Technical Memorandum

Prepared for: Lower South Platte Water Conservancy District

Project Title: South Platte Regional Water Development Concept Feasibility Study

Subject: Cost Estimates

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Copy to: SPROWG Advisory Committee

SPROWG Feasibility Study consulting team

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Executive Summary

Conceptual capital cost and life-cycle cost estimates were prepared for infrastructure associated with the four South Platte Regional Operations Water Group (SPROWG) conceptual alternatives using a combination of unit costs and other assumptions from the previous SPROWG Phase 2 planning effort, the South Platte Storage Study, and experience of the SPROWG project team. Cost estimates are conceptual level estimates with a range of -50% to +100%.

The SPROWG cost estimates are useful for comparing alternatives on a relative basis and for understanding the rough order of magnitude of project development costs. Project costs presented in this Technical Memorandum (TM) and the facility layouts they were based on should not be used for design, budgeting or project financing.

Estimates were prepared for capital costs, operation and maintenance (O&M) costs, and life-cycle costs. Wherever practical, cost estimates were based on the previous work performed for the SPSS and SPROWG Phase 2 studies. This included unit costs, costs for entire facilities, and multipliers for factors such as permitting, engineering, and contingencies. In general costs for storage components (reservoirs, gravel lakes, aquifer storage and recovery) were derived from SPSS values and costs for conveyance facilities (pipelines, pump stations) were derived from SPROWG Phase 2 values.

Figure ES-1 through Figure ES-3 present the total capital and life-cycle costs for the four SPROWG alternatives. In summary:

- Capital cost for all facilities to deliver raw water is $1.2 billion to $1.8 billion, with a unit cost of $18,400 to $22,800 per acre-foot.
- Capital cost for all facilities to deliver treated water is $2.4 billion to $3.4 billion, with a unit cost of $33,600 to $43,200 per acre-foot.
- Life-cycle cost including 50 years of O&M is $1.8 billion to $2.6 billion for raw water and $3.2 billion to $4.4 billion for treated water. Unit life-cycle cost varies from $25,800 to $33,400 per acre-foot for raw water and from $44,100 to $58,300 per acre-foot for treated water.
- Alternative 4 is the most expensive but due to economies of scale it has the lowest unit cost per acre-foot of water produced.

The costs of SPROWG alternatives compare favorably with costs of other regional water supplies. Costs of other major regional water projects in the Front Range region have typically been in the range of $20,000 to $30,000 per acre-ft for raw water. Units of Colorado-Big Thompson Project (C-BT) water are currently selling for about $60,000 per unit. C-BT units produce an average of about 0.7 AF/unit, based on an annual quota set by Northern Water. Therefore, the cost per acre-foot for raw water is about $85,700/AF. This source has a high market value in part because it provides water every year, subject to the quota, and has excellent quality that does not require advanced water treatment for municipal use. Based on a cursory evaluation, SPROWG water appears to be cost-competitive with alternate regional water sources.

