Appendix A

Basis of Cost Estimating TM

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TECHNICAL MEMORANDUM

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SUBJECT: Basis for Cost Estimating for West County Water Quality and Recycled Water Supply Feasibility Study

West Yost is preparing a Water Quality and Recycled Water Supply Feasibility Study (Project) for the Russian River Community Services District (RRCSD). This technical memorandum (TM) details the basis for cost estimating used for economic evaluations of alternatives for the Project. The factors that influence the cost estimating process presented in this TM include:

- Present Worth Analysis
- Cost Estimate Basis
- Basis of Costs Over Time
- Construction Cost Estimating Assumptions
- Project-Related Capital Cost Assumptions
- Operation and Maintenance Cost Assumptions

PRESENT WORTH ANALYSIS

The economic evaluation of alternatives depends on a comparison of the present worth cost for each alternative. The present value of future annual costs, including operation and maintenance (O&M) and refurbishment costs, is calculated based on the period of operation and the value of money, which is termed as the discount rate. The U.S. Bureau of Reclamation sets the interest rate to be used by federal agencies in the formulation and evaluation of plans for water and related land resource projects. The discount rate set for Fiscal Year 2025 was 3.00 percent, which is used for life cycle cost analyses in this Project.

COST ESTIMATE BASIS

Construction and operating costs for the alternatives are based on an evaluation of each specific alternative. Estimates are prepared using the construction costs of similar unit processes and from vendor quotes for major equipment. The cost estimates presented for the Project are Association of Advancement of Cost Engineering Class 5 planning estimates, for Study or Feasibility purposes. Class 5 estimates have 0 to 2 percent of project definition with a targeted -50 percent to +100 percent accuracy.

The primary purpose of these estimates is to provide a basis for comparing alternatives. The aggregate cost of a particular course of action may also be used for long-range capital improvement planning, with appropriate consideration for the potential variability in project scope, economic factors, and the ongoing evolving construction materials and techniques. Preliminary design and detailed design efforts will be necessary to refine and confirm the estimated costs.

BASIS FOR COSTS OVER TIME

Costs can be expected to undergo long-term changes consistent with corresponding changes in the national economy. One of the best available barometers of these changes is the Engineering News Record (ENR) Construction Cost Index (CCI). The CCI is computed from the prices for structural steel, Portland cement, lumber and common labor; and is based on a value of 100 in the year 1913. The trend of the ENR 20-City average CCI since year 2000 is shown on Figure 1.

Future changes in the costs of material, labor and equipment as inflation increases capital costs will affect all alternatives. Therefore, decisions based on today's cost would be similar as costs inflate. The evaluation of alternatives is therefore based on existing costs with an ENR CCI of 13,798.3, representative of the 20-City average for April 2025.

The operating costs developed in this report are based on estimated costs over a 20-year period from 2025 to 2045. These costs were developed based on current (2025) costs and inflated at rate of 3.0 percent per year for the duration of the 20-year project lifetime.

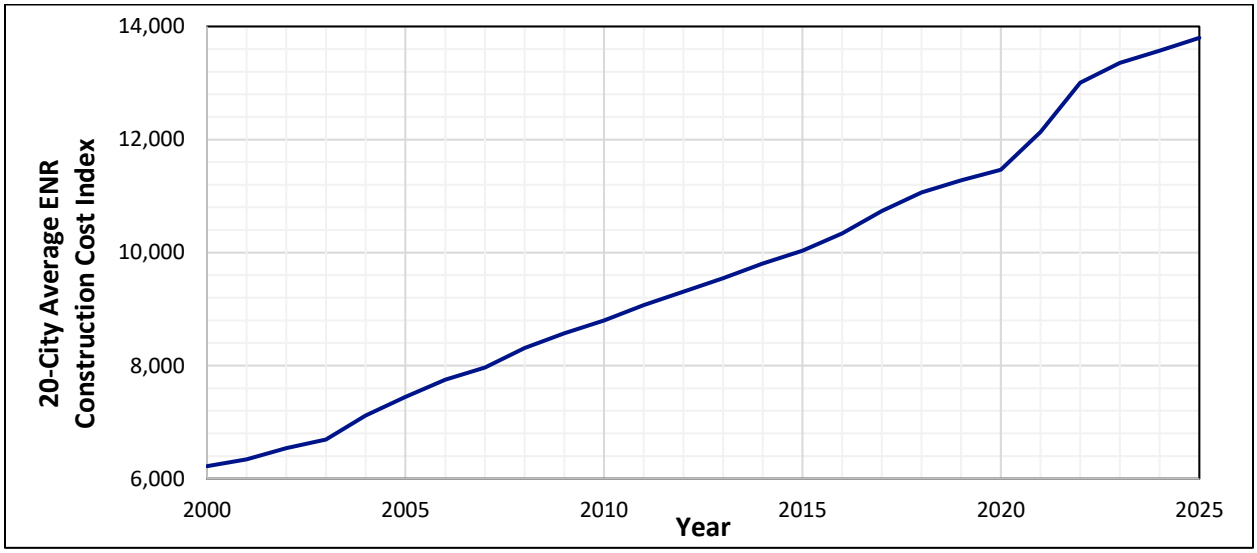

Figure 1. ENR Construction Cost Index for Year 2000 to 2025

CONSTRUCTION COST ESTIMATING ASSUMPTIONS

The construction costs presented for this Project represent an engineer's preliminary opinion of probable construction cost (OPCC). The OPCC represents the sum of the following:

- component costs,
- distributed costs,
- estimating contingency, and
- contractor costs and profit.

