$ 30.21 /tn	$ 224,814.00
		Load Excess Spoils for Off-Site Hauling, Excavator, Cat 330	6,908.00 cy	$ 1,408.00			$ 4,091.00		$ 0.80 /cy	$ 5,500.00	$ 0.96 /cy	$ 6,646.00
		Haul Excess Spoils Round Robin, 12 yd capacity, 5 miles RT	5,016.00 cy	$ 5,456.00			$ 12,107.00		$ 3.50 /cy	$ 17,563.00	$ 4.23 /cy	$ 21,225.00
		Haul Excess Spoils Off-Site, 12 yd capacity, 10 miles RT	6,908.00 cy	$ 8,946.00			$ 19,849.00		$ 4.17 /cy	$ 28,795.00	$ 5.04 /cy	$ 34,798.00
		Excess Spoils Dump Charges for 12 yd tandem, per cy	6,908.00 cy		$ 86,350.00				$ 12.50 /cy	$ 86,350.00	$ 15.11 /cy	$ 104,353.00
		42" CS pipe Class 300 - NWP Quote - CML - Single lap after backfill	5,700.00 LF	$ 86,712.00	$ 1,373,700.00		$ 163,614.00		$ 284.92 /LF	$ 1,624,026.00	$ 344.32 /LF	$ 1,962,613.00
		42" CS Ell, 90	1.00 ea	$ 326.00	$ 7,180.00		$ 615.00		$ 8,121.14 /ea	$ 8,121.00	$ 9,814.30 /ea	$ 9,814.00
		42" CS Ell, 11.25	3.00 ea	$ 978.00	$ 5,550.00		$ 1,845.00		$ 2,791.14 /ea	$ 8,373.00	$ 3,373.05 /ea	$ 10,119.00
		42" mechanical coupling, 150#	2.00 ea	$ 672.00	$ 840.00		$ 1,267.00		$ 1,389.38 /ea	$ 2,779.00	$ 1,679.04 /ea	$ 3,358.00
		42" CS bell & spigot weld	293.00 ea			$ 259,012.00			$ 884.00 /ea	$ 259,012.00	$ 1,068.30 /ea	$ 313,012.00
		Tape wrap joint, 42" pipe	50.00 ea	$ 3,887.00					$ 77.75 /ea	$ 3,887.00	$ 93.96 /ea	$ 4,698.00
		Grout joint, I.D., 42" pipe	50.00 ea	$ 11,570.00	$ 1,100.00				$ 253.40 /ea	$ 12,670.00	$ 306.24 /ea	$ 15,312.00
		42" CS Magnetic Particle Testing	293.00 ea			$ 154,563.00			$ 527.52 /ea	$ 154,563.00	$ 637.50 /ea	$ 186,788.00
		Unload and Spread Pipe	5,700.00 lf	$ 3,505.00			$ 4,608.00		$ 1.42 /lf	$ 8,113.00	$ 1.72 /lf	$ 9,805.00

Bid Item	WorkActiv	Description	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount	Grand Total Unit Price	Grand Total
		Add for Obstructions	17.10 ea	$ 1,394.00	$ 12,825.00		$ 2,630.00		$ 985.29 /ea	$ 16,848.00	$ 1,190.70 /ea	$ 20,361.00
		Add for tie-in to existing (Adjust productivity)	1.00 ea	$ 2,608.00	$ 50,000.00		$ 4,921.00		$ 57,529.11 /ea	$ 57,529.00	$ 69,523.12 /ea	$ 69,523.00
		Pipe Marking, ID Tape	5,700.00 lf	$ 3,298.00	$ 741.00				$ 0.71 /lf	$ 4,039.00	$ 0.86 /lf	$ 4,881.00
		42'- Sloped Install in sloped area of E-470	**5,700.00 LS**	**$ 133,847.00**	**$ 1,724,315.00**	**$ 413,575.00**	**$ 217,115.00**		**$ 436.64 /LS**	**$ 2,488,853.00**	**$ 527.67 /LS**	**$ 3,007,743.00**
	42'-Open	**Install in open easement**										
		Utility Pot Hole	60.00 ea	$ 10,829.00			$ 5,501.00		$ 272.16 /ea	$ 16,330.00	$ 328.90 /ea	$ 19,734.00
		Bedding Stone, Material Only	25,021.00 tn		$ 625,525.00				$ 25.00 /tn	$ 625,525.00	$ 30.21 /tn	$ 755,938.00