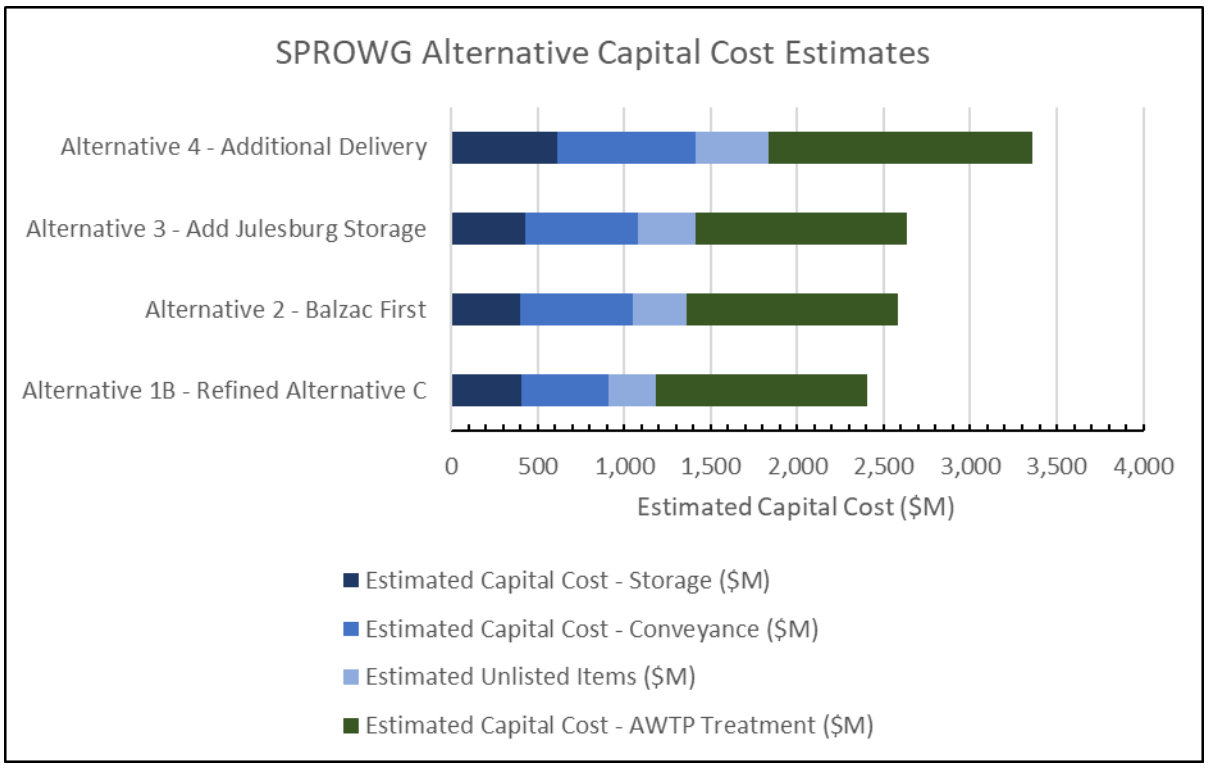

Figure ES-1. SPROWG Alternative Capital Cost Estimates

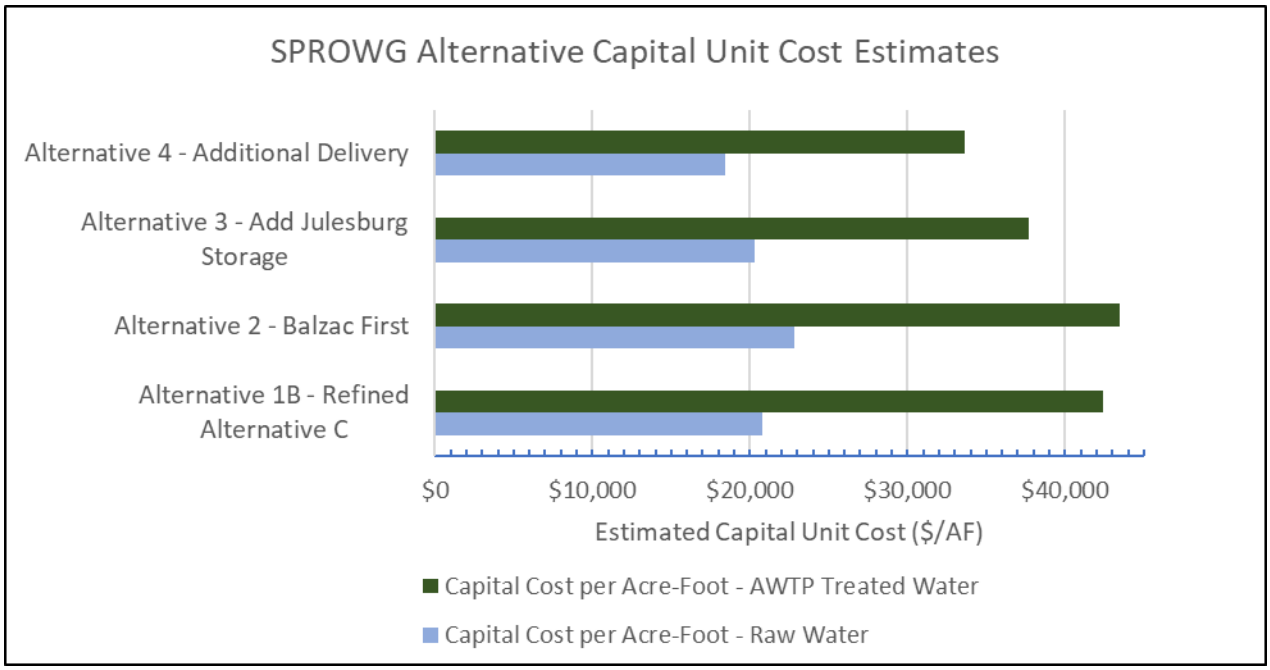

Figure ES-2. SPROWG Alternative Capital Unit Cost Estimates

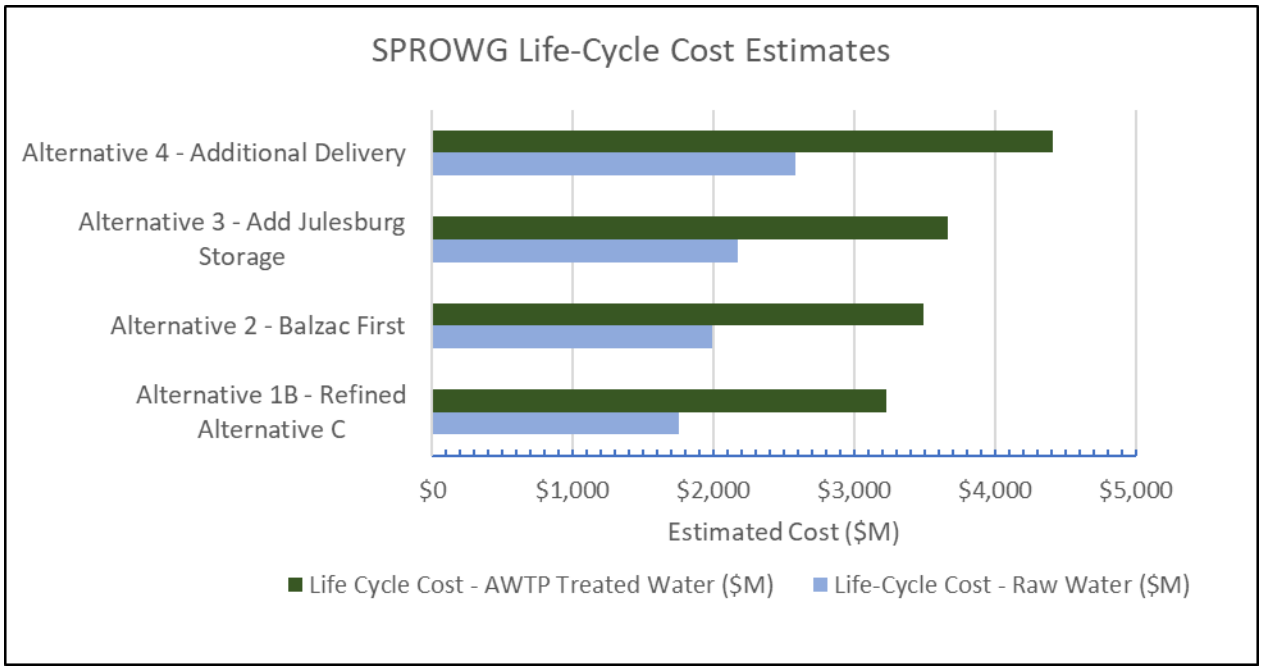

Figure ES-3. SPROWG Alternative Life-Cycle Cost Estimates

Section 1: Introduction

This Technical Memorandum (TM) presents the cost estimates prepared for the South Platte Regional Opportunities Water Group (SPROWG) conceptual water supply project feasibility study. Conceptual capital cost and life-cycle cost estimates were prepared for infrastructure associated with four SPROWG conceptual alternatives using a combination of unit costs and other assumptions from the previous SPROWG planning effort (Applegate Group and Wilson Water Group, 2017); the South Platte Storage Study (SPSS) (Stantec, 2017); and experience of the SPROWG project team. Cost estimates are considered to be Association for the Advancement of Cost Engineering (AACE) Class V (conceptual level) estimates with a range of -50% to +100%.

The SPROWG cost estimates are useful for comparing alternatives on a relative basis and for understanding the rough order of magnitude of project costs. Project costs presented in this TM and the facility layouts they were based on should not be used for design, budgeting or project financing.

Cost estimates were prepared by Stantec Consulting Services, Inc. under a subcontract to Brown and Caldwell.

Section 2: SPROWG Conceptual Alternatives

2.1 Conceptual Alternatives Overview

This TM presents cost estimates for four SPROWG conceptual alternatives developed by the study team and supported by the SPROWG Advisory Committee. The target water delivery amounts, project components and assumed operations for the four conceptual alternatives were developed by the SPROWG project team through the modeling and analysis task. The results of that work are described in detail in the Concept Refinement Alternatives Modeling TM prepared for this project.

The alternatives for which costs were developed are summarized as follows.

- Alternative 1: Refine the Initial Concept – Alternative 1 has generally the same overall delivery goals and infrastructure as Initial Concept C from the previous SPROWG planning effort, but refinements based on feedback from outreach conducted for the current project were incorporated.
- Alternative 2: Balzac First – Alternative 2 is a scenario in which a storage facility downstream of Fort Morgan (near Balzac) is the primary facility from which deliveries are made. In addition, this alternative sets higher delivery goals for agriculture and for small municipalities downstream of Kersey. Municipal demands in the Denver Metro Area and Northern Colorado (NoCo) Area are the same as in Alternative 1.
- Alternative 3: Add Julesburg Storage - Alternative 3 builds on Alternative 2 by adding another storage facility near the Colorado-Nebraska state line and increasing delivery goals for agriculture and small municipalities downstream of Kersey. Denver Metro and NoCo demands are the same as in Alternative 1.
- Alternative 4: Additional Delivery – Alternative 4 builds on Alternative 3 by increasing delivery goals by 25 percent throughout the South Platte Basin and increasing storage facilities to meet the demands.

The four conceptual alternatives have common water delivery points at:

- Denver Metro Gateway, serving potential municipal participants in the Denver Metro and southern NoCo area
- NoCo Gateway, serving potential municipal participants in the northern NoCo area
- Mid basin municipal demands (Fort Morgan/Sterling area)
- Lower basin municipal demands (Julesburg area)
- Mid and lower basin agricultural demands

The alternatives vary in the infrastructure used to meet target demands at the assumed water delivery points; sizes of storage and conveyance facilities vary based on the yield objectives.

In developing conceptual water supply alternatives, diversion, storage and conveyance locations were not defined specifically because they were not needed for the modeling and alternative refinement analysis. In order to prepare reasonable conceptual-level cost estimates, more specific assumptions were made for reservoir locations, aquifer storage and recovery options, and conveyance facilities where appropriate. Nonetheless, infrastructure components for all the alternatives are still defined at a conceptual level and will require substantial additional analysis at future stages of SPROWG development.

The facilities associated with each alternative as incorporated into the cost estimate analysis are listed below. Water treatment facilities and costs for each alternative are described in detail in the Water Treatment Alternatives TM.

2.2 Alternative 1: Refine the Initial Concept

Alternative 1: Refine the Initial Concept is a refinement of Concept C from the previous SPROWG planning effort. It consists of storage at Henderson, Kersey, and Balzac, and meets all demands through direct river diversions, releases from storage, or exchanges to the two Gateway diversion points. The primary storage facility is a reservoir in the Kersey area.

Facilities included in Alternative 1 are described in Table 2-1 through Table 2-4.

Table 2-1. Alternative 1 Storage Facilities

Item	Description	Size	Comments
Henderson Storage	Gravel pits along the South Platte River mainstem and ASR storage	45,000 AF. 30,000 AF in gravel pit storage, 15,000 AF in Upper Lost Creek ASR storage.	30,000 AF is approximate upper limit of gravel pit storage available to SPROWG based on informal conversations with water providers and gravel mining companies. Upper Lost Creek Basin was selected as best fit for ASR in this area based on SPSS.
Kersey Storage	Sandborn Reservoir	150,000 AF	Sandborn was selected as best fit from SPSS. Max capacity is 220,000 AF.
Balzac Storage	Fremont Butte Reservoir	25,000 AF	Fremont Butte was selected as best fit from SPSS. Max capacity is 95,000 AF.

Table 2-2. Alternative 1 Conveyance Facilities

Item	Description	Size	Comments
Henderson Storage Intake	Canal feeding series of gravel pits along the South Platte mainstem	52,800 ft long	Taken from SPROWG Phase 2 concept. No specific alignment considered.
Henderson Gravel Pit River Return Pipeline	Pipeline from 1 or more gravel pits to discharge to river to meet NoCo Gateway demands	60” gravity pipeline(s), total 5,280 ft long	No specific alignment(s) considered. No additional infrastructure included to get water to Metro Gateway.
ASR Fill Pipeline and Pumping	Fill Upper Lost Creek ASR from the Henderson Gravel Pit complex	158,400 ft of 30” pipeline; 5,890 HP pump station(s)	Alignment following existing roads from Fort Lupton to Upper Lost Creek ASR complex.
ASR Return Conveyance	Deliver ASR product water to Metro Gateway	105,600 ft of 30” pipeline; 3,930 HP pump station(s)	Alignment following existing roads from Upper Lost Creek ASR complex to Prairie Waters North Campus.
NoCo Gateway Conveyance	Deliver water from river to NoCo Gateway	100,500 ft of 42” pipeline; 7,430 HP pump station(s)	Alignment following existing roads from new diversion below the Poudre River confluence to the NoCo (Gold Hill) WTP site.

Table 2-2. Alternative 1 Conveyance Facilities			
Item	Description	Size	Comments
Sandborn Reservoir Conveyance	Bi-directional pipeline to fill and empty Sandborn Reservoir	65,100 ft 96" pipeline; 15,900 HP pump station	Divert into Riverside Reservoir; bi-directional pipeline from Riverside Reservoir to Sandborn Reservoir. Use same pipeline to release to South Platte for exchange to Metro or NoCo Gateways or to meet downstream demands. May be able to use excess capacity in Riverside Canal to get SPROWG water to Riverside Reservoir.
Fremont Butte Conveyance	Intake from diversion to regulating storage Gravel pit regulating storage Bi-directional pipeline to Fremont Butte Reservoir	5,000 ft of canal to new gravel pit 5,000 AF gravel pit storage 60,000 ft of 42" pipeline; 3,100 HP pump station(s)	Did not assume use of Prewitt Canal or Prewitt Reservoir by SPROWG due to Parker's planned water supply project. Conveyance alignment follows existing roads.

Table 2-3. Alternative 1 Diversion and Bypass Facilities			
Item	Description	Size	Comments
Diversion to Henderson Storage	New river diversion dam and regulating gates	Not considered	Typical diversion dam and regulating gates at location above the highest gravel pit
Diversion to NoCo Gateway	New river diversion dam and regulating gates	Not considered	Typical diversion dam and regulating gates at a location just downstream of the Poudre River confluence
Diversion to Kersey Storage	New river diversion dam and regulating gates	Not considered	Typical diversion dam and regulating gates at location near Riverside Reservoir
Diversion to Balzac Storage	New river diversion dam and regulating gates	Not considered	Typical diversion dam and regulating gates at location near Fort Morgan
Jay Thomas / Hewes Cook Diversion Bypass	New river diversion, pipeline and pump station	11,880 ft of 96" pipeline, 1,300 HP pump	Assumed SPROWG Phase 2 facilities
North Sterling Canal Bypass	Bypass pipeline and pump station	5,300 ft of 32" pipeline, 400 HP pump	Assumed SPROWG Phase 2 facilities

Table 2-4. Alternative 1 Water Treatment Facilities			
Item	Description	Size	Comments
Metro Gateway Water Treatment Plant	Advanced water treatment plant near Prairie Waters North Campus	74 MGD for pretreatment and disinfection 37 mgd for RO	Conventional pretreatment, reverse osmosis, mechanical evaporation for brine treatment, disinfection. See Water Treatment Alternatives TM for description of facilities and other treatment options considered.
NoCo Gateway Water Treatment Plant	Advanced water treatment plant at the Gold Hill site	44 MGD for pretreatment and disinfection 24 MGD for RO	Conventional pretreatment, reverse osmosis, mechanical evaporation for brine treatment, disinfection. See Water Treatment Alternatives TM for description of facilities and other treatment options considered.