The assumptions and methods used to prepare these elements of the OPCC are documented below.

Component Costs

Costs for individual facility components were estimated using a variety of sources. When possible, equipment quotes were obtained from appropriate vendors and assumptions were made regarding the cost of the equipment installation as a percentage of the equipment cost. Estimates of quantities of materials were also developed where appropriate. In some cases, lump sum costs that include the distributed and contractor costs discussed below were used, where these costs were based on total construction costs from similar projects.

Distributed Costs

Distributed costs account for costs that are not included in the component costs at this level of planning. Distributed costs include:

- plant paving, grading and yard piping
- miscellaneous mechanical and piping
- electrical
- instrumentation and controls

These distributed costs are calculated as a multiple of the total base costs. The default multipliers used are listed in Table 1. For each facility component, facility-specific multipliers were adjusted to account for the related distributed costs.

Table 1. Multipliers for Distributed Costs

Item	Multiplier, percent
Plant Paving, Grading, and Yard Piping[(a)]	10
Mechanical and Piping	10
Electrical	25
Instrumentation and Controls	15

Estimating Contingencies

Because of the limitations of cost estimates based on planning information, cost estimates must allow for the following:

- items not identified in the conceptual development of a given alternative,
- unanticipated improvements,
- variation in final quantities,
- adverse construction conditions, and
- other unforeseeable difficulties that will increase the final construction cost.

A total contingency allowance of 30 percent is applied to project-phase level OPCCs to cover costs for these items.

Contractor Costs and Profit

Contractor costs include:

- mark-up on subcontractors
- bonds
- insurance
- mobilization and demobilization
- general overhead

These cost factors, as well as contractor profit are calculated as a multiple of the total base and distributed costs, with the exception of the markup on subcontractor costs. The markup of subcontractors work is only applied to the calculated electrical and instrumentation and controls costs. The default multipliers used are listed in Table 2. The amounts for some items, such as the portion subject to subcontractor markup, mobilization or demobilization will vary in practice depending on the nature of the work and the particular contractor selected; nevertheless, the factors provide a reasonable estimate and are useful when used in conjunction with appropriate contingencies.

Table 2. Multipliers for Other Contractor Costs and Profit

Item	Multiplier, percent
Contractor's Markup of Subcontractors' Work[(a)]	10
Mobilization and Demobilization	5
Contractor's Overhead and Profit	15
Contractor's General Conditions (Bonds and Insurance, other requirements)	10

(a) Applied only to electrical and instruction and controls costs.

PROJECT-RELATED CAPITAL COST ASSUMPTIONS

The OPCC plus the construction contingency represents an estimated construction budget. The engineer's preliminary opinion of probable total capital cost (OPTCC) is calculated as the sum of the following:

- engineer's preliminary OPCC,
- construction contingency, and
- other project-related capital costs

The construction contingency is a reserved amount of money in a project's budget that accounts for unexpected costs or changes that occur during construction. It's serves as a financial buffer to help manage risks and uncertainties that arise after the project starts. At this stage of planning, a construction contingency has not been applied.

The project-related costs, which are costs not included in the construction contract and construction contingency, are predicted as a percentage of the estimated construction costs. Depending on the size and type of project, non-construction costs may range from 13 to 25 percent of the contract cost when all the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small, complicated projects and to projects that involve extensive remodeling of existing plants. For this project, which may include improvements to existing WWTPs, total engineering costs are anticipated to average 25 percent of the contract cost.

O&M COST ASSUMPTIONS

O&M costs were developed for each alternative that included the following elements:

- **Power (Electricity) Costs:** Power costs were determined according to the power demands of equipment, estimated annual operating hours, and unit power costs paid by the RRCSD.
- **Chemical Costs:** The polymer unit cost for thickening and dewatering processes were based on a similar project. Chlorine gas and sulfur dioxide unit costs were based on chemical purchase bids.
- **Maintenance Costs:** Maintenance costs were calculated for replacement parts based on information from the equipment manufacturers, unless specified otherwise.
- **Solids Hauling Costs:** The cost of hauling and disposing of biosolids and annual biosolids production was estimated based on a similar project.

All the applied O&M cost assumptions are summarized in Table 3. In addition, the current annual O&M costs were used where applicable to estimate O&M cost savings.

Table 3. Assumed Unit Costs for Developing Annual Operating Cost		
Item	Unit Cost, dollars	Unit Basis
Chemical Costs		
Polymer-Thickening	5	per neat pound
Polymer-Dewatering	5	per neat pound
Chlorine Gas	3,050	per ton
Sulfur Dioxide	0.61	per pound
Non-Chemical Costs		
Electrical Power	0.15[(a)]	per kilowatt-hour
Solids Hauling	70	per wet ton
(a) Assumed electrical power unit cost provided by RRCSD staff.		

REFERENCES

Association of Advancement of Cost Engineering (AACE) International Recommended Practice No 17R-97. August 2020. Cost Estimate Classification System

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