		Load Excess Spoils for Off-Site Hauling, Excavator, Cat 330	23,229.00 cy	$ 4,736.00			$ 13,758.00		$ 0.80 /cy	$ 18,494.00	$ 0.96 /cy	$ 22,349.00
		Haul Excess Spoils Off-Site, 17 yd capacity, 10 miles RT	23,229.00 cy	$ 21,731.00			$ 60,988.00		$ 3.56 /cy	$ 82,719.00	$ 4.30 /cy	$ 99,965.00
		Excess Spoils Dump Charges for 17 yd end dumps, per cy	23,229.00 cy		$ 239,259.00				$ 10.30 /cy	$ 239,259.00	$ 12.45 /cy	$ 289,141.00
		42" CS pipe Class 300 - NWP Quote - CML - Single lap after backfill	19,167.00 LF	$ 156,215.00	$ 4,025,070.00		$ 294,755.00		$ 233.53 /LF	$ 4,476,040.00	$ 282.22 /LF	$ 5,409,231.00
		42" CS Ell, 90	7.00 ea	$ 2,282.00	$ 50,260.00		$ 4,306.00		$ 8,121.14 /ea	$ 56,848.00	$ 9,814.28 /ea	$ 68,700.00
		42" CS Ell, 22.5	1.00 ea	$ 326.00	$ 2,450.00		$ 615.00		$ 3,391.14 /ea	$ 3,391.00	$ 4,098.14 /ea	$ 4,098.00
		42" CS Ell, 11.25	2.00 ea	$ 652.00	$ 3,700.00		$ 1,230.00		$ 2,791.14 /ea	$ 5,582.00	$ 3,373.06 /ea	$ 6,746.00
		42" CS bell & spigot weld	500.00 ea			$ 442,000.00			$ 884.00 /ea	$ 442,000.00	$ 1,068.30 /ea	$ 534,151.00
		Tape wrap joint, 42" pipe	500.00 ea	$ 38,875.00					$ 77.75 /ea	$ 38,875.00	$ 93.96 /ea	$ 46,979.00
		Grout joint, I.D., 42" pipe	500.00 ea	$ 115,702.00	$ 11,000.00				$ 253.40 /ea	$ 126,702.00	$ 306.24 /ea	$ 153,118.00
		42" CS Magnetic Particle Testing	500.00 ea			$ 263,760.00			$ 527.52 /ea	$ 263,760.00	$ 637.50 /ea	$ 318,750.00
		Add for Box Culvert Obstruction	1.00 ea	$ 2,608.00	$ 750.00		$ 4,921.00		$ 8,279.11 /ea	$ 8,279.00	$ 10,005.19 /ea	$ 10,005.00
		Unload and Spread Pipe	19,167.00 lf	$ 8,313.00			$ 12,064.00		$ 1.06 /lf	$ 20,376.00	$ 1.28 /lf	$ 24,624.00
		Add for Obstructions	60.00 ea	$ 4,890.00	$ 45,000.00		$ 9,227.00		$ 985.29 /ea	$ 59,117.00	$ 1,190.70 /ea	$ 71,442.00
		Pipe Marking, ID Tape	19,167.00 lf	$ 11,088.00	$ 2,492.00				$ 0.71 /lf	$ 13,580.00	$ 0.86 /lf	$ 16,411.00
		42'-Open Install in open easement	**19,167.00 LF**	**$ 378,246.00**	**$ 5,005,505.00**	**$ 705,760.00**	**$ 407,365.00**		**$ 338.96 /LF**	**$ 6,496,877.00**	**$ 409.63 /LF**	**$ 7,851,383.00**
	42'-Open Rd Xings	**Install in Road Crossings - CLSM Backfill**										
		Utility Pot Hole	20.00 ea	$ 3,610.00			$ 1,834.00		$ 272.16 /ea	$ 5,443.00	$ 328.90 /ea	$ 6,578.00
		CLSM, Material Only	452.55 cy		$ 49,781.00				$ 110.00 /cy	$ 49,781.00	$ 132.93 /cy	$ 60,159.00
		Load Excess Spoils for Off-Site Hauling, Excavator, Cat 330	528.56 cy	$ 108.00			$ 313.00		$ 0.80 /cy	$ 421.00	$ 0.96 /cy	$ 509.00
		Haul Excess Spoils Off-Site, 17 yd capacity, 10 miles RT	528.56 cy	$ 494.00			$ 1,388.00		$ 3.56 /cy	$ 1,882.00	$ 4.30 /cy	$ 2,275.00