2.3 Alternative 2: Balzac First

Alternative 2: Balzac First makes use of the same storage facilities as Alternative 1, but the primary storage facility is a reservoir in the Balzac area. The other significant difference from Alternative 1 is that Alternative 2 includes a pipeline from Balzac storage to the Henderson area (Metro Area Pipeline) so the project is not

entirely dependent on exchanges to move water from the lower basin to the demand gateways. Alternative 2 uses the same storage sites and conveyance concepts as Alternative 1.

Facilities included in Alternative 2 are described in Table 2-5 through Table 2-8.

Table 2-5. Alternative 2 Storage Facilities

Item	Description	Size	Comments
Henderson Storage	Gravel pits along the South Platte River mainstem and ASR storage	40,000 AF. 30,000 AF in gravel pit storage, 10,000 AF in Upper Lost Creek ASR storage.	See Alternative 1
Kersey Storage	Sandborn Reservoir	100,000 AF	See Alternative 1
Balzac Storage	Fremont Butte Reservoir	75,000 AF	See Alternative 1

Table 2-6. Alternative 2 Conveyance Facilities

Item	Description	Size	Comments
Henderson Storage Intake	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Henderson Gravel Pit River Return Pipeline	Same as Alternative 1	Same as Alternative 1	See Alternative 1
ASR Fill Pipeline and Pumping	Same as Alternative 1	Same as Alternative 1	See Alternative 1.
ASR Return Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
NoCo Gateway Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Sandborn Reservoir Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Fremont Butte Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Metro Area Conveyance	Conveyance from Fremont Butte Reservoir to Metro Gateway at Prairie Waters North Campus	422,400 ft 30” pipeline (30 cfs capacity) 10,920 HP pump station(s)	Alignment follows I-76 corridor and existing roads

Table 2-7. Alternative 2 Diversion and Bypass Facilities			
Item	Description	Size	Comments
Diversion to Henderson Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to NoCo Gateway	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to Kersey Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to Balzac Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Jay Thomas / Hewes Cook Diversion Bypass	Same as Alternative 1	Same as Alternative 1	See Alternative 1
North Sterling Canal Bypass	Same as Alternative 1	Same as Alternative 1	See Alternative 1

Table 2-8. Alternative 2 Water Treatment Facilities			
Item	Description	Size	Comments
Metro Gateway Water Treatment Plant	Same as Alternative 1	54 MGD for pretreatment 27 MGD for RO 74 MGD for disinfection	See Alternative 1
NoCo Gateway Water Treatment Plant	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Fremont Butte Water Treatment Plant	Advanced water treatment plant at intake to Metro Area Pipeline at Fremont Butte Reservoir	20 MGD for pretreatment 13 MGD for RO	Conventional pretreatment, reverse osmosis, mechanical evaporation for brine treatment, disinfection. See Water Treatment Alternatives TM for description of facilities and other treatment options considered.

2.4 Alternative 3: Add Julesburg Storage

Alternative 3: Add Julesburg Storage is similar to Alternative 2, but adds storage in the Julesburg area to improve deliveries to lower basin municipal and agricultural water users. All other facilities are similar, including the Metro Area Pipeline from Balzac Storage to the Metro Gateway.

Facilities included in Alternative 3 are described in Table 2-9 through Table 2-12.

Table 2-9. Alternative 3 Storage Facilities			
Item	Description	Size	Comments
Henderson Storage	Same as Alternative 2	Same as Alternative 2	See Alternative 1
Kersey Storage	Same as Alternative 2	Same as Alternative 2	See Alternative 1
Balzac Storage	Same as Alternative 2	Same as Alternative 2	See Alternative 1
Julesburg Storage	Ovid Reservoir	8,000 AF	Ovid was selected as best fit from SPSS. Max capacity is 8,000 AF.

Table 2-10. Alternative 3 Conveyance Facilities			
Item	Description	Size	Comments
Henderson Storage Intake	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Henderson Gravel Pit River Return Pipeline	Same as Alternative 1	Same as Alternative 1	See Alternative 1
ASR Fill Pipeline and Pumping	Same as Alternative 1	Same as Alternative 1	See Alternative 1.
ASR Return Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
NoCo Gateway Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Sandborn Reservoir Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Fremont Butte Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Metro Area Conveyance	Same as Alternative 2	Same as Alternative 2	See Alternative 2
Ovid Reservoir Inlet Canal	Use existing Peterson Ditch and diversion	37,000 ft of existing canal improvement	Assumes 50% of Peterson Ditch length between existing diversion and Ovid reservoir site must be enlarged
Ovid Reservoir Return Pipeline	Gravity pipeline to make releases to South Platte for exchange to demand points higher on the river	15,000 ft of 42” pipeline	Shortest logical distance from reservoir site to the river

Table 2-11. Alternative 3 Diversion and Bypass Facilities			
Item	Description	Size	Comments
Diversion to Henderson Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to NoCo Gateway	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to Kersey Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to Balzac Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Jay Thomas / Hewes Cook Diversion Bypass	Same as Alternative 1	Same as Alternative 1	See Alternative 1
North Sterling Canal Bypass	Same as Alternative 1	Same as Alternative 1	See Alternative 1

Table 2-12. Alternative 3 Water Treatment Facilities			
Item	Description	Size	Comments
Metro Gateway Water Treatment Plant	Same as Alternative 2	Same as Alternative 2	See Alternative 1
NoCo Gateway Water Treatment Plant	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Fremont Butte Water Treatment Plant	Same as Alternative 2	Same as Alternative 2	See Alternative 2

2.5 Alternative 4: Additional Delivery

Alternative 4: Additional Delivery is similar to Alternative 3 in terms of the layout of infrastructure, but adds additional storage capacity to deliver an additional 25% of municipal supply and an additional 50% of agricultural supply.

Facilities included in Alternative 4 are described in Table 2-13 through Table 2-16.

Table 2-13. Alternative 4 Storage Facilities

Item	Description	Size	Comments
Henderson Storage	Gravel pits along the South Platte River mainstem and ASR storage	85,000 AF. 30,000 AF in gravel pit storage, 55,000 AF in Upper Lost Creek ASR storage.	See Alternative 1
Kersey Storage	Sandborn Reservoir	200,000 AF	See Alternative 1
Balzac Storage	Fremont Butte Reservoir	95,000 AF	See Alternative 1
Julesburg Storage	Ovid Reservoir and Julesburg Reservoir Enlargement	29,000 AF. 8,000 AF in Ovid Reservoir, 21,000 AF in Julesburg Reservoir Enlargement.	Ovid and Julesburg Enlargement were selected as best fits from SPSS. Max capacity in Julesburg Reservoir Enlargement is 21,000 AF.

Table 2-14. Alternative 4 Conveyance Facilities

Item	Description	Size	Comments
Henderson Storage Intake	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Henderson Gravel Pit River Return Pipeline	Same as Alternative 1	Same as Alternative 1	See Alternative 1
ASR Fill Pipeline and Pumping	Same as Alternative 1	Same as Alternative 1	See Alternative 1.
ASR Return Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
NoCo Gateway Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Sandborn Reservoir Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Fremont Butte Conveyance	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Metro Area Conveyance	Same as Alternative 2	Same as Alternative 2	See Alternative 2
Ovid Reservoir Inlet Canal	Same as Alternative 3	Same as Alternative 3	See Alternative 3
Ovid Reservoir Return Pipeline	Same as Alternative 3	Same as Alternative 3	See Alternative 3
Julesburg Reservoir Inlet Canal	Use existing Harmony Ditch #1 and diversion	79,200 ft of existing canal improvement	Assumes 50% of Harmony Ditch #1 length between existing diversion and Julesburg Reservoir must be enlarged
Julesburg Reservoir Return Pipeline	Gravity pipeline to make releases to South Platte for exchange to demand points higher on the river	21,000 ft of 42” pipeline	Shortest logical distance from reservoir site to the river

Table 2-15. Alternative 4 Diversion and Bypass Facilities

Item	Description	Size	Comments
Diversion to Henderson Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to NoCo Gateway	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to Kersey Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1
Diversion to Balzac Storage	Same as Alternative 1	Same as Alternative 1	See Alternative 1

Table 2-15. Alternative 4 Diversion and Bypass Facilities			
Item	Description	Size	Comments
Jay Thomas / Hewes Cook Diversion By-pass	Same as Alternative 1	Same as Alternative 1	See Alternative 1
North Sterling Canal Bypass	Same as Alternative 1	Same as Alternative 1	See Alternative 1

Table 2-16. Alternative 4 Water Treatment Facilities			
Item	Description	Size	Comments
Metro Gateway Water Treatment Plant	Same as Alternative 2	72 MGD for pretreatment 36 MGD for RO 92 MGD for disinfection	See Alternative 1
NoCo Gateway Water Treatment Plant	Same as Alternative 1	55 MGD for pretreatment and disinfection 30 MGD for RO	See Alternative 1
Fremont Butte Water Treatment Plant	Same as Alternative 2	20 MGD for pretreatment 13 MGD for RO	See Alternative 2

Section 3: Basis of Cost Estimates

3.1 Introduction

This section describes the basis of the unit costs and key assumptions used in preparing facility cost estimates for the various types of facilities comprising the SPROWG alternatives. Wherever practical, cost estimates were based on the previous work performed for the SPSS and SPROWG Phase 2. This included unit costs, costs for entire facilities, and multipliers for factors such as permitting, engineering, and contingencies. Cost estimates are generally representative of 2019 conditions.

