The following is an excerpt from the Benefit Cost Analysis Monitoring Method [MM-11]

SGM Grant Program Requirements for Post-Performance Monitoring and Reporting

Benefit Cost Analysis (BCA) Monitoring Method

Project / Action Type	Benefit Cost Analysis (BCA) is a standardized method for displaying and comparing a proposed project's costs and benefits.
Similar / Related Project Types	BCA applies to all project types.
Metric	Benefit-cost ratio. Cost effectiveness. Net benefits
Measurement Unit	Benefit-cost ratio of present US dollar value of the benefits divided by the present US dollar value of the project costs. Cost effectiveness in the US dollar cost per physical benefit achieved (based on project/action benefit, example is volume of recharge in acre-feet). Net benefits in the US dollar value of benefit minus US dollar cost of project
Beneficial User	Applicable to all users.

Benefit Cost Analysis Monitoring

BCA is a well-established method for the evaluation of public and private investments in potential projects. For water projects, there are federal and State guidelines for conducting BCA (see Resources section below). BCA has been widely applied for many decades, with a large body of supporting agency reports and peer-reviewed economic publications describing its application and advancing methods.

BCA is a standardized method for evaluating the investment of public funds in water projects. It should be applied at the initial planning stage of project development. However, it also can be applied for project monitoring after award of grant funds. As project benefits and costs are realized, these can be used to update the BCA and monitor project progress. Project monitoring could include periodic assessments of project cost-effectiveness to ensure grant funding is being used to support projects that generate the intended benefits at the least cost. Results of this monitoring could be used, for example, to update criteria for ranking and selecting projects in future grant solicitations.

Appropriate quantification of benefits is important for evaluating the economic feasibility of grant-funded projects. It also is important because costs can be allocated in proportion to project benefits. For example, a project may provide different types of benefits to multiple entities (e.g., groundwater level benefits to the broader subbasin and subsidence benefits to a specific area). Quantifying and monetizing project benefits allows multiple local project proponents to allocate costs in proportion to the benefits received. It also provides a basis of information for assigning and recovering local cost shares.

Background and Context

Groundwater sustainability plans require consideration of all beneficial uses and users of groundwater in the development and implementation of the plan. Groundwater sustainability is generally approached by developing projects and actions that improve groundwater management, develop new sources of supply, and in some regions reduce groundwater demand. Project actions are costly, and while some may be partially funded by State grants, a substantial share of their costs can be funded by local businesses and individuals in the subbasin. BCA provides important information for businesses and individuals about the costs, benefits, economic feasibility, and cost-effectiveness of project actions to achieve sustainability objectives specified in a sustainability play. All project effects (benefits and costs) should be included and quantified to the extent possible, including external, unintentional, and uncertain effects.

BCA is a standard method for evaluating project benefits and costs. It is an important consideration for ensuring that the sustainability plans are feasible and ensuring that stakeholders can achieve their sustainability objectives. For example, an implementation plan that includes some projects that are not economically feasible (i.e., have a B/C ratio less than 1) might not be able to achieve the desired benefits (e.g., groundwater recharge) and therefore might not achieve sustainability.

BCA is also justified as a method for project monitoring. It is a standardized approach to comparing project benefits and costs. As projects are implemented and become operational, costs and benefits can be updated, and the BCA can be refined. For example, this can be used to monitor the benefits received per dollar of state grant investment. If benefit categories are well defined (e.g., public and private benefits) then the return on the State's investment can be calculated and compared across different kinds of projects. Information gathered from ongoing monitoring of project benefits and costs could be used to refine future grant solicitations.

A Step-by-Step Guide to Applying the Benefit Cost Analysis Method

BCA is developed and applied according to the following general steps. These steps cover both planning-level BCA (when all costs and benefits should be estimated rather than observed) and post-implementation BCA (based on observations of actual costs and outcomes). All project effects (benefits and costs) should be included and quantified to the extent possible, including external, unintentional, and uncertain effects.

1. Describe and quantify the project in sufficient detail to provide a basis for cost and benefit estimates. This includes project design, construction, and operations and the resulting expected kind, location, and timing of physical benefits.
2. Describe and quantify conditions without the project. Project benefits can only be calculated by reference to a condition without the project.