		Excess Spoils Dump Charges for 17 yd end dumps, per cy	528.56 cy		$ 5,444.00				$ 10.30 /cy	$ 5,444.00	$ 12.45 /cy	$ 6,579.00
		42" CS pipe Class 300 - NWP Quote - CML - Single lap after backfill	260.00 LF	$ 13,040.00	$ 62,660.00		$ 24,605.00		$ 385.79 /LF	$ 100,306.00	$ 466.22 /LF	$ 121,218.00
		42" CS Ell, 45 - Depression - 5 each	20.00 ea	$ 6,548.00	$ 78,000.00		$ 9,712.00		$ 4,712.99 /ea	$ 94,260.00	$ 5,695.59 /ea	$ 113,912.00
		42" CS bell & spigot weld	6.00 ea			$ 5,304.00			$ 884.00 /ea	$ 5,304.00	$ 1,068.30 /ea	$ 6,410.00
		42" CS bell & spigot weld - Depression	10.00 ea			$ 8,840.00			$ 884.00 /ea	$ 8,840.00	$ 1,068.30 /ea	$ 10,683.00
		Tape wrap joint, 42" pipe	6.00 ea	$ 466.00					$ 77.75 /ea	$ 466.00	$ 93.96 /ea	$ 564.00
		Tape wrap joint, 42" pipe Depression	10.00 ea	$ 777.00					$ 77.75 /ea	$ 777.00	$ 93.96 /ea	$ 940.00
		Grout joint, I.D., 42" pipe	6.00 ea	$ 1,388.00	$ 132.00				$ 253.40 /ea	$ 1,520.00	$ 306.24 /ea	$ 1,837.00
		Grout joint, I.D., 42" pipe Depression	10.00 ea	$ 2,314.00	$ 220.00				$ 253.40 /ea	$ 2,534.00	$ 306.23 /ea	$ 3,062.00
		42" CS Magnetic Particle Testing	6.00 ea			$ 3,165.00			$ 527.52 /ea	$ 3,165.00	$ 637.50 /ea	$ 3,825.00
		42" CS Magnetic Particle Testing Depression	10.00 ea			$ 5,275.00			$ 527.52 /ea	$ 5,275.00	$ 637.50 /ea	$ 6,375.00
		Unload and Spread Pipe	260.00 lf	$ 113.00			$ 164.00		$ 1.06 /lf	$ 276.00	$ 1.28 /lf	$ 334.00
		Add for Obstructions	20.00 ea	$ 1,630.00	$ 15,000.00		$ 3,076.00		$ 985.29 /ea	$ 19,706.00	$ 1,190.70 /ea	$ 23,814.00
		Add for depression at every road crossing	5.00 ea	$ 13,040.00	$ 3,750.00		$ 24,605.00		$ 8,279.11 /ea	$ 41,396.00	$ 10,005.19 /ea	$ 50,026.00
		Pipe Marking, ID Tape	260.00 lf	$ 150.00	$ 34.00				$ 0.71 /lf	$ 184.00	$ 0.86 /lf	$ 223.00
		42'-Open Rd Xings Install in Road Crossings - CLSM Backfill	**260.00 LS**	**$ 43,680.00**	**$ 215,020.00**	**$ 22,584.00**	**$ 65,696.00**		**$ 1,334.54 /LS**	**$ 346,981.00**	**$ 1,612.78 /LS**	**$ 419,322.00**
		6 42" Welded Steel Pipe	**25,823.00 LF**	**$ 591,120.00**	**$ 7,194,038.00**	**$ 1,190,829.00**	**$ 733,258.00**		**$ 375.99 /LF**	**$ 9,709,245.00**	**$ 454.38 /LF**	**$ 11,733,484.00**
7		**CARV Vault - Complete**										
	CARV	**CARV CARV Vault - Complete**										
		CARV Vault - Complete This is based on Ridgate Rough Average	11.00 EA	$ 154,000.00	$ 154,000.00	$ 154,000.00	$ 154,000.00	154,000	$ 70,000.00 /EA	$ 770,000.00	$ 84,594.00 /EA	$ 930,534.00
		CARV CARV Vault - Complete	**11.00 EA**	**$ 154,000.00**	**$ 154,000.00**	**$ 154,000.00**	**$ 154,000.00**	**154,000**	**$ 70,000.00 /EA**	**$ 770,000.00**	**$ 84,594.00 /EA**	**$ 930,534.00**