Cost were developed for facilities required to deliver water to the two demand gateways or to release it back to the river to be picked up downstream. Costs for additional facilities needed to deliver water from the demand gateways to project participant water systems were not included.

The basis for three types of cost estimates are described in this section: capital costs, operation and maintenance (O&M) costs, and life-cycle costs.

3.2 Basis of Capital Cost Estimates

The basis of capital cost estimates for the various types of infrastructure components in the SPROWG alternatives are described below. In all cases the approach was to adopt unit costs or project costs based on the most reliable and readily available information. Simple parametric unit cost factors (e.g., $/AF for storage or $/ft for pipelines) were used for the conceptual cost estimates developed in this Study. Because of the conceptual nature of facility sizes, locations and layouts, more detailed cost estimating methods were not included in the project scope.

3.2.1 Storage Components

Major Surface Water Reservoirs. Construction costs for major surface water reservoirs were based on estimates developed for the SPSS. The SPSS included site specific cost estimates for several surface reservoir options in the SPROWG study area that were based either on past storage studies or new analyses by the SPSS project team. SPSS cost estimates were adopted for Sandborn Reservoir (Kersey Storage), Fremont

Butte Reservoir (Balzac Storage), Ovid Reservoir and Julesburg Reservoir Enlargement (Julesburg Storage). These costs include land/easement acquisition, permitting, and engineering/legal/administration. The SPSS included costs only for the largest feasible reservoir size at each site. For smaller sizes used in the SPROWG alternatives, relative unit costs were developed from the SPSS value and applied to the smaller capacities.

Gravel Pit Storage. Construction costs for gravel pit reservoirs were estimated using the unit cost of $1,500/AF from the SPSS analysis. Multipliers for land/easements, permitting and engineering/legal/admin were applied as described below.

Aquifer Storage and Recovery (ASR). The unit cost used for ASR facilities was $10,000 per AF per month of delivery capacity. This was based on the SPSS assessment of ASR options in the Lost Creek basin. The SPSS developed a cost of $39,667,000 for an ASR complex with a production capacity of 4,000 AF per month. This included recharge basins, recovery wells, ancillary onsite infrastructure, land costs, permitting, and engineering. The resulting unit cost of $9,917 per AF per month of delivery capacity was rounded up to $10,000 per AF per month of delivery capacity.

3.2.2 Conveyance Components

Conveyance Sizing. Pipelines and pump stations were sized based on the maximum monthly delivery planned in dry years when deliveries would be highest. Assumed flow rates were based on the conceptual alternative modeling described in the Concept Refinement Alternatives Modeling TM prepared for this project. Flow rates used to size conveyance facilities are summarized in Table 3-1. Pipeline diameters were sized based on the required capacity and a maximum velocity of 6-8 feet/second.

Table 3-1. Flow Rates for Conveyance Components

Conveyance Component	Alternative 1 Flow Rate (CFS)	Alternative 2 Flow Rate (CFS)	Alternative 3 Flow Rate (CFS)	Alternative 4 Flow Rate (CFS)
Henderson Storage Intake	500	500	500	500
Henderson Gravel Pit River Return Pipeline	150	150	150	175
ASR Fill Pipeline and Pumping	23	18	18	57
ASR Return Conveyance	23	18	18	57
NoCo Gateway Conveyance	68	68	68	85
Sandborn Reservoir Conveyance	400	400	400	400
Fremont Butte Conveyance	400	400	400	400
Metro Area Conveyance	Not used	30	30	30
Ovid Reservoir Inlet Canal	Not used	Not used	400	400
Ovid Reservoir Return Pipeline	Not used	Not used	75	75
Julesburg Reservoir Inlet Canal	Not used	Not used	Not used	400
Julesburg Reservoir Return Pipeline	Not used	Not used	Not used	75
Jay Thomas / Hewes Cook Diversion Bypass	250	250	250	250
North Sterling Canal Bypass	32	32	32	32

Pipeline Costs. Pipeline unit costs for a range of pipe diameters were expressed in dollars per foot of length, and varied based on land use conditions (rural or urban). Unit pipeline costs developed for the SPROWG Phase 2 analysis were adopted for this study. These unit costs were based on past experience from Northern Colorado Water Conservancy District, Texas Water Development Board, U.S. Bureau of Reclamation, and other sources. Unit costs used in this analysis are shown in Table 3-2.

Table 3-2. Pipeline Unit Costs	
Pipeline Size and Condition	Unit Cost ($/ft)
24" Pipeline, Rural	110
30" Pipeline, Rural	145
36" Pipeline, Rural	180
42" Pipeline, Rural	220
60" Pipeline, Rural	325
66" Pipeline, Rural	380
96" Pipeline, Rural	820
114" Pipeline, Rural	1,100
24" Pipeline, Urban	153
30" Pipeline, Urban	205
36" Pipeline, Urban	250
42" Pipeline, Urban	300
60" Pipeline, Urban	460
66" Pipeline, Urban	530
96" Pipeline, Urban	1,150
114" Pipeline, Urban	1,560

Pump Station Costs. Pumping requirements in horsepower were determined for each conveyance facility based on the static head (difference between inlet and discharge elevations) and head losses in the pipeline based on the length and flow rate. Because the pipeline alignments are only conceptual, more detailed analyses of pumping requirements were not performed at this level of project development. Total pumping requirements were used to estimate pumping costs. Whether pumping would be more efficiently performed in one or multiple pump stations was not assessed at this level.

Unit pump station costs in $/horsepower were adopted from SPROWG Phase 2. Unit costs were expressed for ranges of horsepower as summarized in Table 3-3.

Table 3-3. Pump Station Unit Costs	
Pumping Horsepower Range	Unit Cost ($/HP)
HP <= 500	5,500
HP > 500 and <= 1500	4,500
HP > 1500 and <= 3000	3,500
HP > 3000	2,500

3.2.3 Diversion Components

Both the SPSS and the SPRWOG Phase 2 studies used a total cost for river diversion structures of about $3 million. Because specific diversion locations and capacities have not been determined at this stage of project development, this standard value was used for all new river diversions.

3.2.4 Water Treatment Components

The basis of water treatment costs was described in the Water Treatment Alternatives TM prepared for this project. When combined with the rest of the SPROWG component costs, a multiplier of 20% was added to the base water treatment facility costs to account for replacement of mechanical equipment over the period of 50 years used as the basis for life-cycle cost estimates (see discussion below).

Estimates of water treatment facility costs used in this TM were based on the cost of advanced water treatment facility requirements for each SPROWG Concept alternative described in the Water Treatment Alternatives TM. Treatment process requirements were based on assumed source water quality. A number of factors, including application of nonpoint source management practices in the tributary watershed, could affect future source water quality and the corresponding required treatment processes and costs.

3.2.5 Construction Cost Multipliers

The following multipliers were applied to the base construction cost to estimate total capital cost.

Land Acquisition and Easements. A unit cost of $10,000/acre was used for land acquisition (e.g., for reservoirs, pump stations, canals) and a unit cost of $5,000/acre was used for easements (e.g., for pipelines). Land requirements for pipelines were based on a typical 80 ft wide corridor. Land requirements for canals were based on a typical 500 ft wide corridor. For pump stations a standard land requirement of 5 acres was adopted. Gravel pit storage land acquisition requirements were based on an assumed average pit depth of 20 feet and an allowance for ancillary facilities such as berms, access roads, control structures, etc.

Permitting. The allowance for environmental permitting was calculated as a percentage of the base construction cost. Multipliers for different types of facilities were based on a combination of SPSS and SPROWG Phase 2 factors, and are listed below.

- New reservoirs – 15%
- Reservoir enlargements – 10%
- Gravel pit storage – 10%
- ASR – 10%
- Pipelines – 10%
- Canals – 10%
- Pump Stations – 5%
- Diversion Structures – 10%

Engineering/Legal/Admin. Engineering, legal and administration costs were estimated as a percentage of base construction cost. The total multiplier was 20% for all types of facilities, based on an assumption of 8% of mobilization, 6% for engineering, and 6% for construction management.

Contingency. A standard contingency of 30% was used for all facility types to account for uncertainty in location, design, operation, and other features of infrastructure components.

Unlisted Items. The conceptual layouts of SPROWG alternatives describe the major infrastructure components required for each alternative, but do not include every individual component needed for a fully functional water storage, delivery and treatment system. A factor of 30% of total construction cost was added to each alternative capital cost to capture unlisted items not specifically itemized in the cost tables.

3.3 Basis of O&M Cost Estimates

Conceptual annual O&M costs for each component of each alternative were estimated at a high level as a percentage of construction cost. Conceptual annual O&M costs were estimated based on the type of facility, as listed in Table 3-4.

Table 3-4. Annual O&M Cost Factors	
Facility Type	Annual O&M Cost as a Percentage of Construction Cost
Traditional Reservoir	0.5%
Gravel Pit Reservoir	0.5%
Aquifer Storage and Recovery	0.5%
Pipeline	0.5%
Pump Station	2.5%
Diversion Structure	0.5%
Bypass Structure	1.5%
Water Treatment Facilities	See Water Treatment Alternatives TM

Energy costs were estimated separately for operating water treatment facilities and pump stations. Water treatment facility energy costs were included in the O&M estimates presented in the Water Treatment Alternatives TM. For pump station energy cost estimates, average annual flow and horsepower requirements were converted to kilowatt-hours (kWh), and a unit cost of $0.07/kWh was assumed based on current typical industrial energy costs in Colorado.

3.4 Basis of Life-Cycle Cost Estimates

Life-cycle costs combine capital cost and the net present worth of recurring annual O&M costs. Net present worth of annual O&M was computed using the following assumptions.

- Recurring annual cost is the sum of all annual costs for raw and treated water facilities.
- The cost period is 50 years. Over this long period mechanical equipment in pump stations and water treatment plants would have to be replaced. The average annual O&M percentages listed in the previous section are assumed to account for periodic replacement of this type of equipment.
- The discount rate is 4%.

Net present worth of water treatment O&M was computed as part of the water treatment costs described in the Water Treatment Alternatives TM.

Section 4: Alternative Cost Estimates

This section presents the capital and life-cycle cost estimates for the SPROWG alternatives and provides graphical comparisons of the alternative costs to one another and to other sources of new supply available to the South Platte Basin.

4.1 SPROWG Alternative Costs

Tables in Attachment A provide the SPROWG alternative costs by line item for all the associated raw water facilities. Water treatment costs are incorporated from the Water Treatment Alternatives TM. Several versions of Alternative 1 were assessed in the Concept Refinement Alternatives Modeling TM. That TM selected Alternative 1B to carry forward as one of the four SPROWG conceptual alternatives. Alternative 1 cost estimates are based on Alternative 1B facilities and operations.

Table 4-1 and Figure 4-1 through Figure 4-3 present the total capital and life-cycle costs for the four SPROWG alternatives. In summary:

- Capital cost for all facilities to deliver raw water is $1.2 billion to $1.8 billion, with a unit cost of $18,400 to $22,800 per acre-foot.
- Capital cost for all facilities to deliver treated water is $2.4 billion to $3.4 billion, with a unit cost of $33,600 to $43,200 per acre-foot.
- Life-cycle cost including 50 years of O&M is $1.8 billion to $2.6 billion for raw water and $3.2 billion to $4.4 billion for treated water. Unit life-cycle cost varies from $25,800 to $33,400 per acre-foot for raw water and from $44,100 to $58,300 per acre-foot for treated water.
- Alternative 4 is the most expensive but due to economies of scale it has the lowest unit cost per acre-foot of water produced.

Table 4-1. Alternative Cost Comparisons

Cost Parameter	Alternative 1 - Refine the Initial Concept	Alternative 2 - Balzac First	Alternative 3 - Add Julesburg Storage	Alternative 4 - Additional Delivery
Average Annual Yield (AFY)	56,750	59,750	71,500	99,875
Estimated Capital Cost - Storage ($M)	405	397	429	610
Estimated Capital Cost - Conveyance ($M)	504	651	651	803
Estimated Unlisted Items ($M)	273	314	335	424
Estimated Capital Cost - AWTP Treatment ($M)	1,222	1,222	1,222	1,522
Estimated Capital Cost - Raw Water ($M)	$1,182	$1,361	$1,453	$1,836
Capital Cost per Acre-Foot - Raw Water	$20,800	$22,800	$20,300	$18,400
Estimated Capital Cost - AWTP Treated Water ($M)	$2,404	$2,583	$2,675	$3,357
Capital Cost per Acre-Foot - AWTP Treated Water	$42,400	$43,500	$37,700	$33,600
Life-Cycle Cost - Raw Water ($M)	$1,755	$1,993	$2,167	$2,577
Life-Cycle Cost per Acre-Foot - Raw Water	$30,900	$33,400	$30,300	$25,800
Life Cycle Cost - AWTP Treated Water ($M)	$3,224	$3,486	$3,660	$4,406
Life-Cycle Cost per Acre-Foot - Treated Water	$56,800	$58,300	$51,200	$44,100

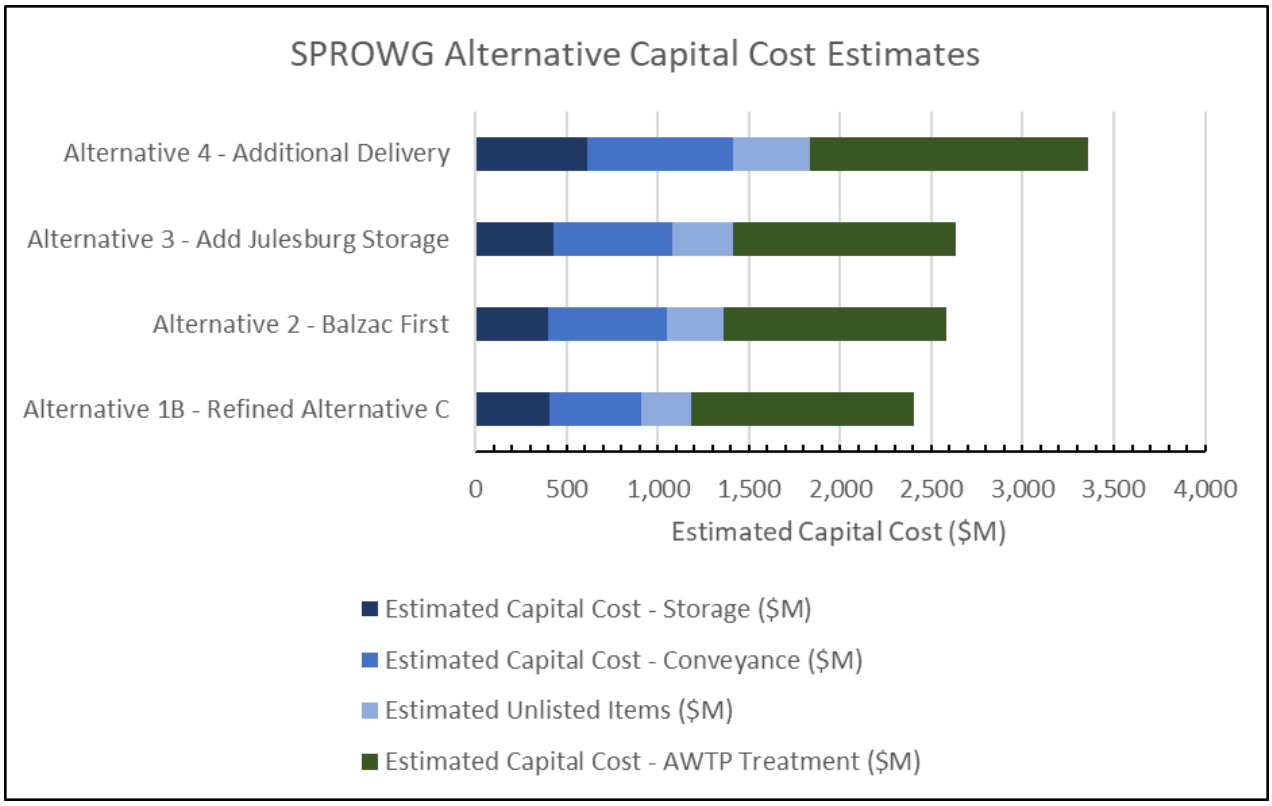

Figure 4-1. SPROWG Alternative Capital Cost Estimates

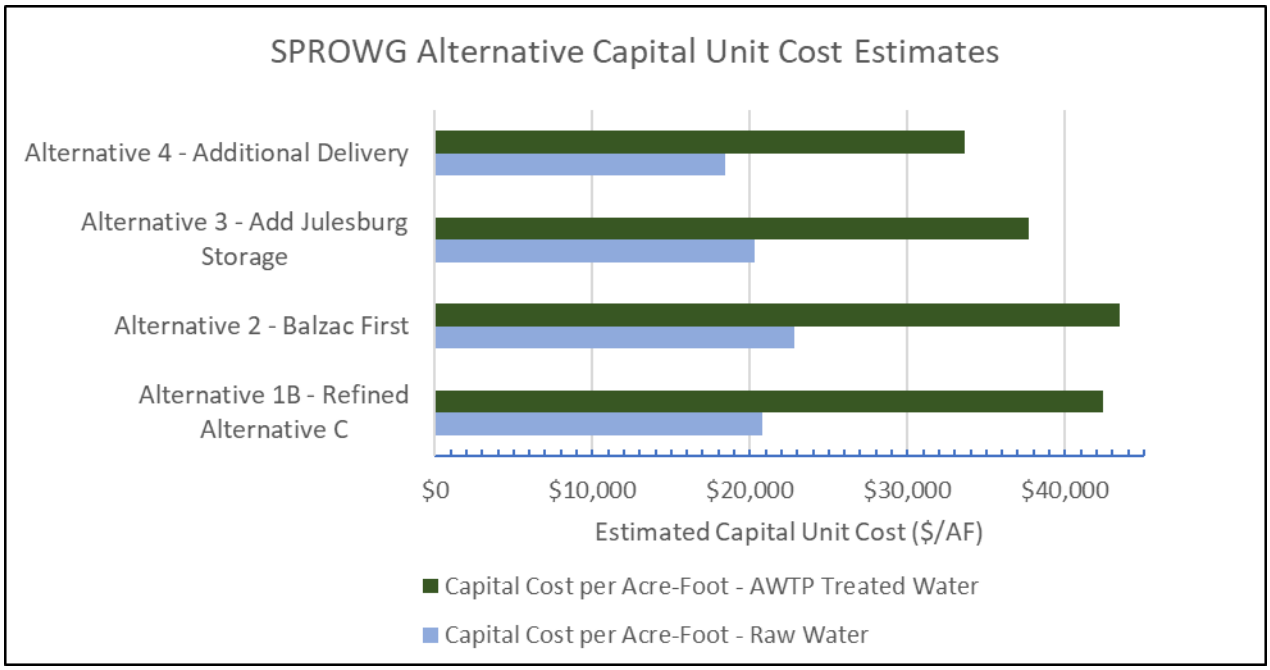

Figure 4-2. SPROWG Alternative Capital Unit Cost Estimates

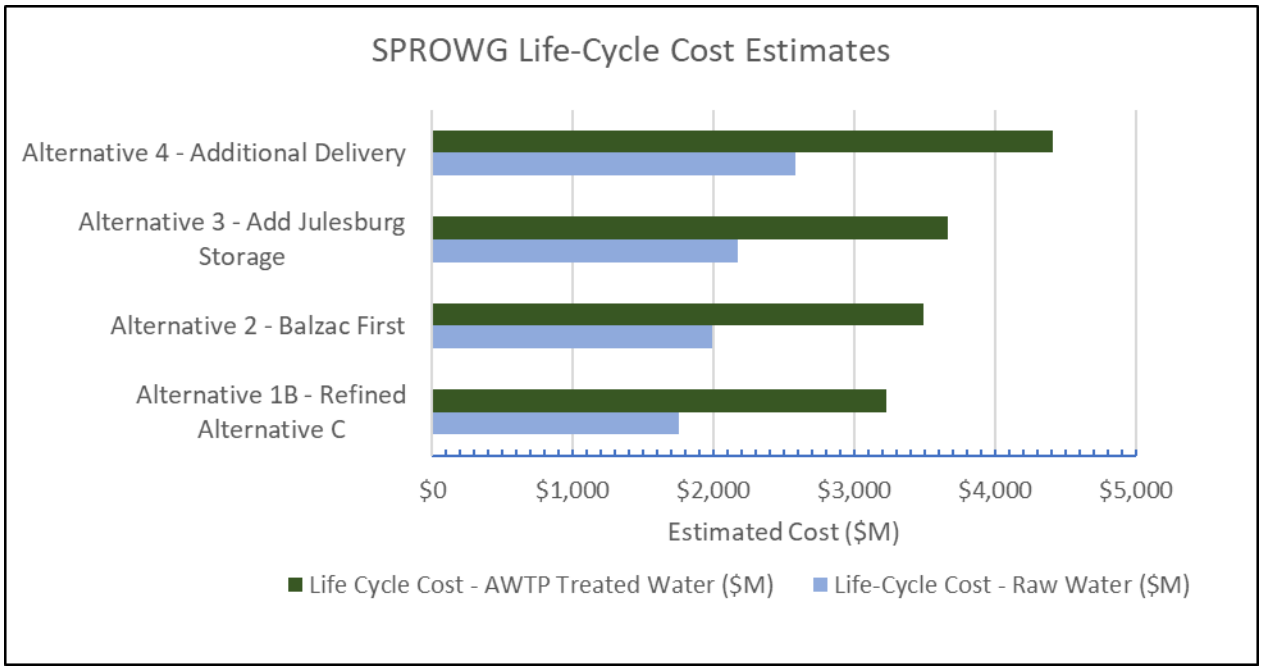

Figure 4-3. SPROWG Alternative Life-Cycle Cost Estimates

4.2 Comparison to Costs for Other Water Supplies

The costs of SPROWG alternatives compare favorably with costs of other regional water supplies. Costs of other major regional water projects in the Front Range region have typically been in the range of $20,000 to $30,000 per acre-ft for raw water. Units of Colorado-Big Thompson water are currently selling for about $60,000 per unit. C-BT units produce an average of about 0.7 AF/unit, based on an annual quota set by Northern Water. Therefore, the cost per acre-foot for raw water is about $85,700/AF. This source has the benefit of providing water every year, even in dry years, subject to the quota, and has excellent quality that does not require advanced water treatment for municipal use. These factors help explain the high market value of C-BT units.

The cost of SPROWG water appears to be competitive with these alternate sources. Comparisons of different water supplies should be treated as conceptual only; many factors other than cost could be important, including water quality, reliability, delivery location, sustainability, and resilience against future risks such as climate change or competition from other planned projects. In addition, SPROWG Concept alternative costs are very preliminary whereas costs of other potential projects may be based on more advanced engineering, completed permitting, and other factors that create more cost certainty.

References

Stantec, *South Platte Storage Study*, Colorado Water Conservation Board and Lower South Platte Water Conservancy District, 2017.

Applegate Group and Wilson Water Group, South Platte Regional Development Concept Phase 2 work products, 2017.

Attachment A: Cost Estimate Tables

SPROWG CAPITAL COST ESTIMATE

Alternative 1B - Three Storage Facilities - Refined Alternative C

Average Annual Yield: **56,750** **AFY**

Date: 24-Jan-20

Location	Reservoir Storage	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Storage - Gravel Pit	30,000	AF	1,500	45,000,000	2,250	10,000	10%	20%	30%	94,500,000		0.5%	472,500
Near Henderson	Henderson Storage - Upper Lost Creek ASR	15,000	AF	-	36,160,000	0		$0	0%	30%	47,008,000	Based on SPSS cost - excludes contingency	0.5%	235,040
Near Milliken	Gravel Pit Storage at Milliken Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Kersey	Kersey Storage - Sandborn Reservoir	150,000	AF	817	122,614,688	0	0	0%	0%	30%	159,399,094	Based on SPSS all-in cost; added contingency	0.5%	796,995
Near Balzac	Gravel Pit Storage at Balzac Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Balzac	Balzac Storage - Fremont Butte	25,000	AF	2,000	50,000,000	0	0	0%	0%	30%	65,000,000	Based on SPSS all-in cost; added contingency	0.5%	325,000
Storage Subtotal		**230,000**	**AF**		**268,774,688**						**404,907,094**			**2,024,535**

Location	Conveyance	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Gravel Pit Inlet Canal	52,800	LF	1,100	58,080,000	97	10,000	10%	20%	30%	93,898,000	SPROWG facilities and base unit cost	0.5%	469,490
Near Henderson	Henderson Gravel Pit River Return Pipeline	5,280	LF	325	1,716,000	10	5,000	10%	20%	30%	2,794,100	60" Pipeline	0.5%	13,971
Near Henderson	ASR Fill Pipeline - Fort Lupton to ASR	158,400	LF	145	22,968,000	291	5,000	10%	20%	30%	38,203,800	30" pipeline	0.5%	191,019
Near Henderson	ASR Fill Pump Station	5,890	HP	2,500	14,725,000	5	10,000	5%	20%	30%	22,873,750		13.5%	3,087,956
Near Henderson	ASR Return Pipeline to Prairie Waters North Campus	105,600	LF	145	15,312,000	194	5,000	10%	20%	30%	25,469,200	30" pipeline	0.5%	127,346
Near Henderson	ASR Return Pump Station	3,930	HP	2,500	9,825,000	5	10,000	5%	20%	30%	15,278,750		13.5%	2,062,631
Blw Poudre Conf	NoCo Gateway Pipeline - to Gold Hill WTP	100,500	LF	220	22,110,000	184	5,000	10%	20%	30%	36,296,000	42"Pipeline	0.5%	181,480
Blw Poudre Conf	NoCo Gateway Pump Station	7,430	HP	2,500	18,575,000	5	10,000	5%	20%	30%	28,841,250		13.5%	3,893,569
Near Kersey	Sandborn Reservoir Bidirectional Pipeline	65,100	LF	-	43,750,000	0	0	0%	0%	30%	56,875,000	96"; SPSS est incl land, permitting, admin	0.5%	284,375
Near Kersey	Sandborn Reservoir Inlet Pump Station	15,900	HP	-	50,360,000	0	0	0%	0%	30%	65,468,000	SPSS est incl land, permitting, admin	13.5%	8,838,180
Near Balzac	Fremont Butte Intake to Regulating Storage	5,000	LF	1,100	5,500,000	57	10,000	10%	20%	30%	9,370,000	SPROWG unit cost	0.5%	46,850
Near Balzac	Freemont Butte Reservoir Bi-Directional Pipeline	60,000	LF	350	21,000,000	110	5,000	10%	20%	30%	34,150,000	42"; SPROWG facilities and base unit cost	0.5%	170,750
Near Balzac	Freemont Butte Reservoir Inlet Pump Station	3100	HP	3500	10,850,000	5	10,000	5%	20%	30%	16,867,500	SPROWG facilities and base unit cost	13.5%	2,277,113
Conveyance Subtotal					**294,771,000**						**446,385,350**			**21,644,729**

Location	Diversion Structures	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Blw Poudre Conf	Below Poudre Diversion to NoCo Gateway	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Kersey	Kersey Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Balzac	Balzac Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Kersey	Jay Thomas/ Hewes Cook Diversion Bypass	1	LS	19,892,000	19,892,000	42	5,000	10%	20%	30%	32,037,200	SPROWG base cost	7.5%	2,402,790
Near Balzac	North Sterling Canal Bypass	1	LS	4,154,000	4,154,000	15	5,000	10%	20%	30%	6,721,400	SPROWG base cost	7.5%	504,105
Diversion Subtotal					**$36,046,000**						**$57,958,600**			**$3,002,895**

	Estimated Project Cost of Listed Components										$909,000,000			
	Contingency for Unlisted Items (30%)										$272,700,000			
	Estimated Project Cost for Raw Water										**$1,181,700,000**	**Total Raw Water Annual O&M**		$26,672,160
	Average Annual Project Yield (AFY)										**56,750**	Period		50
												Discount Rate		4
	Cost per Acre-Foot for Raw Water										**$20,800**	**Life Cycle Cost for Raw Water**		**$1,754,676,259**
	Estimated Water Treatment Cost (AWTP Option)										$1,221,960,000	Treatment Annual O&M		$11,510,000
	Estimated Project Cost for Treated Water										**$2,403,660,000**	Total Annual O&M		$38,182,160
	Cost per Acre-Foot for Treated Water										**$42,400**	**Life Cycle Cost for Treated Water**		**$3,223,896,204**

SPROWG CAPITAL COST ESTIMATE

Alternative 2 - Balzac First

Average Annual Yield: **59,750** **AFY** Date: 24-Jan-20

Location	Reservoir Storage	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Storage - Gravel Pit	30,000	AF	1,500	45,000,000	2,250	10,000	10%	20%	30%	94,500,000		0.5%	472,500
Near Henderson	Henderson Storage - Upper Lost Creek ASR	10,000	AF	-	27,120,000	0		$0	0%	30%	35,256,000	Based on SPSS cost - excludes contingency	0.5%	176,280
Near Milliken	Gravel Pit Storage at Milliken Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Kersey	Kersey Storage - Sandborn Reservoir	100,000	AF	1,022	102,178,906	0	0	0%	0%	30%	132,832,578	Based on SPSS all-in cost; added contingency	0.5%	664,163
Near Balzac	Gravel Pit Storage at Balzac Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Balzac	Balzac Storage - Fremont Butte	75,000	AF	976	73,163,487	0	0	0%	0%	30%	95,112,533	Based on SPSS all-in cost; added contingency	0.5%	475,563
Storage Subtotal		**225,000**	**AF**		**262,462,393**						**396,701,111**			**1,983,506**