3. For planning, estimate the project costs and when they are expected to occur. Uncertainty in costs can be addressed using probabilities of outcomes (such as costs by year type), scenario analysis, and sensitivity analysis. Revise with actual costs (including external or unexpected costs) after they are incurred for post-implementation BCA updates.
4. Quantify project physical benefits. For planning-level BCA, projected physical benefits may be based on modelling or other analysis of the without and with-project conditions. Uncertainty in benefits can be addressed using probabilities of outcomes (such as benefits by year type), scenario analysis, and sensitivity analysis. Post-implementation, monitoring and measurement of outcomes (including external or unexpected outcomes) is used to update benefits.
5. Use results from Steps 3 and 4 to calculate cost-effectiveness (if it is used as a metric).
6. If using net benefit and/or B/C ratio as a metric, calculate the dollar value of physical project benefits using appropriate monetizing methods.
7. Use the project benefits and costs from Steps 3 and 6 to calculate present values and metrics.
8. Continue to monitor project performance and update metrics when significant new cost or benefit information becomes available.

Data and Protocols - Fundamentals

Information / Data Requirements

Data requirements of BCA can be broken down into two fundamental components: project benefits and project costs. Project costs require defining the design, construction, and operation of the project. Some projects also may impose costs that are not included in the engineering costs – these typically require establishing the physical effects and then assigning a monetary value to them. Benefits require establishing the physical benefits of the project and monetizing those benefits. Benefits and costs caused by physical effects are calculated by comparison of a without-project and with-project condition. Physical benefits should be clearly defined so that appropriate monetization is applied. For example, recharge project yield can be expressed in terms of expected annual recharge, storage capacity, or net groundwater recharge. If yields vary by hydrologic condition (e.g., a project plans to extract yield in dry or critical years only) then monetizing needs should account for that. These different physical measures would be valued in different ways.

Cost estimates are critical for developing a BCA. Project costs depend on design and operating options and are typically split into design, construction, operations, maintenance, monitoring, replacement, and contingencies. Standard costing approaches are available that vary with project planning and design, ranging from preliminary estimates to more refined estimates as the project development progresses. More refined costs can be used to verify that the project is still feasible and cost-effective. Preparation of cost estimates follows standard approaches based on Association for the Advancement of Cost Engineering classifications and associated requirements for specific agencies. The Water Storage Investment Program Technical Reference (California Water Commission, 2015) provides an overview of the different approaches and requirements. After costs are estimated they can be expressed in current dollars using an appropriate index to escalate earlier estimates if needed and then converted to present value using an appropriate discount rate.

Once project physical benefits are established it is necessary to calculate the monetary value of those benefits. Monetizing project benefits can be a substantial effort. Benefits associated with water projects vary widely and the most appropriate method to monetize benefits can vary by project type and location.

California's Groundwater Update 2020 (California DWR, 2021) includes a summary section (see Chapter 2, page 2-16) describing the economic benefits of groundwater in California. That document provides a general overview of the different types of benefits associated with groundwater management. Different methods would be used to monetize the value of such benefits.

Data Standards

Data standards for BCA include the standards for the physical benefits used in the BCA. For example, if the project provides groundwater level benefits, appropriate data standards for monitoring groundwater levels would be applied and then carried into the BCA. Other economic data standards are specified as part of the BCA guidelines (see accompanying Excel® summary workbook for examples). For example, a federal feasibility study has specific BCA requirements for discount rates and project economic life. Economic information and methods used to convert physical benefits into monetary benefits should follow the most recent guidelines and standards developed for state feasibility studies (currently the Technical Reference for the Water Storage Investment Program).

Key Protocols

Due to the wide variety of benefits, project types, and locations, no single protocol applies. The key is to follow the accepted practices for BCA. For example, for federal feasibility analyses, federal guidelines apply. For three decades, the standard for federal water resource development projects was the 1983 Principles and Guidelines (U.S. Water Resources Council, 1983). An updated principles document was developed in 2013 and implemented through more specific agency Principles, Guidelines, and Requirements (see for example U.S. Dept. of Interior, 2015). The national accounting perspective differs from the state perspective.

For state projects, the DWR guidelines –that are generally consistent with the federal feasibility guidelines— apply (California DWR, 2008). Other programs, such as the Water Storage Investment Program (California Water Commission, 2015), can have other specific requirements. The Technical Reference for the Water Storage Investment Program consolidated accepted practices from both federal and State guidelines and augmented them with specific recommended methods, data, and studies.

The general structure of the BCA does not change across all these guidelines. However, specific protocols may apply for certain purposes according to applicable statutes, regulations, or program guidelines. For example, a specific discount or cost accounting method may be required by federal or State law. The best methods for estimating the economic value of water-related benefits are often specific to the kind and location of the project or activity generating the benefits. As a result, a number of methods can potentially be used, and the analyst should be familiar with the methods and limitations to select and apply the proper methods. Young and Loomis (2014) provide a good description of general methods and their applications and limitations.

The attached Excel® workbook includes a summary of the different guidelines for water project BCA.