		7 CARV Vault - Complete	**11.00 EA**	**$ 154,000.00**	**$ 154,000.00**	**$ 154,000.00**	**$ 154,000.00**	**154,000**	**$ 70,000.00 /EA**	**$ 770,000.00**	**$ 84,594.00 /EA**	**$ 930,534.00**
8		**Blowoff Assembly**										
	BO	**BO Blowoff Assembly**										
		Blowoff Assembly This is based on Ridgate Rough Average	9.00 EA	$ 90,000.00	$ 90,000.00	$ 90,000.00	$ 90,000.00	90,000	$ 50,000.00 /EA	$ 450,000.00	$ 60,424.29 /EA	$ 543,819.00
		BO Blowoff Assembly	**9.00 EA**	**$ 90,000.00**	**$ 90,000.00**	**$ 90,000.00**	**$ 90,000.00**	**90,000**	**$ 50,000.00 /EA**	**$ 450,000.00**	**$ 60,424.29 /EA**	**$ 543,819.00**
		8 Blowoff Assembly	**9.00 EA**	**$ 90,000.00**	**$ 90,000.00**	**$ 90,000.00**	**$ 90,000.00**	**90,000**	**$ 50,000.00 /EA**	**$ 450,000.00**	**$ 60,424.29 /EA**	**$ 543,819.00**
9		**Isolation Valve and Vault**										
	VALVE	**Isolation Valve and Vault**										
		Isolation Valve and Vault This is based on Ridgate Rough Average	4.00 EA	$ 80,000.00	$ 80,000.00	$ 80,000.00	$ 80,000.00	80,000	$ 100,000.00 /EA	$ 400,000.00	$ 120,848.58 /EA	$ 483,394.00
		VALVE Isolation Valve and Vault	**4.00 EA**	**$ 80,000.00**	**$ 80,000.00**	**$ 80,000.00**	**$ 80,000.00**	**80,000**	**$ 100,000.00 /EA**	**$ 400,000.00**	**$ 120,848.58 /EA**	**$ 483,394.00**
		9 Isolation Valve and Vault	**4.00 EA**	**$ 80,000.00**	**$ 80,000.00**	**$ 80,000.00**	**$ 80,000.00**	**80,000**	**$ 100,000.00 /EA**	**$ 400,000.00**	**$ 120,848.58 /EA**	**$ 483,394.00**
11		**Pipe Testing**										
	42'- Deep 15'	**Install Deep Due to Utility Conflicts At Pump House Location**										
		Pipe Testing	653.00 lf			$ 2,286.00			$ 3.50 /lf	$ 2,286.00	$ 4.23 /lf	$ 2,762.00
		42'- Deep 15' Install Deep Due to Utility Conflicts At Pump House l	**653.00 LF**			**$ 2,286.00**			**$ 3.50 /LF**	**$ 2,286.00**	**$ 4.23 /LF**	**$ 2,762.00**
	42'- Sloped	**Install in sloped area of E-470**										
		Pipe Testing	5,700.00 lf			$ 19,950.00			$ 3.50 /lf	$ 19,950.00	$ 4.23 /lf	$ 24,109.00

Bid Item	WorkActiv	Description	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount	Grand Total Unit Price	Grand Total
		42'- Sloped Install in sloped area of E-470	5,700.00 LS			$ 19,950.00			$ 3.50 /LS	$ 19,950.00	$ 4.23 /LS	$ 24,109.00
	42'-Open	Install in open easement										
		Pipe Testing	19,470.00 lf			$ 68,145.00			$ 3.50 /lf	$ 68,145.00	$ 4.23 /lf	$ 82,352.00
		42'-Open Install in open easement	19,470.00 LF			$ 68,145.00			$ 3.50 /LF	$ 68,145.00	$ 4.23 /LF	$ 82,352.00