Location	Conveyance	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Gravel Pit Inlet Canal	52,800	LF	1,100	58,080,000	97	10,000	10%	20%	30%	93,898,000	SPROWG facilities and base unit cost	0.5%	469,490
Near Henderson	Henderson Gravel Pit River Return Pipeline	5,280	LF	325	1,716,000	10	5,000	10%	20%	30%	2,794,100	60" Pipeline	0.5%	13,971
Near Henderson	ASR Fill Pipeline - Fort Lupton to ASR	158,400	LF	145	22,968,000	291	5,000	10%	20%	30%	38,203,800	30" pipeline	0.5%	191,019
Near Henderson	ASR Fill Pump Station	5,890	HP	2,500	14,725,000	5	10,000	5%	20%	30%	22,873,750		13.5%	3,087,956
Near Henderson	ASR Return Pipeline to Prairie Waters North Campus	105,600	LF	145	15,312,000	194	5,000	10%	20%	30%	25,469,200	30" pipeline	0.5%	127,346
Near Henderson	ASR Return Pump Station	3,930	HP	2,500	9,825,000	5	10,000	5%	20%	30%	15,278,750		13.5%	2,062,631
Blw Poudre Conf	NoCo Gateway Pipeline - to Gold Hill WTP	100,500	LF	220	22,110,000	184	5,000	10%	20%	30%	36,296,000	42"Pipeline	0.5%	181,480
Blw Poudre Conf	NoCo Gateway Pump Station	7,430	HP	2,500	18,575,000	5	10,000	5%	20%	30%	28,841,250		13.5%	3,893,569
Near Kersey	Sandborn Reservoir Bidirectional Pipeline	65,100	LF	-	43,750,000	0	0	0%	0%	30%	56,875,000	96"; SPSS est incl land, permitting, admin	0.5%	284,375
Near Kersey	Sandborn Reservoir Inlet Pump Station	15,900	HP	-	50,360,000	0	0	0%	0%	30%	65,468,000	SPSS est incl land, permitting, admin	13.5%	8,838,180
Near Balzac	Fremont Butte Intake to Regulating Storage	5,000	LF	1,100	5,500,000	57	10,000	10%	20%	30%	9,370,000	SPROWG unit cost	0.5%	46,850
Near Balzac	Freemont Butte Reservoir Bi-Directional Pipeline	60,000	LF	350	21,000,000	110	5,000	10%	20%	30%	34,150,000	42"; SPROWG facilities and base unit cost	0.5%	170,750
Near Balzac	Freemont Butte Reservoir Inlet Pump Station	3100	HP	3500	10,850,000	5	10,000	5%	20%	30%	16,867,500	SPROWG facilities and base unit cost	13.5%	2,277,113
Near Balzac	Metro Area Pipeline: I-76 Balzac to North Campus	422,400	LF	145	61,248,000	776	7,500	10%	20%	30%	103,816,800	30" pipeline	0.5%	519,084
Near Balzac	Metro Area Pipeline: I-76 Balzac to North Campus	10,920	HP	2500	27,300,000	15	7,500	5%	20%	30%	42,427,500	3 pump stations along pipeline	13.5%	2,277,113
Conveyance Subtotal					**383,319,000**						**592,629,650**			**24,440,926**

Location	Diversion Structures	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Blw Poudre Conf	Below Poudre Diversion to NoCo Gateway	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Kersey	Kersey Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Balzac	Balzac Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Kersey	Jay Thomas/ Hewes Cook Diversion Bypass	1	LS	19,892,000	19,892,000	42	5,000	10%	20%	30%	32,037,200	SPROWG base cost	7.5%	2,402,790
Near Balzac	North Sterling Canal Bypass	1	LS	4,154,000	4,154,000	15	5,000	10%	20%	30%	6,721,400	SPROWG base cost	7.5%	504,105
Diversion Subtotal					**$36,046,000**						**$57,958,600**			**$3,002,895**

	Estimated Project Cost of Listed Components										$1,047,000,000			
	Contingency for Unlisted Items (30%)										$314,100,000			
	Estimated Project Cost for Raw Water										**$1,361,100,000**	**Total Raw Water Annual O&M**		$29,427,326
	Average Annual Project Yield (AFY)										**59,750**	Period		50
												Discount Rate		4
	Cost per Acre-Foot for Raw Water										**$22,800**	**Life Cycle Cost for Raw Water**		**$1,993,263,256**
	Estimated Water Treatment Cost (AWTP Option)										$1,238,880,000	Treatment Annual O&M		$11,820,000
	Estimated Project Cost for Treated Water										**$2,599,980,000**	Total Annual O&M		$41,247,326
	Cost per Acre-Foot for Treated Water										**$43,500**	**Life Cycle Cost for Treated Water**		**$3,486,062,679**

SPROWG CAPITAL COST ESTIMATE

Alternative 3 - Add Julesburg Storage

Average Annual Yield: **71,500** **AFY** Date: 24-Jan-20

Location	Reservoir Storage	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Storage - Gravel Pit	30,000	AF	1,500	45,000,000	2,250	10,000	10%	20%	30%	94,500,000		0.5%	472,500
Near Henderson	Henderson Storage - Upper Lost Creek ASR	10,000	AF	-	27,120,000	0		$0	0%	30%	35,256,000	Based on SPSS cost - excludes contingency	0.5%	176,280
Near Milliken	Gravel Pit Storage at Milliken Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Kersey	Kersey Storage - Sandborn Reservoir	100,000	AF	1,022	102,178,906	0	0	0%	0%	30%	132,832,578	Based on SPSS all-in cost; added contingency	0.5%	664,163
Near Balzac	Gravel Pit Storage at Balzac Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Balzac	Balzac Storage - Fremont Butte	75,000	AF	976	73,163,487	0	0	0%	0%	30%	95,112,533	Based on SPSS all-in cost; added contingency	0.5%	475,563
Near Julesburg	Julesburg Storage - Ovid Reservoir	8,000	AF	3,107	24,858,182	0	0	0%	0%	30%	32,315,636	Based on SPSS all-in cost; added contingency	0.5%	161,578
Near Julesburg	Julesburg Storage - Julesberg Reservoir Enlargement	0	AF	2,103	0	0	0	0%	0%	30%	-	Based on SPSS all-in cost; added contingency	0.5%	-
Storage Subtotal		**233,000**	**AF**		**287,320,575**						**429,016,747**			**2,145,084**

Location	Conveyance	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Gravel Pit Inlet Canal	52,800	LF	1,100	58,080,000	97	10,000	10%	20%	30%	93,898,000	SPROWG facilities and base unit cost	0.5%	469,490
Near Henderson	Henderson Gravel Pit River Return Pipeline	5,280	LF	325	1,716,000	10	5,000	10%	20%	30%	2,794,100	60" Pipeline	0.5%	13,971
Near Henderson	ASR Fill Pipeline - Fort Lupton to ASR	158,400	LF	145	22,968,000	291	5,000	10%	20%	30%	38,203,800	30" pipeline	0.5%	191,019
Near Henderson	ASR Fill Pump Station	5,890	HP	2,500	14,725,000	5	10,000	5%	20%	30%	22,873,750		13.5%	3,087,956
Near Henderson	ASR Return Pipeline to Prairie Waters North Campus	105,600	LF	145	15,312,000	194	5,000	10%	20%	30%	25,469,200	30" pipeline	0.5%	127,346
Near Henderson	ASR Return Pump Station	3,930	HP	2,500	9,825,000	5	10,000	5%	20%	30%	15,278,750		13.5%	2,062,631
Blw Poudre Conf	NoCo Gateway Pipeline - to Gold Hill WTP	100,500	LF	220	22,110,000	184	5,000	10%	20%	30%	36,296,000	42"Pipeline	0.5%	181,480
Blw Poudre Conf	NoCo Gateway Pump Station	7,430	HP	2,500	18,575,000	5	10,000	5%	20%	30%	28,841,250		13.5%	3,893,569
Near Kersey	Sandborn Reservoir Bidirectional Pipeline	65,100	LF	-	43,750,000	0	0	0%	0%	30%	56,875,000	96"; SPSS est incl land, permitting, admin	0.5%	284,375
Near Kersey	Sandborn Reservoir Inlet Pump Station	15,900	HP	-	50,360,000	0	0	0%	0%	30%	65,468,000	SPSS est incl land, permitting, admin	13.5%	8,838,180
Near Balzac	Fremont Butte Intake to Regulating Storage	5,000	LF	1,100	5,500,000	57	10,000	10%	20%	30%	9,370,000	SPROWG unit cost	0.5%	46,850
Near Balzac	Freemont Butte Reservoir Bi-Directional Pipeline	60,000	LF	350	21,000,000	110	5,000	10%	20%	30%	34,150,000	42"; SPROWG facilities and base unit cost	0.5%	170,750
Near Balzac	Freemont Butte Reservoir Inlet Pump Station	3100	HP	3500	10,850,000	5	10,000	5%	20%	30%	16,867,500	SPROWG facilities and base unit cost	13.5%	2,277,113
Near Balzac	Metro Area Pipeline: I-76 Balzac to North Campus	422,400	LF	145	61,248,000	776	7,500	10%	20%	30%	103,816,800	30" pipeline	0.5%	519,084
Near Balzac	Metro Area Pipeline: I-76 Balzac to North Campus	10,920	HP	2500	27,300,000	15	7,500	5%	20%	30%	42,427,500	3 pump stations along pipeline	13.5%	5,727,713
Near Julesburg	Ovid Inlet Canal	37,000	LF	550	20,350,000	85	10,000	10%	20%	30%	33,410,000	Peterson Canal expansion	0.5%	167,050
Near Julesburg	Ovid River Return	15,000	LF	220	3,300,000	28	5,000	10%	20%	30%	5,420,000	42"Pipeline	0.5%	27,100
Conveyance Subtotal					**406,969,000**						**631,459,650**			**28,085,676**

Location	Diversion Structures	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Blw Poudre Conf	Below Poudre Diversion to NoCo Gateway	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Kersey	Kersey Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Balzac	Balzac Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Kersey	Jay Thomas/ Hewes Cook Diversion Bypass	1	LS	19,892,000	19,892,000	42	5,000	10%	20%	30%	32,037,200	SPROWG base cost	7.5%	2,402,790
Near Balzac	North Sterling Canal Bypass	1	LS	4,154,000	4,154,000	15	5,000	10%	20%	30%	6,721,400	SPROWG base cost	7.5%	504,105
Diversion Subtotal					**$36,046,000**						**$57,958,600**			**$3,002,895**

	Estimated Project Cost of Listed Components										$1,118,000,000			
	Contingency for Unlisted Items (30%)										$335,400,000			
	Estimated Project Cost for Raw Water										**$1,453,400,000**	**Total Raw Water Annual O&M**		$33,233,654
	Average Annual Project Yield (AFY)										**71,500**	Period		50
												Discount Rate		4
	Cost per Acre-Foot for Raw Water										**$20,300**	**Life Cycle Cost for Raw Water**		**$2,167,331,501**
	Estimated Water Treatment Cost (AWTP Option)										$1,238,880,000	Treatment Annual O&M		$11,820,000
	Estimated Project Cost for Treated Water										**$2,692,280,000**	Total Annual O&M		$45,053,654
	Cost per Acre-Foot for Treated Water										**$37,700**	**Life Cycle Cost for Treated Water**		**$3,660,130,923**

SPROWG CAPITAL COST ESTIMATE

Alternative 4 - Additional Delivery

Average Annual Yield: 99,875 AFY Date: 24-Jan-20

Location	Reservoir Storage	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Storage - Gravel Pit	30,000	AF	1,500	45,000,000	2,250	10,000	10%	20%	30%	94,500,000		0.5%	472,500
Near Henderson	Henderson Storage - Upper Lost Creek ASR	55,000	AF	-	87,741,176	0		$0	0%	30%	114,063,529	Based on SPSS cost - excludes contingency	0.5%	570,318
Near Milliken	Gravel Pit Storage at Milliken Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Kersey	Kersey Storage - Sandborn Reservoir	200,000	AF	584	116,775,893	0	0	0%	0%	30%	151,808,661	Based on SPSS all-in cost; added contingency	0.5%	759,043
Near Balzac	Gravel Pit Storage at Balzac Diversion	5,000	AF	1,500	7,500,000	750	10,000	10%	20%	30%	19,500,000		0.5%	97,500
Near Balzac	Balzac Storage - Fremont Butte	95,000	AF	976	92,673,750	0	0	0%	0%	30%	120,475,875	Based on SPSS all-in cost; added contingency	0.5%	602,379
Near Julesburg	Julesburg Storage - Ovid Reservoir	8,000	AF	3,107	24,858,182	0	0	0%	0%	30%	32,315,636	Based on SPSS all-in cost; added contingency	0.5%	161,578
Near Julesburg	Julesburg Storage - Julesberg Reservoir Enlargement	21,000	AF	2,103	44,162,329	0	0	0%	0%	30%	57,411,027	Based on SPSS all-in cost; added contingency	0.5%	287,055
Storage Subtotal		**419,000**	**AF**		**426,211,330**						**609,574,729**			**3,047,874**

Location	Conveyance	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Gravel Pit Inlet Canal	52,800	LF	1,100	58,080,000	97	10,000	10%	20%	30%	93,898,000	SPROWG facilities and base unit cost	0.5%	469,490
Near Henderson	Henderson Gravel Pit River Return Pipeline	5,280	LF	380	2,006,400	10	5,000	10%	20%	30%	3,258,740	66" Pipeline	0.5%	16,294
Near Henderson	ASR Fill Pipeline - Fort Lupton to ASR	158,400	LF	220	34,848,000	291	5,000	10%	20%	30%	57,211,800	42" pipeline	0.5%	286,059
Near Henderson	ASR Fill Pump Station	5,650	HP	2,500	14,125,000	5	10,000	5%	20%	30%	21,943,750		13.5%	2,962,406
Near Henderson	ASR Return Pipeline to Prairie Waters North Campus	105,600	LF	220	23,232,000	194	5,000	10%	20%	30%	38,141,200	42" pipeline	0.5%	190,706
Near Henderson	ASR Return Pump Station	3,760	HP	2,500	9,400,000	5	10,000	5%	20%	30%	14,620,000		13.5%	1,973,700
Blw Poudre Conf	NoCo Gateway Pipeline - to Gold Hill WTP	100,500	LF	273	27,386,250	184	5,000	10%	20%	30%	44,738,000	48" Pipeline	0.5%	223,690
Blw Poudre Conf	NoCo Gateway Pump Station	7,430	HP	2,500	18,575,000	5	10,000	5%	20%	30%	28,841,250		13.5%	3,893,569
Near Kersey	Sandborn Reservoir Bidirectional Pipeline	65,100	LF	-	54,687,500	0	0	0%	0%	30%	71,093,750	108"; SPSS est incl land, permitting, admin	0.5%	355,469
Near Kersey	Sandborn Reservoir Inlet Pump Station	15,900	HP	-	50,360,000	0	0	0%	0%	30%	65,468,000	SPSS est incl land, permitting, admin	13.5%	8,838,180
Near Balzac	Fremont Butte Intake to Regulating Storage	5,000	LF	1,100	5,500,000	57	10,000	10%	20%	30%	9,370,000	SPROWG unit cost	0.5%	46,850
Near Balzac	Freemont Butte Reservoir Bi-Directional Pipeline	60,000	LF	350	21,000,000	110	5,000	10%	20%	30%	34,150,000	42"; SPROWG facilities and base unit cost	0.5%	170,750
Near Balzac	Freemont Butte Reservoir Inlet Pump Station	3100	HP	3500	10,850,000	5	10,000	5%	20%	30%	16,867,500	SPROWG facilities and base unit cost	13.5%	2,277,113
Near Balzac	Metro Area Pipeline: I-76 Balzac to North Campus	422,400	LF	145	61,248,000	776	7,500	10%	20%	30%	103,816,800	30" pipeline	0.5%	519,084
Near Balzac	Metro Area Pipeline: I-76 Balzac to North Campus	10,920	HP	2500	27,300,000	15	7,500	5%	20%	30%	42,427,500	3 pump stations along pipeline	13.5%	5,727,713
Near Julesburg	Ovid Inlet Canal	19,000	LF	550	10,450,000	85	10,000	10%	20%	30%	17,570,000	Peterson Canal expansion	0.5%	87,850
Near Julesburg	Ovid River Return	15,000	LF	220	3,300,000	28	5,000	10%	20%	30%	5,420,000	42" Pipeline	0.5%	27,100
Near Julesburg	Julesburg Reservoir Inlet Canal	79,200	LF	550	43,560,000	85	10,000	5%	20%	30%	68,368,000	Harmony Ditch expansion	0.5%	341,840
Near Julesburg	Julesburg Reservoir Return Pipeline	21,000	LF	220	4,620,000	39	5,000	10%	20%	30%	7,587,000	42" Pipeline	0.5%	37,935
Conveyance Subtotal					**480,528,150**						**744,791,290**			**28,445,796**

Location	Diversion Structures	Quantity	Unit	Unit Price ($)	Construction Cost ($)	Land Easements / Acquisition (ac)	Land Cost ($/ac)	Permitting (% of Const)	Engr / Legal / Admin (% of Const)	Contingency (% of Const)	Estimated Project Cost	Comments	Annual O&M (% of Capital)	Annual O&M ($M)
Near Henderson	Henderson Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Blw Poudre Conf	Below Poudre Diversion to NoCo Gateway	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Kersey	Kersey Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Balzac	Balzac Diversion to Storage	1	LS	3,000,000	3,000,000			10%	20%	30%	4,800,000	SPSS base construction cost	0.5%	24,000
Near Julesburg	Julesburg Diversion to Storage	0	LS	3,000,000	0			10%	20%	30%	-	SPSS base construction cost	0.5%	-
Near Kersey	Jay Thomas/ Hewes Cook Diversion Bypass	1	LS	19,892,000	19,892,000	42	5,000	10%	20%	30%	32,037,200	SPROWG base cost	7.5%	2,402,790
Near Balzac	North Sterling Canal Bypass	1	LS	4,154,000	4,154,000	15	5,000	10%	20%	30%	6,721,400	SPROWG base cost	7.5%	504,105
Diversion Subtotal					**$36,046,000**						**$57,958,600**			**$3,002,895**

	Estimated Project Cost of Listed Components										$1,412,000,000			
	Contingency for Unlisted Items (30%)										$423,600,000			
	Estimated Project Cost for Raw Water										**$1,835,600,000**	**Total Raw Water Annual O&M**		$34,496,565
	Average Annual Project Yield (AFY)										**99,875**	Period		50
												Discount Rate		4
	Cost per Acre-Foot for Raw Water										**$18,400**	**Life Cycle Cost for Raw Water**		**$2,576,661,580**
	Estimated Water Treatment Cost (AWTP Option)										$1,521,216,000	Treatment Annual O&M		$14,350,000
	Estimated Project Cost for Treated Water										**$3,356,816,000**	Total Annual O&M		$48,846,565
	Cost per Acre-Foot for Treated Water										**$33,600**	**Life Cycle Cost for Treated Water**		**$4,406,146,929**