		11 Pipe Testing	**25,823.00 LF**			**$ 90,381.00**			**$ 3.50 /LF**	**$ 90,381.00**	**$ 4.23 /LF**	**$ 109,224.00**
12		**Cathodic Protection**										
	Cathodic	Cathodic Protection										
			1.00 ls						***/ls***		***/ls***	
		Cathodic protection, anode, 30 lbs	500.00 ea	$ 115,702.00	$ 225,000.00				$ 681.40 /ea	$ 340,702.00	$ 823.47 /ea	$ 411,734.00
		Cathodic protection, test station	10.00 ea	$ 579.00	$ 1,500.00				$ 207.85 /ea	$ 2,079.00	$ 251.19 /ea	$ 2,512.00
		Cathodic protection, design & testing service	1.00 ea			$ 25,000.00			$ 25,000.00 /ea	$ 25,000.00	$ 30,212.14 /ea	$ 30,212.00
		Cathodic Cathodic Protection	1.00 LS	$ 116,281.00	$ 226,500.00	$ 25,000.00			$ 367,780.51 /LS	$ 367,781.00	$ 444,457.52 /LS	$ 444,458.00
		12 Cathodic Protection	**1.00 LS**	**$ 116,281.00**	**$ 226,500.00**	**$ 25,000.00**			**$ 367,780.51 /LS**	**$ 367,781.00**	**$ 444,457.52 /LS**	**$ 444,458.00**

Appendix F—Construction Schedule

ID	Task Mod	Task Name	Duration	Start	Finish	Predecessors
1		**WISE Binney Pipeline Overall Project Implementatio**	**700 days**	**Tue 10/30/18**	**Mon 7/5/21**	
2		**Final Design Activities**	**275 days**	**Tue 10/30/18**	**Mon 11/18/19**	
3		Preliminary Design	60 days	Tue 10/30/18	Mon 1/21/19	
4		Preliminary Design Review	14 days	Tue 1/22/19	Fri 2/8/19	3
5		Permit Applications and Approvals	185 days	Tue 3/5/19	Mon 11/18/19	3FS+30 day
6		Easement Acquisition	180 days	Mon 2/11/19	Fri 10/18/19	4
7		Utility Documentation and Location	80 days	Tue 11/13/18	Mon 3/4/19	3SS+10 day
8		Survey and Geotechnical Exploration	120 days	Tue 11/13/18	Mon 4/29/19	3SS+10 day
9		60% Design	40 days	Mon 2/11/19	Fri 4/5/19	4
10		60% Design Review	14 days	Mon 4/8/19	Thu 4/25/19	9
11		90% Design	40 days	Fri 4/26/19	Thu 6/20/19	10
12		90% Design Review	14 days	Fri 6/21/19	Wed 7/10/19	11
13		Public Works Plan Review #1	30 days	Thu 7/11/19	Wed 8/21/19	12
14		Public Works Plan Review #2	30 days	Thu 8/22/19	Wed 10/2/19	13
15		Public Works Plan Review #3	20 days	Thu 10/3/19	Wed 10/30/19	14
16		Bid Documents	10 days	Thu 10/31/19	Wed 11/13/19	15
17		Bid Phase	30 days	Tue 11/19/19	Mon 12/30/19	16,5,6
18		Contract Award	45 days	Tue 12/31/19	Mon 3/2/20	17
19		**Construction**	**350 days**	**Tue 3/3/20**	**Mon 7/5/21**	
20		Mobilization/Material Delivery	60 days	Tue 3/3/20	Mon 5/25/20	18
21		Active Construction	200 days	Tue 5/26/20	Mon 3/1/21	20
22		Startup/Testing	30 days	Tue 3/2/21	Mon 4/12/21	21
23		Project Closeout	60 days	Tue 4/13/21	Mon 7/5/21	22



Project: SMWA-Binney_Pipeline
Date: Wed 7/11/18

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone